

Recognizing Pediatric Sleep Disorders

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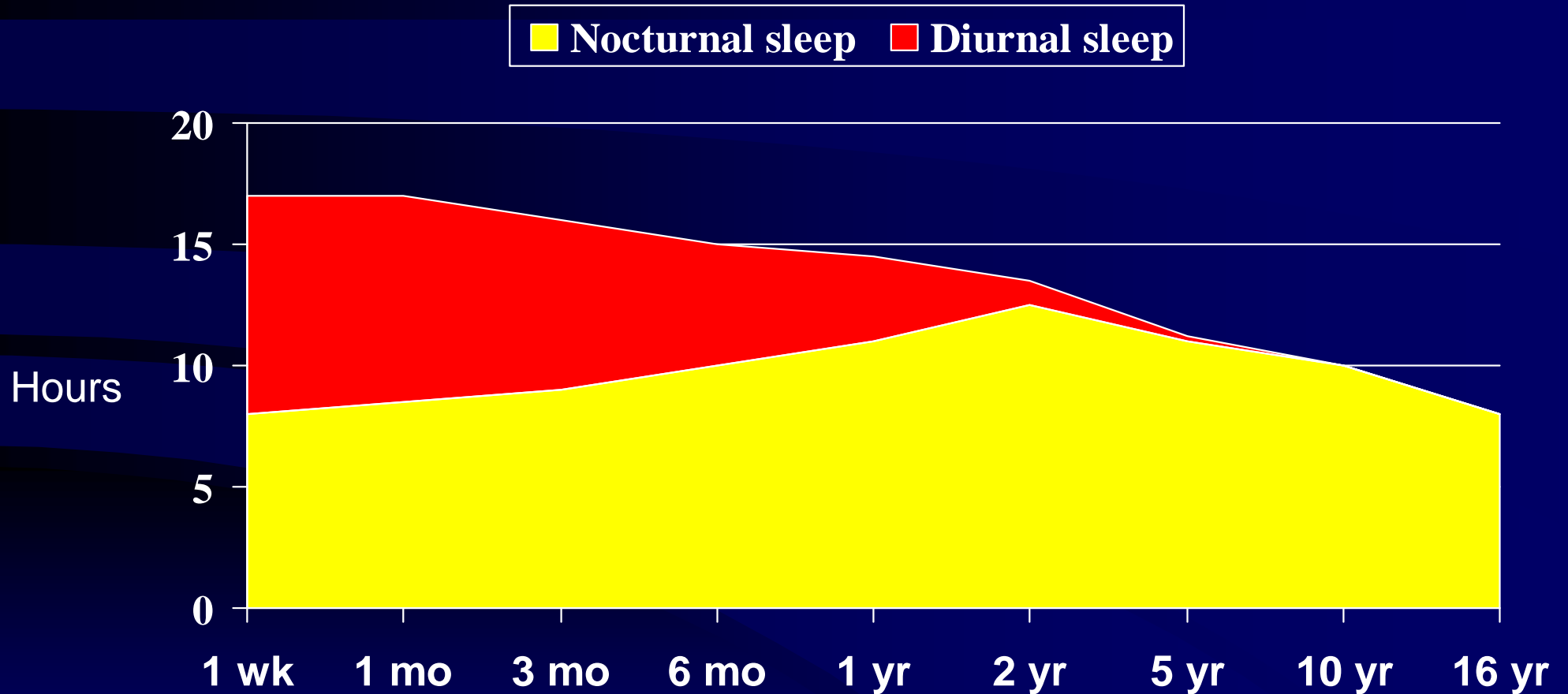
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Outline

- **Function of sleep**
- **Normal sleep in the pediatric population**
- **Common pediatric sleep disorders**

