Pediatric Sleep:
Normal or Not and What to Do About It

Rachel Immen, MD

Psychiatry and Sleep Medicine

Objectives:

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... define and review with parents and kids what **target total sleep times and circadian rhythms** are at different stages from birth through teen years. Knowing the range of normal sleep across the pediatric population allows us to recognize what is not within normal limits.

... express why **diagnosing OSA** in toddlers to teens is important, use a screening tool, implement at-home testing and guide next steps.

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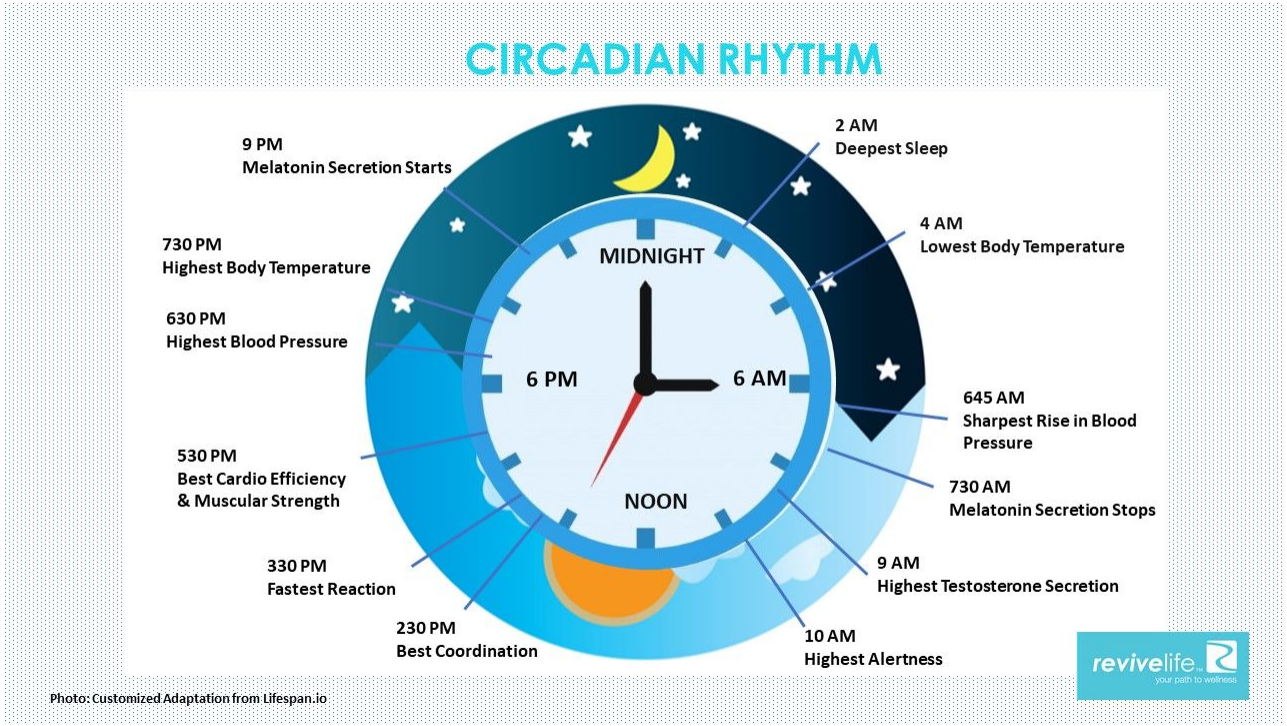
Total Sleep Time and Circadian Rhythm

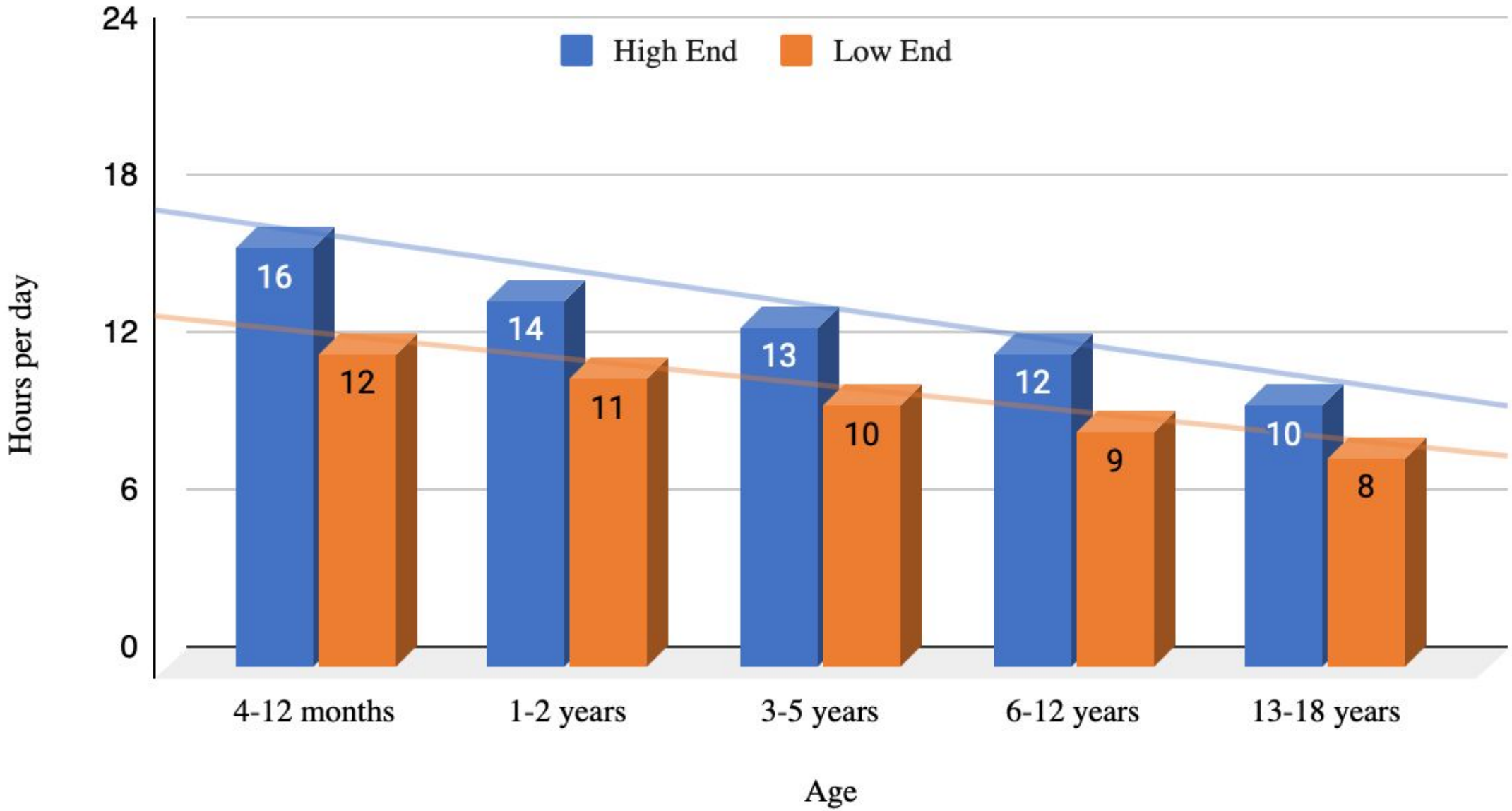
Total Sleep Time (TST):
the amount of time asleep over a 24-hour period