Total Sleep Time



Modified from Sheldon *et al*, 1992

Wake

Sleep

Sleep Pressure

100

50

0

0

8

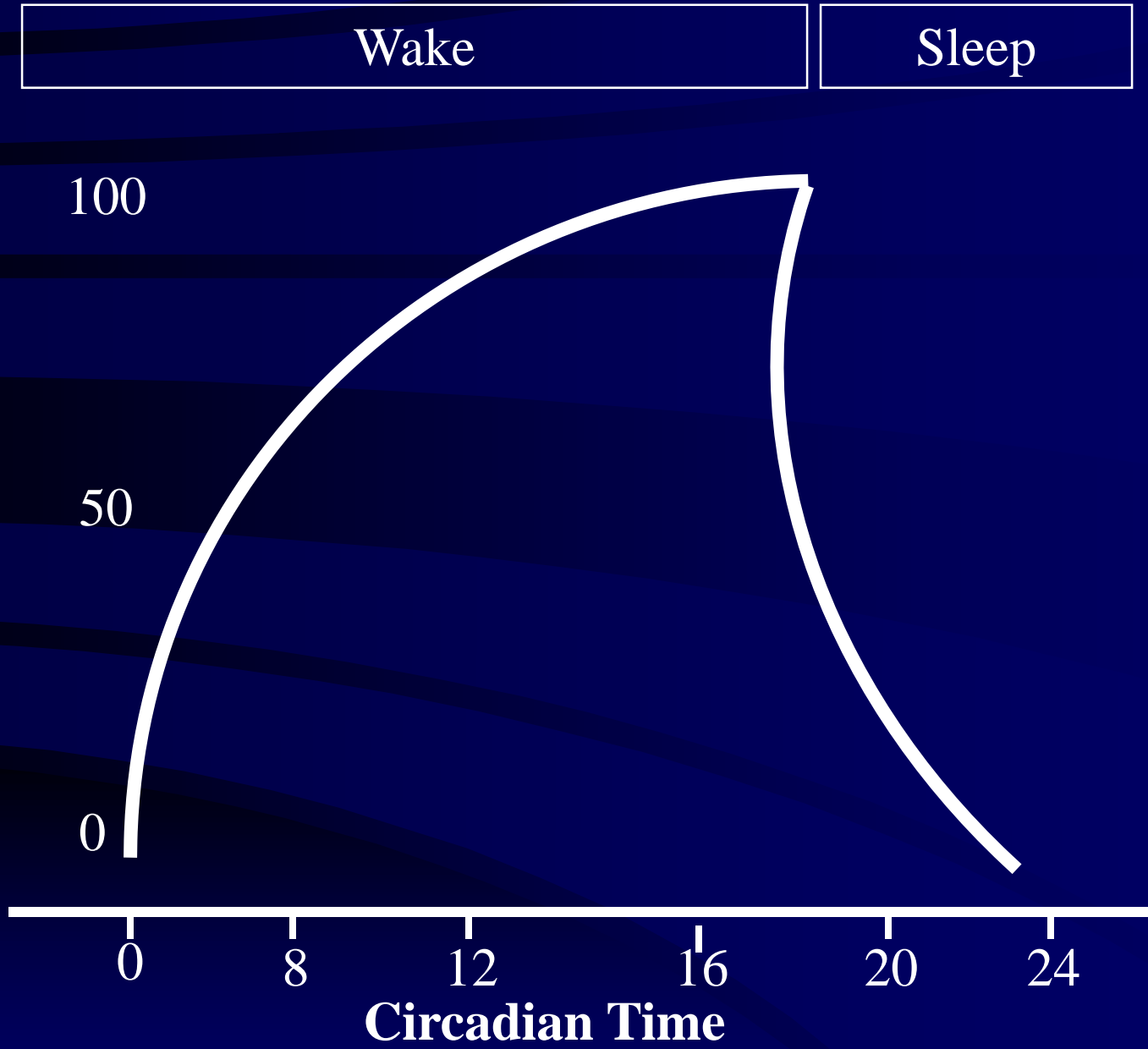
12

16

20

24

Circadian Time



Lessons on function of Sleep

- **Sleep in humans and animals is necessary for life and for neuropsychological function**
- **Theories regarding function of sleep:**
 - **Possible role in energy conservation**
 - **Memory consolidation and reinforcement**
- **Learning, memory, cognition**
- **Maintain body homeostasis: sleep necessary for life**
 - **regulate body temperature**
 - **heart rate; blood pressure**
 - **appetite**

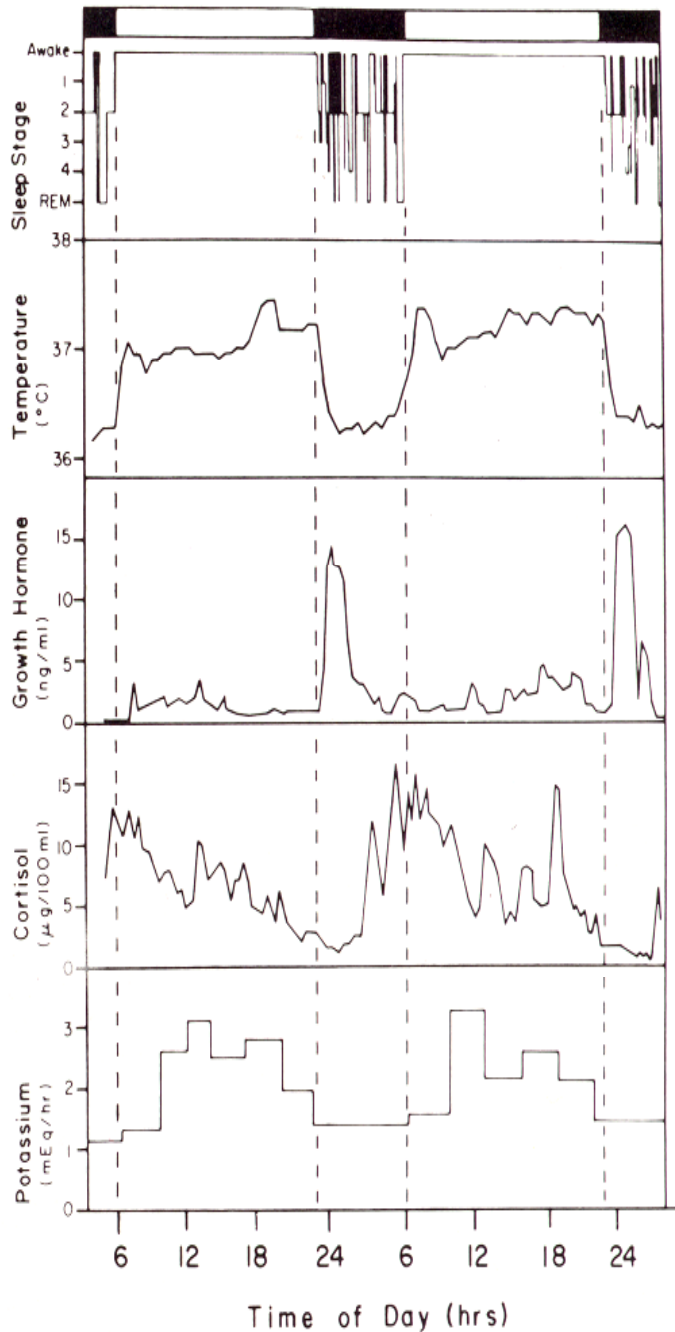
Moore-Ede, *N Engl Med J*, 1983

Rhythmicity of physiological functions

Blood pressure

Drug toxicity and effectiveness

Melatonin: independent of sleep



Sleep Architecture

- **Wake, REM and Non-REM sleep states**
- **REM sleep: Dream sleep**
 - **characterized by profound muscle atonia**
- **Non-REM is divided into four stages and shows a general slowing of cardiac and respiratory function, tolerance of hypoxia and hypercarbia**