Circadian Rhythm:

- when on the clock is sleep happening



AASM TST Recommended Ranges Across Pediatric Ages



Circadian Rhythm

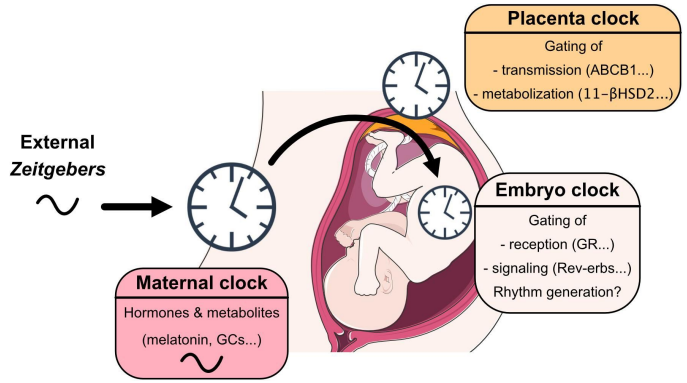
Evidence for rhythms in activity in utero

From birth to 2 months of age there are minimal circadian markers

About 2 months of age melatonin, cortisol patterns, and body temperature variation begins

The Children's ChronoType Questionnaire (CCTQ) is a 27 question survey to help determine a child's chronotype (i.e. early bird or night owl)

Light is the primary zeitgeber ("time giver") impacting the alignment and entrainment of the circadian rhythm



1. De Weerth C, Zijl RH, Buitelaar JK. Development of cortisol circadian rhythm in infancy. Early human development 2003; 73(1-2):39-52
2. Sadeh A. Sleep and melatonin in infants: A preliminary study. Sleep 1997; 20(3):185-91
3. Shanahan TL, Czeisler CA. Light exposure induces equivalent phase shifts of the endogenous circadian rhythms of circulating plasma melatonin and core body temperature. Journal of Clinical endocrinology Metab 1991;73(2):227-35

Circadian Rhythm and TST in Infancy and Toddlerhood

Infancy

0-6 weeks old: wake and sleep patterns are randomly distributed

6-8 weeks old: longest sleep period is more likely to occur at night

Baby starts to produce melatonin and respond to light and activity entrainment

4 months old: longest wake period is more likely to occur during the day

5 months old: baby can sleep a consolidated 5 hour stretch or longer

6 months old: the longest sleep time immediately follows the longest awake period

6-12 months old: circadian rhythm established with consolidated wake periods and consolidated sleep periods

At 4-12 months of age babies should get 12-16 hours TST

Toddlerhood

Distinct daytime naps

Consolidated sleep period at night

11-14 hours TST

1. Parmelee AH, Stern E. Development of states in infants. In: Clemente CD, Purpura DP, Mayer FE, editors. Sleep and the maturing nervous system. New York; Academic Press; 1972
2. Coons S. Development of sleep and wakefulness during the first 6 months of life. In: Guilleminault C, editor. Sleep and its disorders in children. New York; Raven Press; 1987.

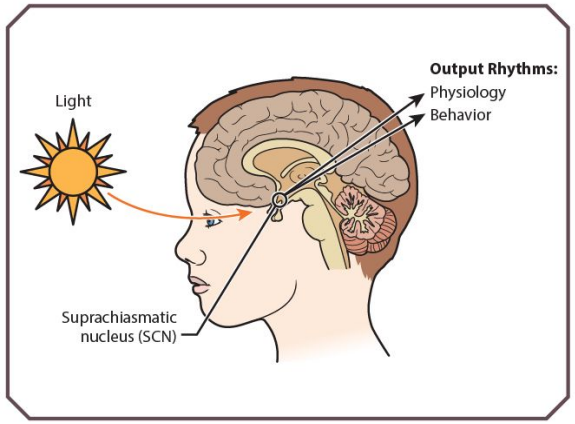
Circadian Rhythm and TST in Childhood

Early Childhood (3-5 years old)

Gradual extinction of daytime naps

Consolidated sleep at night

10-13 hours TST



Childhood (6-12 years old)

Tendency to sleep during the day is at the **lowest**.

Irregular and occasional naps are within normal range.

Routine daytime napping may indicate an abnormal process causing excessive daytime sleepiness.