Awake

REM

NREM 1-2

NREM 3-4



Awake

REM

NREM 1-2

NREM 3-4

 partial arousals

0

1

2

3

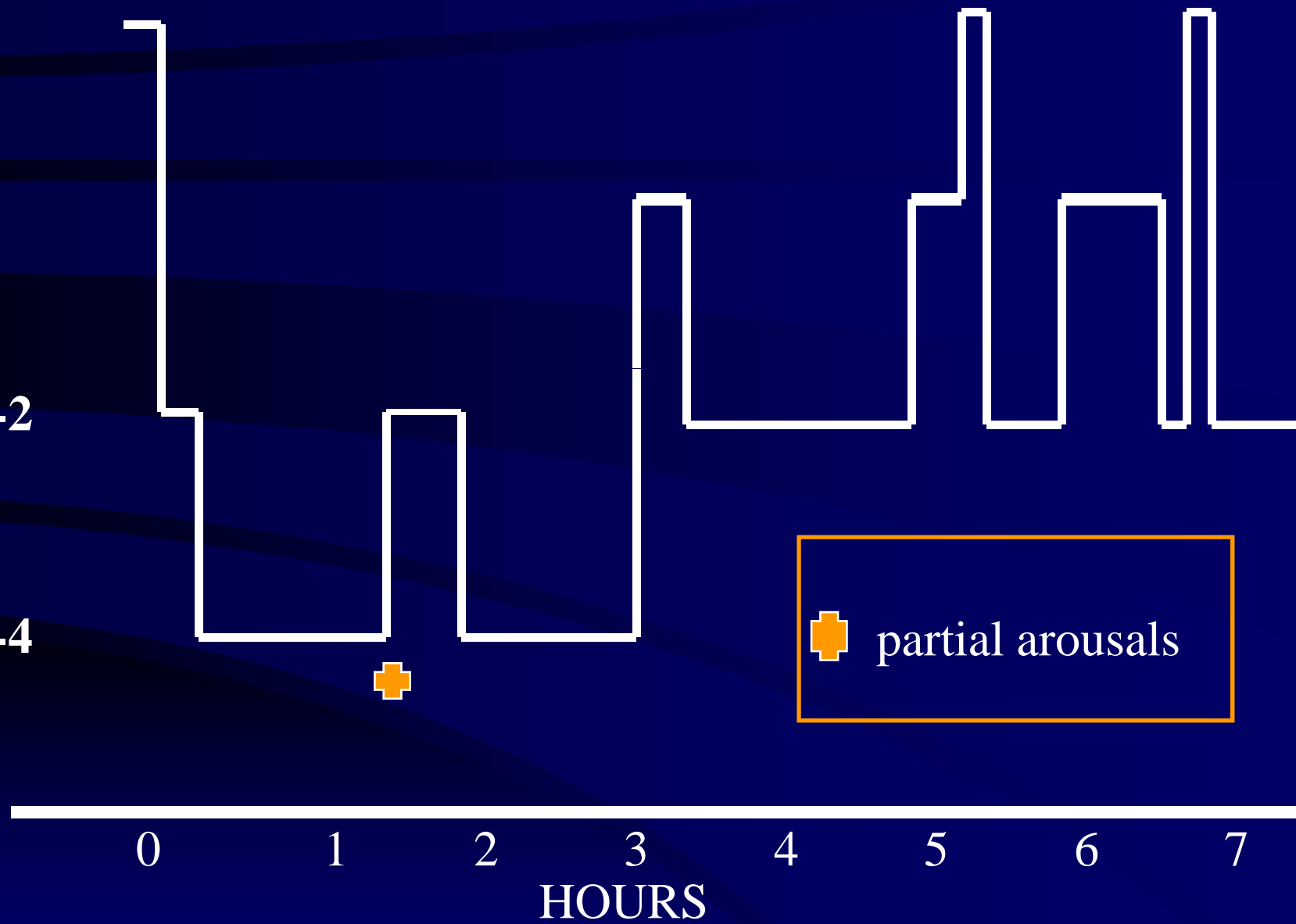
4

5

6

7

HOURS



Sleep Deprivation

- **One day deprivation: Effects mood, performance**
- **Two-three days: “Microsleeps” intrude into wakefulness causing inattentiveness**
 - **Vigilance, spatial orientation, motor control, short term and working memory**
- **Ten days: EEG of wakefulness is indistinguishable from that of sleep**

Sleep Deprivation

Animal Studies: total sleep deprivation

- **Clumped hair, skin lesions**
- **Enormous increase in food intake**
- **Severe increase in metabolic rate**
- **Weight loss despite food intake**
- **All animals died**

Low body temperature was ultimate predictor of death
– **all animals became hypothermic**

Sleep Disorders

One of the most frequent medical complaints

- Sleep disordered breathing
- Circadian rhythm disorders
- Narcolepsy
- Parasomnias
- Seizure
- Insomnia

Presentation changes with age

Excessive daytime somnolence or neuropsychological problems

Presentation of Sleep Disorders in Childhood

Infant

Sleep-disordered breathing
-Apnea of prematurity
-Infant apnea
-SIDS

Toddler/child

Sleep-disordered breathing
-hyperactivity
- Failure to thrive
Parasomnia
Limit-setting sleep disorder

Adolescent

Sleep-disordered breathing
-sleepiness
-obesity
Circadian rhythm disorder
Disorders of excessive sleepiness
Insomnia