9-12 hours TST

1. Carskadon MA, Keenan S, Dement WC. Nighttime sleep and daytime sleep tendency in preadolescence. In:Guilleminault C, editor. Sleep and its disorders in children. New York: Raven Press; 1987

Circadian Rhythm and TST in Adolescents

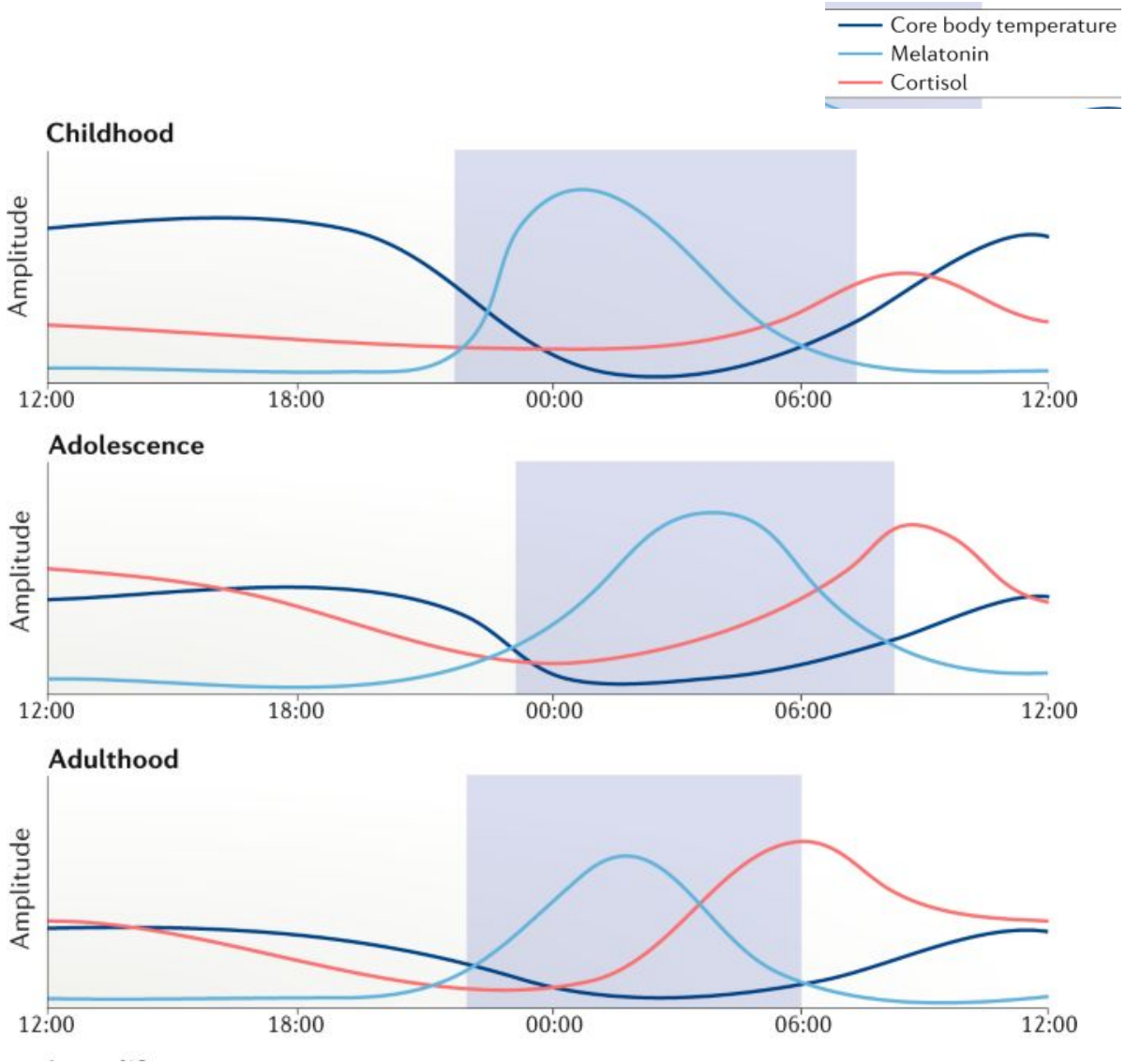
Adolescents

Delayed Phase

Heavy Sleep Inertia

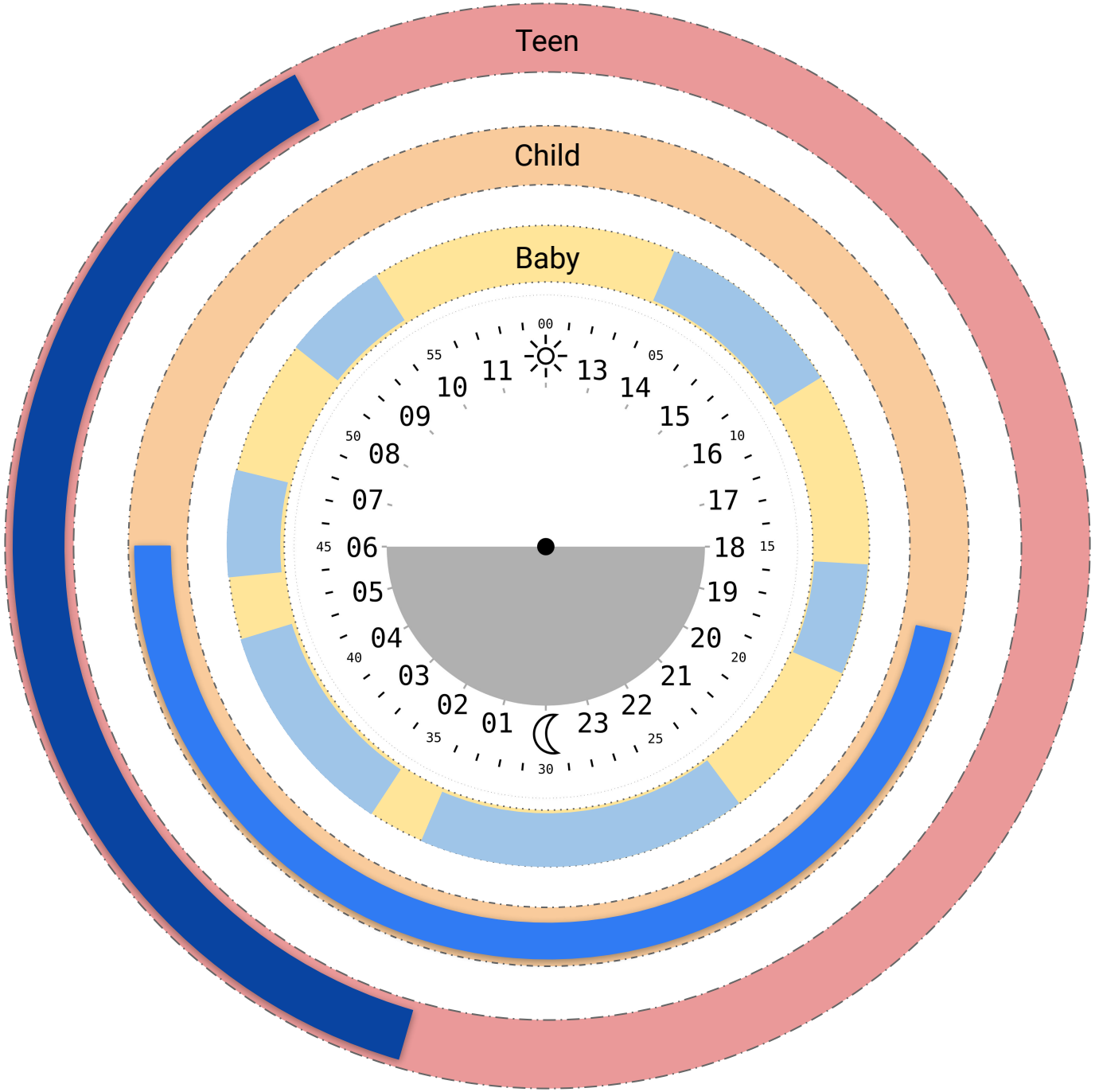
8-10 hours TST

*later school start times, sleeping in on the weekend



1. Carskadon MA, Vieira C, Acebo C. Association Between puberty and delayed phase preference. Sleep 1993; 16(3):258-62

Review of TST & Circadian Rhythm Across the Ages



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Diagnosis OSA in Toddlers to Teens

- *why* it is important
- use a *screening* tool
- in-lab versus *at-home testing*
- guide *next* steps

OSA Importance

- ADHD - disruptive behaviors
- poor growth and even failure to thrive (especially in infants and young children)
- hypertension -further weight gain due to hormone dysregulation
- altered cardiac morphology (ventricular hypertrophy)
- pulmonary hypertension - speech difficulties
- learning disorders / academic difficulty - enuresis
- headaches - mood dysregulation - anxiety

Screening Tool – You!

Roughly 5% of typically developing children will have OSA.

There is a not a great standardized screening tool with both high positive predictive value and negative predictive value. A guideline is to be the screening tool yourself and **have a low threshold to evaluate** with a study if the history or physical exam suggest features of OSA.

Clinical History: snoring, apneas, choking noise, increased work of breathing, heavy breathing, mouth breathing (night or day), enuresis, restless sleep, excessive sweating, hyperextended neck, knees tucked under body (odd sleep position), frequent wake-ups, dry mouth, poor school performance, aggressive behavior, hyperactivity, daytime sleepiness, morning headache, age-INappropriate napping, difficult to wake-up, treatment-resistant depression, anxiety, headaches

Physical Exam: obesity, failure to thrive, swollen mucous membranes, irritated uvula, deviated septum, adenoidal facies (infraorbital darkening, elongated midface, mouth-breathing), tonsillar hypertrophy, high arched palate, small lower jaw and recessed chin (micrognathia/retrognathia), crowded oropharynx, macroglossia, increased neck circumference, hypertension, loud P2 on cardiac exam, edema