Sleep Disorders Affect Daily Function

- **Some sleep disorders are linked to neuropsychological impairments**
 - **Insomnia with ADHD or anxiety**
 - **Obstructive apnea with depression or ADHD symptoms**
- **Sleep Disorders cause neuropsychological symptoms and/or may be misdiagnosed as psychological disease**

Diagnosing Sleep Disorders

- **Sleep history is very important-**
- **Time to bed and wake-schedule: What is average duration of sleep?**
- **If allowed to sleep late, does patient feel refreshed?**

Diagnosing Sleep Disorders

- **Does patient fall asleep in unusual places?**
- **Effect on daytime function or school performance?**

Diagnosing Sleep Disorders

- What prescribed and OTC **medications** are taken?
 - Benadryl increases stage 4 deep sleep and parasomnias
 - Stimulants associated with frequent awakenings, sleep initiation problems and excessive movement
- What medications have recently been withdrawn?
 - Withdrawal of benzo or narcotic causes insomnia
 - Withdrawal of stimulants cause rebound sleep

Sleepiness versus Fatigue

- **Fatigue:**

- Subjective feeling of being tired
- Worn down
- Lack of energy
- Associated depression

- **Sleepiness**

- State of increasing sleep pressure
- Inability to remain awake
- Fall asleep in unusual places
- Most common diagnosis for excessive daytime sleepiness: **Insufficient Sleep**

Sleep Disorders

- **Sleep disordered breathing**
- **Parasomnia**
- **Circadian rhythm disorders**
- **Narcolepsy**
- **Insomnia**

Definition of Obstructive Sleep Apnea

- Attempted breathing with complete obstruction of air movement from the mouth and nose
- Partial obstruction is “hypopnea”, decreased airflow associated with arousal, or oxygen disturbance
- Severity often measured using the AHI
- **Sleep-disordered breathing** -
 - Complete or partial airflow obstructions
 - Sleep fragmentation: arousal secondary to breathing efforts

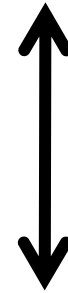
Childhood Sleep-Disordered Breathing

Sleep Apnea: prevalence of 2-4% in children

Habitual snoring seen in 16%

- **Children with sleep apnea utilize health care services 2.6-fold more than normal children**
 - **Hospital days, drug use, visit to emergency dept.**
- **Not yet viewed as a public health problem**

Obesity



**Sleep Disruption and
Sleep-disordered breathing
Excessive Sleepiness
Hormone imbalance**

Adenoid Facies- Long Face Syndrome

- a. long and narrow face.**
- b. narrow nose and nasal passage**
- c. short and flaccid upper lip**
- d. contracted upper arch with posterior cross bite**
- e. An expressionless or blank face**
- f. Decreased maxillary growth**

Anatomic Contributions to OSA

- **Micrognathia**
- **Macroglossia**

Down Syndrome

Nasopharyngeal Narrowing

Midface hypoplasia

Macroglossia

Hypotonia

Obesity

Neuropsychological Impairments in Adult OSA

- **Vigilance**
- **Fine Motor skills**
- **Memory**
- **Executive function**



Executive Function

- **Attention**
- **Inhibition**
- **Immediate working memory**
- **Behavior regulation**
- **Planning/ organizing**
- **Mental flexibility**

Effect of Sleep Disruption on the Developing Brain

- **Gains in EF occur during myelination of frontal lobes- --EF necessary for social skills and school performance**
- **Children are in a state of rapidly developing cognition where alterations of sleep may have long-term neuropsychological consequences**

Evidence for Cognitive Impact of SDB

- D Beebe: **Executive function deficits** in children with mild Sleep Disordered Breathing
- Kennedy 2004: Snoring and very mild oxygen desaturation associated with **IQ, attention and memory deficits**
- O'Brien 2004: Snoring without gas exchange abnormalities associated with **IQ deficits**—role for sleep fragmentation

Mechanism for Cognitive Dysfunction Associated with Sleep Disordered Breathing

- **Sleep Deprivation/fragmentation**
- **Oxygen saturation abnormalities**
- **Pre-existing brain damage**

Sleep Deprivation/Fragmentation

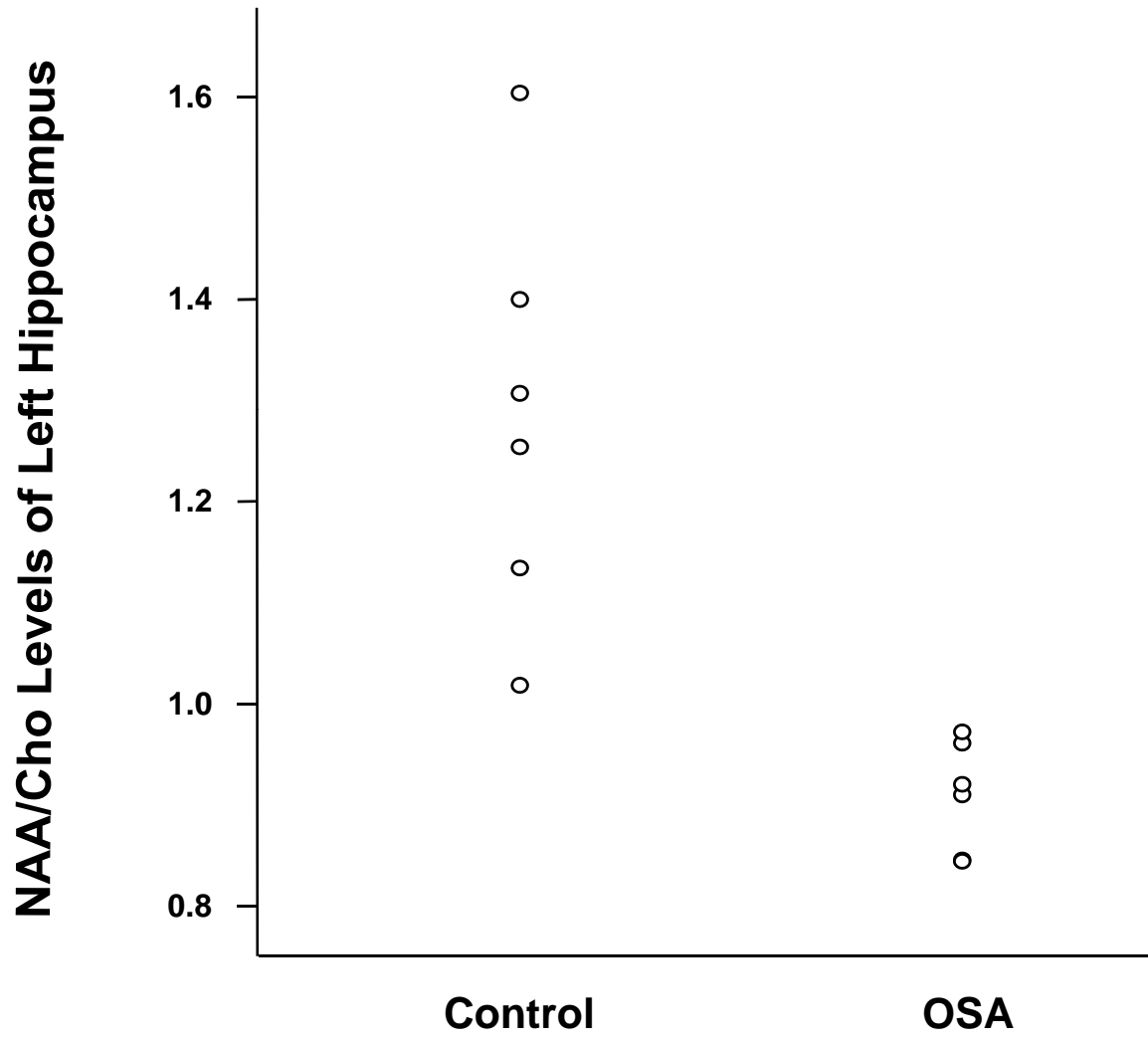
- Impairs reaction time
- Attention
- Short term memory
- Spatial orientation
- Motor control
- Executive function

Brain Areas Vulnerable to Hypoxia

Acute hypoxemia in adult human brain shows hierarchy of neuronal vulnerability: Hippocampus and cerebellum

Crit Rev Neurobiol 1991

Hippocampal Neuronal Metabolites are Decreased in Children With OSA aged 9-16 Years