For insurance purposes, clinical documentation typically needs to include excessive daytime sleepiness, snoring, witnessed apneas.

Special populations: Down's Syndrome/Trisomy 21 (60%+), cerebral palsy, genetic disorders with retrognathia, macroglossia, craniofacial abnormalities, neuromuscular disorders, sickle cell anemia, obesity

9 MOST COMMON SYMPTOMS OF SLEEP APNEA

DISORDERED BREATHING

Periods of normal breathing with subsequent pauses or breath-holding can be a sign of sleep apnea.

MOUTH BREATHING

If air entry through the nose is blocked due to enlarged tonsils or adenoids, children may breathe only through the mouth.

SNORING

Noisy breathing or loud snoring during sleep may be a symptom of apnea, although snoring can also occur in healthy children.

BED WETTING

Noisy breathing or loud snoring during sleep may be a symptom of apnea, although snoring can also occur in healthy children.

ODD SLEEP POSITIONS

Sleeping in abnormal conditions like with the neck arched backward could be a sign the child is trying to open the airways.

FREQUENT INFECTIONS

Chronic ear infections, tonsillitis, strep throat, and swollen adenoids may all occur more frequently.

NIGHT TERRORS

These episodes involve screaming, flailing, and intense fear that occurs while children are still asleep.

TEETH GRINDING

Grinding or clenching the teeth at night is referred to as bruxism and can lead to sore jaw muscles, sensitive teeth, and increased tooth decay.

RESTLESSNESS

Children may toss and turn all night long, rarely going into a deep state of sleep.

Sleep Advisor

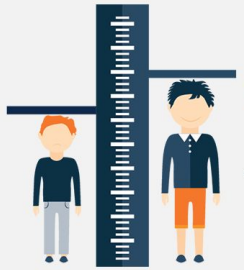
SIGNS OF OSA DURING THE DAYTIME

01 BEHAVIORAL PROBLEMS

Irritability, aggression, difficulty listening, frustration, and anxiety can all be more common.

ADHD OR HYPERACTIVITY 02

Difficulty with listening and paying attention or periods of hyperactivity occur more frequently due to low oxygenation to the brain.



03 GROWTH ISSUES

Delayed growth and development can occur leading to a ack of weight gain slow growth in height and failure to thrive.

LEARNING DISABILITIES 04

Children may experience problems with short and long-term memory, difficulty concentrating, poor problem-solving skills, and trouble paying attention.

Sleep Advisor

in-lab versus *at-home testing*

PSG in the lab: Traditional

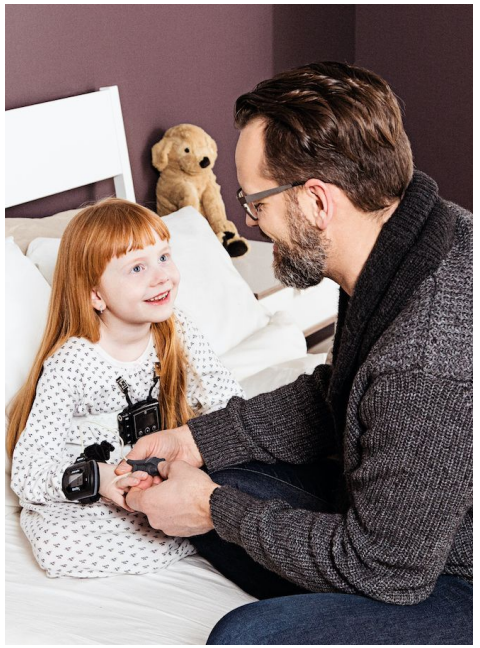
Advantages:
includes EEG, includes video

Disadvantages:
expensive, thousands
start and end times set by policy, time off work and/or school, may be more difficult to sleep (equipment, noise, unfamiliar)

At home testing:

Advantages:
more comfortable
more affordable, hundreds
schedule is flexible

Disadvantages:
no EEG or video
insurance navigation



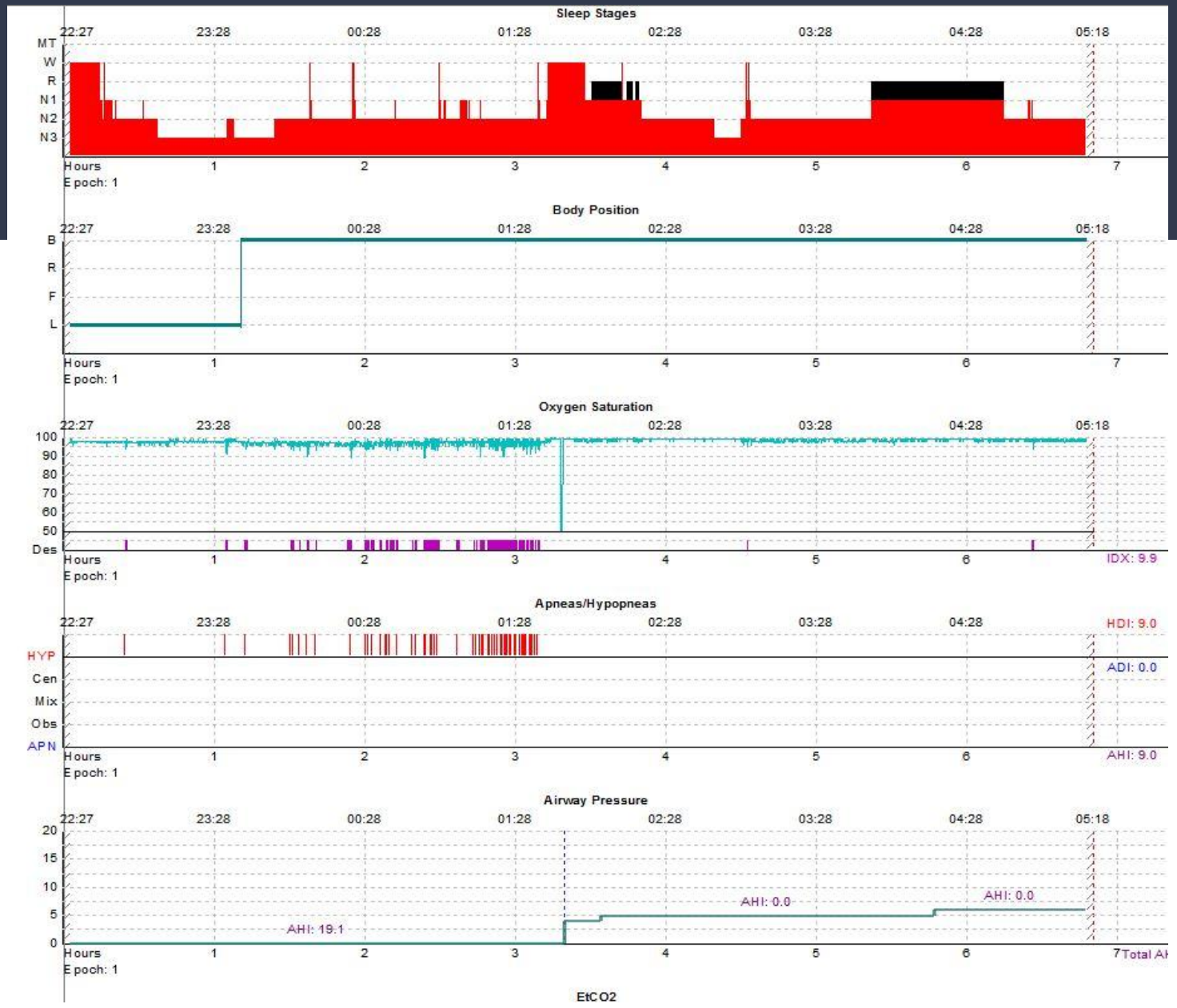
Equivalent: both are able to detect apneas and diagnose OSA (oxygen saturation, flow or PAT, microphone), both can have the option to include carbon dioxide monitoring and leg movements.

At Home Testing

WatchPAT - FDA approved for age 12 and older

NoxT3 - FDA approved for age 2 and older

The American Academy of Pediatrics issued a practice guideline in 2012 that stated the following: “if polysomnography is not available, then alternative diagnostic tests or referral to a specialist for more extensive evaluation may be considered.” Reference is made to ambulatory polysomnography. The American Academy of Sleep Medicine stated in a 2017 position statement that “Use of a home sleep apnea test is not recommended for the diagnosis of obstructive sleep apnea in children. The ultimate judgment regarding propriety of any specific care must be made by the clinician, in light of the individual circumstances presented by the patient, available diagnostic tools, accessible treatment options, and resources.”