Halbower, PLoS 2006

Apnea and the Brain

Some deficits of memory and vigilance in adults have been reported to be permanent (unresponsive to treatment)

Data limited: some dysfunction is reversible in children—There may be a benefit to early diagnosis and treatment

Case

- **A 17 yo snoring male wakes every night out of sleep and screams uncontrollably. His parents say “he looks right through them” and does not respond to their attempts to wake him.**
- **The episodes happen at sleep onset**
- **What is your differential diagnosis?**

Sleep Disorders

Most common medical complaint

- Sleep disordered breathing
- **Parasomnias versus Seizure**
- Circadian rhythm disorders
- Narcolepsy
- Insomnia

Parasomnias

- **Disorder of arousal**
- **EEG signs of sleep during apparent wakefulness**
- **Patients are not sleepy during the day**
- **Examples:**
 - **Sleep walk**
 - **Sleep talk**
 - **Night terrors**

Parasomnias

- Increased by body heat and high room temps
- Increased with fever and illness
- Increased by very hot baths prior to bed
- Increased by antihistamines

- Decreased by the opposite
- Decreased by Aspirin and NSAID's

Seizure

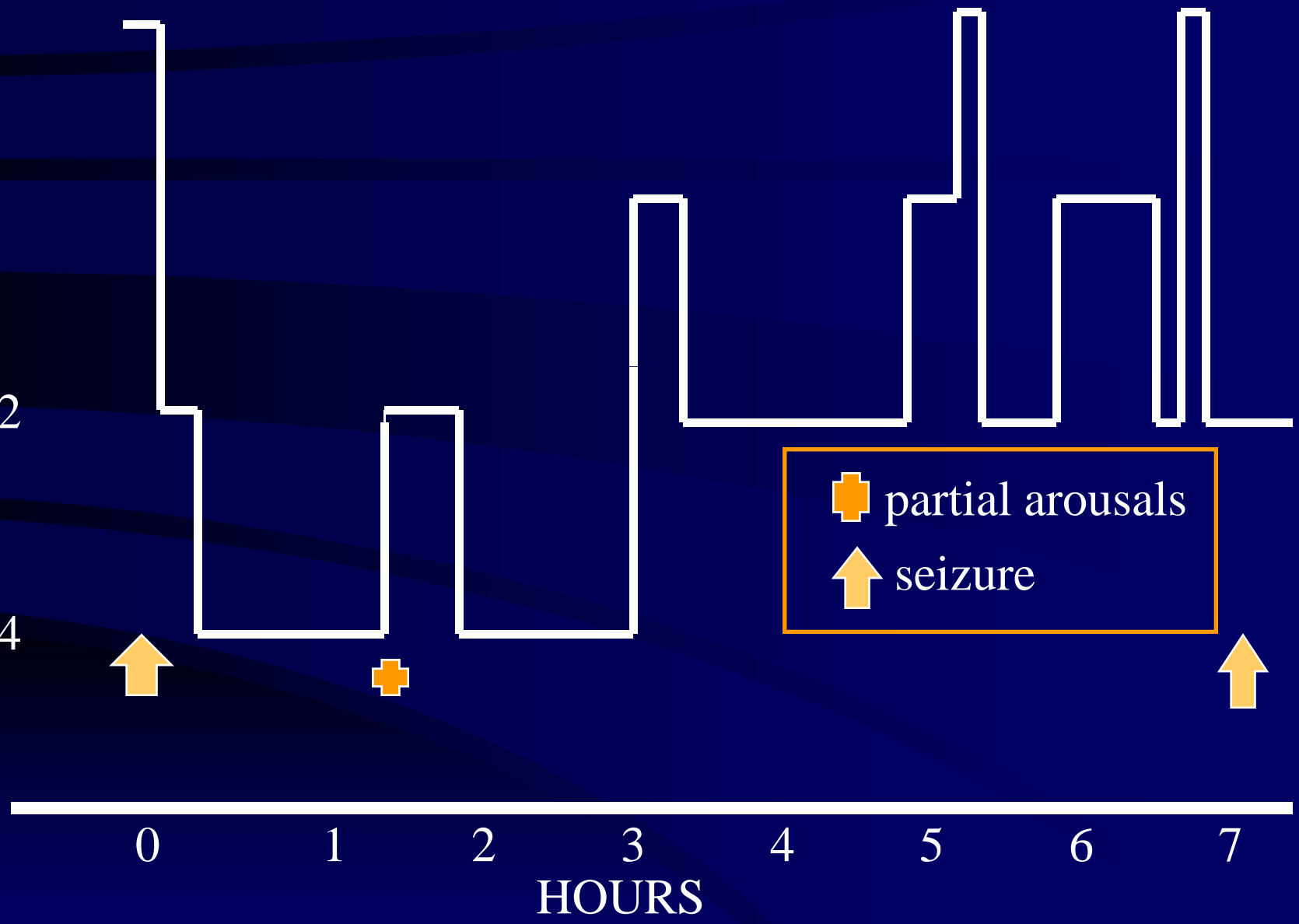
- **Can present as any sleep disorder or parasomnia including sleep walking, night terror, obstructive apnea**
- **Excessive daytime sleepiness due to sleep disruption**