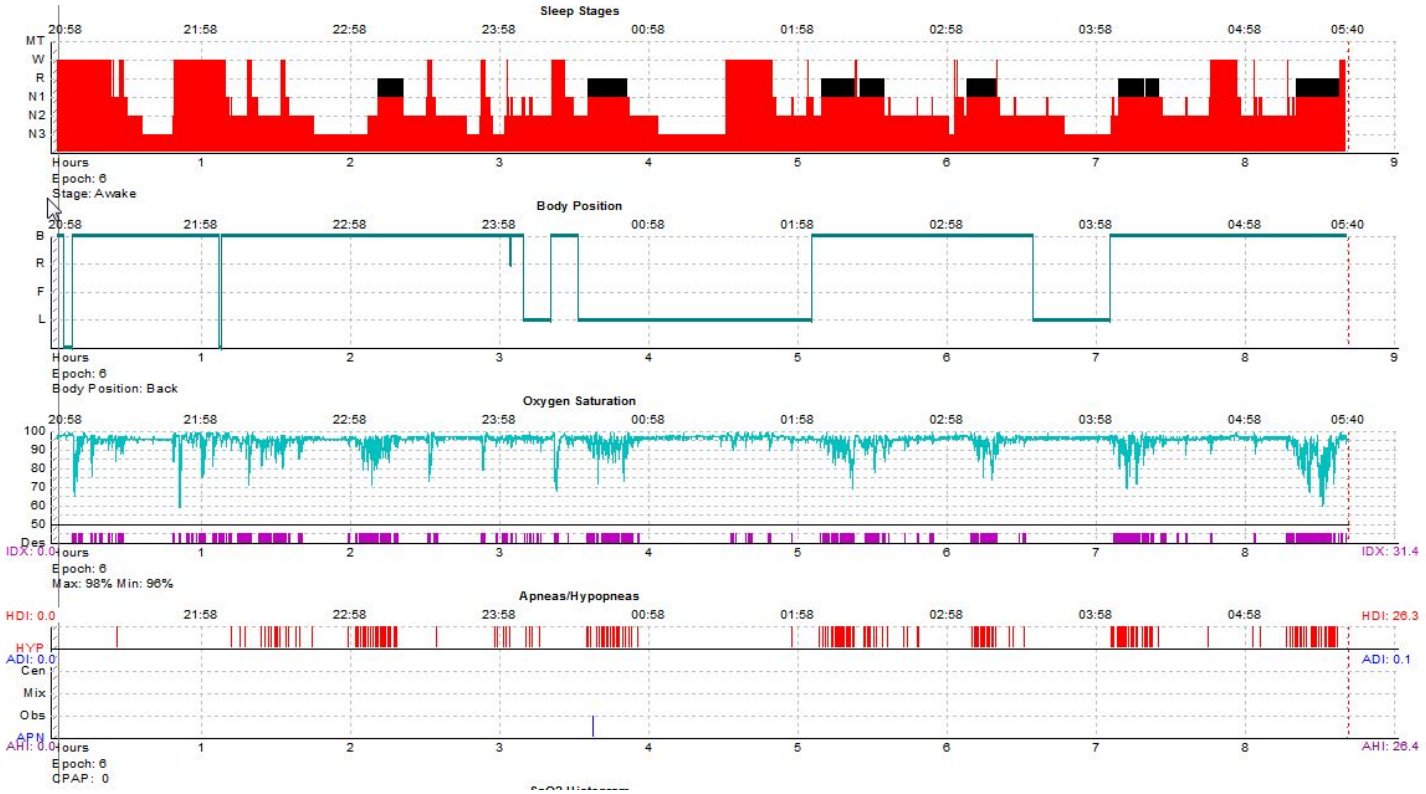
This is a fairly ideal split night study that exemplifies the benefit of treating OSA.

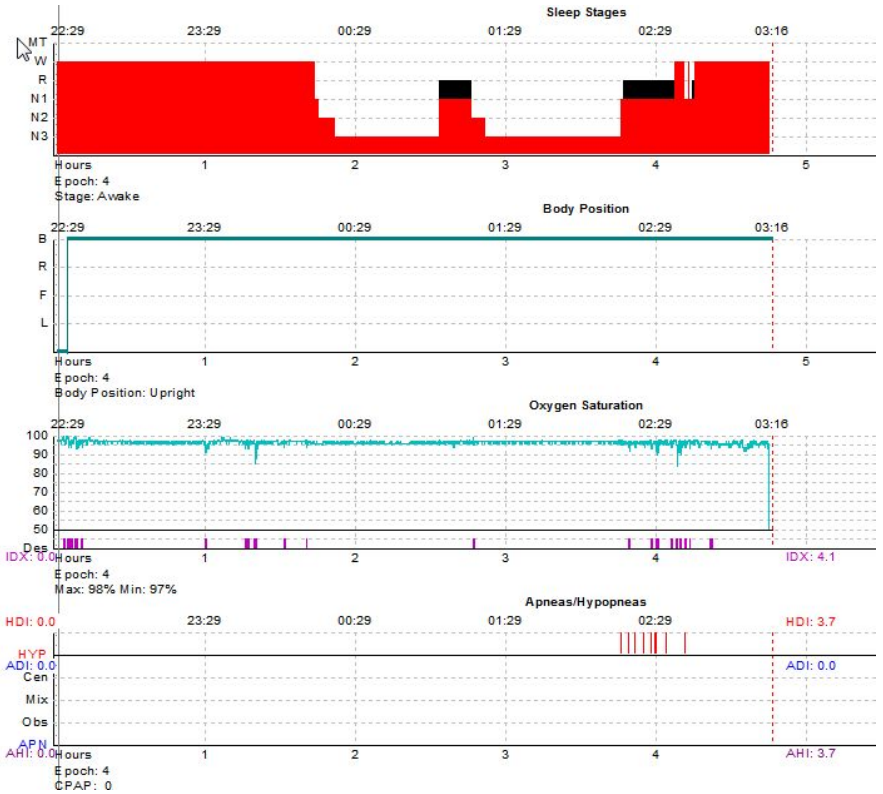
This is a teen individual, moderate intellectual disability as part of a PDD, overweight, snoring per parents but limited clinical history otherwise.

His pre-CPAP portion of the study showed an AHI 19 with SaO2 low 89% (shallow to moderate desaturations, not very low!).

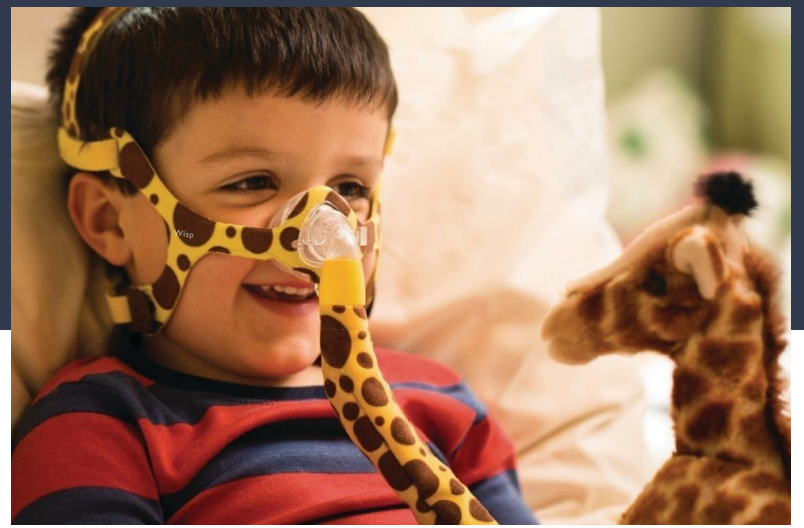
With starting CPAP and increasing to 6 CWP (range is 4-20 CWP) he had resolution of breathing events even in REM supine and he had nice sleep architecture with REM rebound.

This is a 2-year-old child, pre and post tonsillectomy.

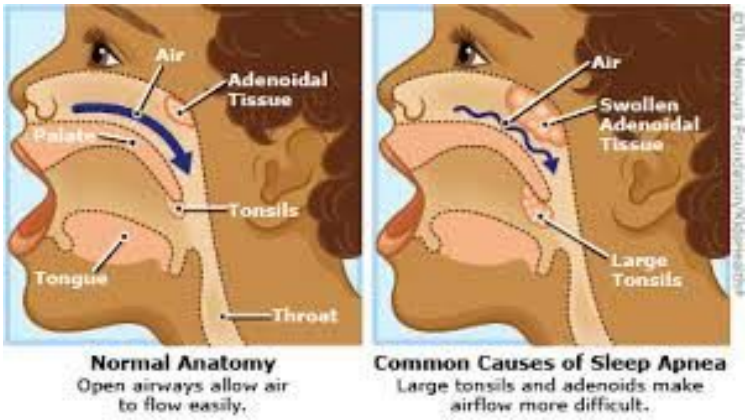


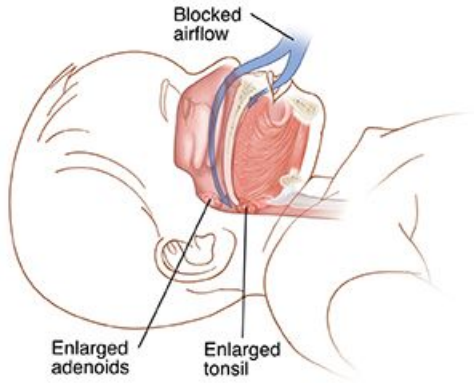


Guide Next Steps



1. Evaluate for a tonsillectomy and adenoidectomy
2. CPAP machine
3. Positional therapy with raising the head of the bed and non-supine
4. *Consider discussing* weight change if there is a path forward that is helpful and not negative





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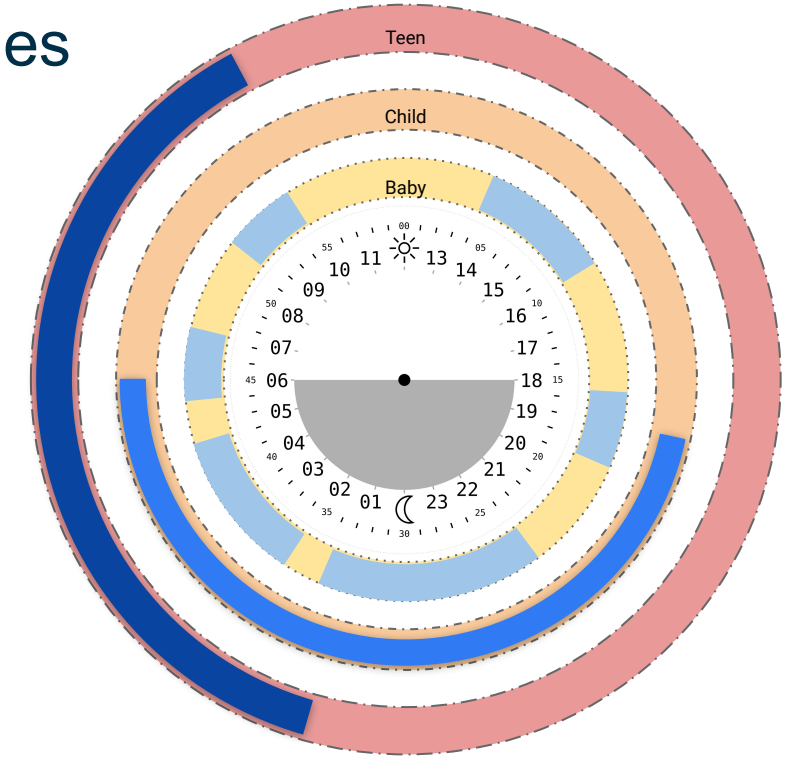