Awake

REM

NREM 1/2

NREM 3/4



Sleep Disorders

Most common medical complaint

- Sleep disordered breathing
- Parasomnias versus Seizure
- **Circadian rhythm disorders: cover in next talk**
- Narcolepsy
- Insomnia

Sleep Disorders

Most common medical complaint

- Sleep disordered breathing
- Parasomnias
- Circadian rhythm disorders
- **Narcolepsy**
- Seizure
- Insomnia

Narcolepsy

- **Incidence: 1:2000 (As common as cystic fibrosis)**
- **Genetic basis: Link to HLA Dw2 on chromosome 6**
- **Full blown symptoms don't develop until adolescence**
- **Complaints of excessive daytime somnolence start in childhood**

Symptoms of Narcolepsy

- **Excessive daytime somnolence: 100%.**
- **Sleep onset in unusual circumstances.**
- **Severe sleepiness leads to inattention, poor memory, blurry vision, diplopia, and automatic behaviors without awareness**
- **Unstable sleep-wake cycle and circadian rhythm of sleep**

Symptoms of Narcolepsy

Onset of REM related phenomenon during waking periods or at sleep onset

- **Short sleep latency-less than 5 minutes**
- **Cataplexy: Abrupt loss of skeletal muscle tone following a strong emotional stimulus**
- **Hypnagogic hallucinations**
- **Sleep onset paralysis**

Pathophysiology of Narcolepsy

- **Deficiency of neuropeptide Hypocretin in hypothalamus**
- **Hypocretin promotes wakefulness and inhibits REM sleep during the day**
- **Influences sleep/wake cycle timing which is irregular in narcolepsy**
- **Influences appetite: obese**

Diagnosis of Narcolepsy

- **Symptom tetrad**
- **Aided by HLA typing**
- **CSF examination for hypocretin**
- **Multiple sleep latency test**
 - **Series of naps**
 - **Examines sleep tendency**
 - **Examines REM tendency**

Excessive Daytime Somnolence

- Parasomnias
- Circadian rhythm disorders
- Sleep disordered breathing
- Narcolepsy
- Seizure
- **Insomnia**

Insomnia

- **Associated with psychiatric illness, medical problems, anxiety, stress, medication**
- **Treatment is lengthy but best involves cognitive behavioral therapy, and relaxation**
- **Sleep restriction**
- **Special circumstances: Autism, PDD, ADHD**
 - **Sleep comforts**
 - **Safe environment to move**
 - **medication**

Guidelines for Good Sleep Hygiene

- Schedule **REGULAR** bedtime and wake-up-
INCLUDING WEEKENDS
- Hot bath few hours before bed and Exercise during
the day promotes rebound body cooling
- **AVOID PROLONGED DAYTIME NAPS**
- Avoid excessive temperature, ETOH, and caffeine (8
hour $\frac{1}{2}$ life)
- Avoid nighttime light exposure

Who Deserves a Pediatric Sleep Evaluation?

- **Clinical suspicion **or** major risk factors for sleep disordered breathing**
- **Children with disturbed sleep**
- **Excessive sleepiness not responsive to therapy**
- **Children with unusual daytime drop attacks with hallucinations**
- **Children with unusual presentation of parasomnias or movement disorders**
- **Sleepiness or nighttime oxygen abnormalities associated with other medical disorders**
- **Insomnia**