Review of Pediatric OSA

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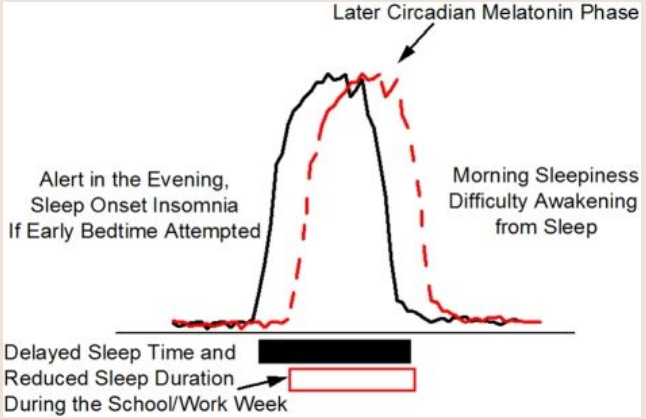
Insomnia and Autism Spectrum Disorder

Screen for circadian phase shift
Stimulus control
Medication

Screen for Phase Shift



Children with ASD are more likely to have delayed circadian rhythms as well as blunted or *absent circadian rhythm* of melatonin

What is perceived as trouble falling asleep / insomnia may be a delayed phase without a strong sleepy cue until later than is preferred.

For example, a child may be asked to go to bed at 8 pm to get enough sleep before waking up at 6 am for the morning routine and school. The child may not feel sleepy and may not fall asleep for 2+ hours. This same child may be able to fall asleep easily and sleep well if allowed to go to bed at midnight and get up at 10 am.

1. Giannotti F, Cortesi F, Cerquiglini A, et al. An open label study of controlled release melatonin in of sleep disorders in children with autism. J Autism Dev Disord 2006;36(6):741-52.
2. Tordjman S, Anderson GM, Pichard N, et al. Nocturnal excretion of 6-sulphatoxymelatonin in children and adolescence with autistic disorder. Biol Psychiatry 2005; 57(2):134-8.
3. Kulman G, Lissoni P, Rovelli F, et al. Evidence of pineal endocrine hypofunction in autistic children. Neuro Endocrinol Lett 2000;21(1) 31-4.

Behavioral Interventions

Sleep hygiene is necessary but *not* adequate to treat insomnia.

Stimulus Control
specific to the child so it creates a strong connection, unique to bedtime, consistent every night

a few books, sound machine, projection night light, comfort item(s) (picture, stuffed animal, music box, etc)

simple bed
(or mattress on the floor)

no toys or extra items in the room

Prescribed Medications QHS – PRN, scheduled or alternating

trazodone (Desyrel, Oleptro) 25-150 mg

mirtazapine (Remeron) 7.5 - 15 mg

doxepin (Silenor) - 3-6 mg or 10-75 mg

amitriptyline (Elavil) - 25-75 mg

hydroxyzine (Vistaril, Atarax) 25-75 mg

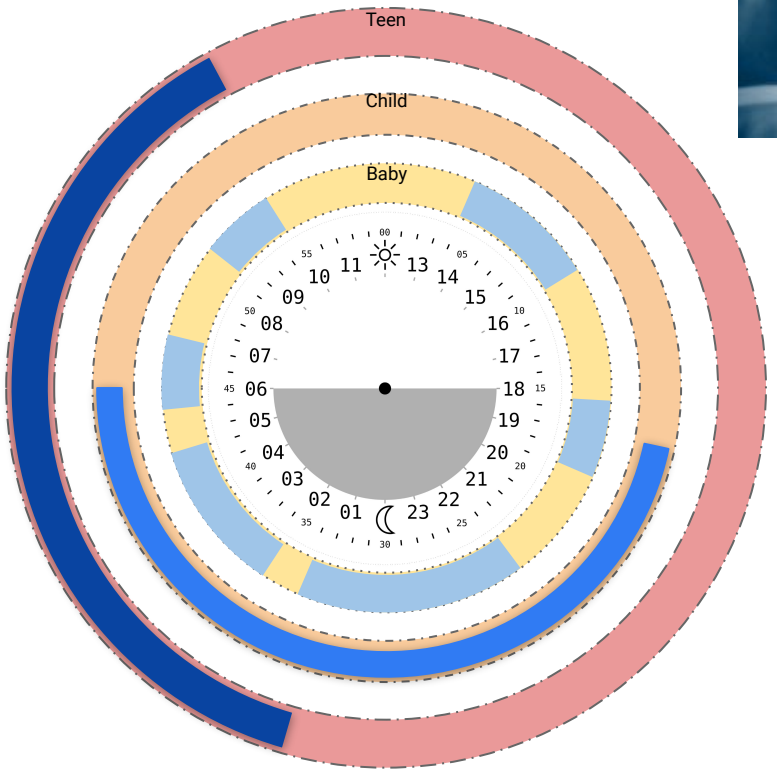
ramelteon (Rozerem) 8-16 mg

clonidine (Catapres) starting at 0.1 mg

guanfacine (Tenex) XR 1-4 mg

Review of Pediatric OSA

Review of TST & Circadian Rhythm Across the Ages



Review of Insomnia and Autism

The End

Questions?

Extra slides?

Extra: Sleep Tips for Babies

- Entrainment with activity and light exposure vs dim light leading up to 6 weeks of age and continuing beyond.
  - baby wakes up, feed baby first, baby interacts/plays second, baby falls back asleep
  - light in the morning, dim or no light at night
- Sprinkle pacifiers or always keep a pacifier pile in one specific corner

Extra: Tips for Kids:

- Kids with ADHD and heavy sleep inertia, schedule PE first hour, consider Jornay

Extra: Tips for Teenagers:

- Phase shift (advance to an earlier bedtime) with melatonin and bright light
  - For example: sleepy bedtime at 2 am, natural melatonin secretion / dim light melatonin onset (DLMO) occurs at midnight with the pineal gland secreting 0.3 milligrams of melatonin, to phase advance give 0.1-1.0 mg exogenous melatonin at 6-8 pm
  - Bright light upon waking
- Heavy sleep inertia apps like Alarmy (do math problems, jumping jacks, picture of a sink, etc to turn the alarm off)
- Delayed school start time if possible
- Schedule PE first hour
- Insomnia: Doze app: Goodnight Mind for Teens by Dr. Colleen Carney