SLEEP ACROSS THE LIFESPAN

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Objectives

- key sleep concepts
- quantity - quality - regularity
  - infancy
  - children
  - teens
  - adults
  - older adults
Sleep

brainstem and hypothalamus
→ cortex

Tuberomammillary nucleus – histamine

Other neurons – orexin (hypocretin)

Ventrolateral preoptic nucleus → inhibits arousal areas

Sleep

Sleep stages

Durations

Frequency (Hz)

Amplitude (μV)

Pattern

1. Delta-waves + sleep spindles

2. 2-4

3. 75-150

4. Random, fast

5. Alpha activity is prevalent as wakefulness approaches

Stage I

Stage II

Stage III

Stage IV

REM

0.5-2

100-200

5-7

Low

8-15

50-150

Random, fast

Saw tooth waves

20%-25%

Of total sleep time

Delta-waves

12%-15%

Of total sleep time

Increased metabolism and oxygen consumption

Reticular neurons in thalamus

Increased metabolism and oxygen consumption

Reticular neurons in pons and spinal cord

Decreased metabolism and body temperature, synthesis of brain proteins and replenishment of energetic reserves

Cortical activation with paradoxical wakefulness-like EEG, muscular atony and rapid eye movements

Sleep & Development

As a child develops, its sleep gradually becomes restricted to the night.

Newborn infant

1 year old

4 years old

10 years old

Adult

Sleep

6 P.M.

Midnight

6 A.M.

Noon

6 P.M.

Time of Day
Sleep Duration - Sleep Quality - Sleep Regularity

Fig. 10.2 The construct of sleep duration: five variables that would be pertinent for screening in primary care settings.


Iglowstein I et al.  Sleep Duration from Infancy to Adolescence: Reference values and generational trends. Pediatrics 2003;111:302-307
Iglowstein I et al. Sleep Duration from Infancy to Adolescence: Reference values and generational trends. Pediatrics 2003;111:302-307
Pre-term/Neonate
How Much Does a Baby Sleep?

<table>
<thead>
<tr>
<th>Baby Age</th>
<th>Night Sleep</th>
<th>Day Naps</th>
<th>Total Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn - 2 months</td>
<td>2-4 hours betw feedings</td>
<td>5 (or more)</td>
<td>16 to 18 hours</td>
</tr>
<tr>
<td>2 to 4 months</td>
<td>4 hours betw feedings</td>
<td>3 naps</td>
<td>14 to 16 hours</td>
</tr>
<tr>
<td>4 to 6 months</td>
<td>5-8 hours</td>
<td>2-3 naps</td>
<td>14 to 15 hours</td>
</tr>
<tr>
<td>6 to 9 months</td>
<td>8-10 hours</td>
<td>2 naps</td>
<td>About 14 hours</td>
</tr>
<tr>
<td>9 to 12 months</td>
<td>10-12 hours</td>
<td>2 naps</td>
<td>About 14 hours</td>
</tr>
<tr>
<td>12 to 18 months</td>
<td>11-12 hours</td>
<td>1-2 naps</td>
<td>13 to 14 hours</td>
</tr>
<tr>
<td>18 to 24 months</td>
<td>11-12 hours</td>
<td>1 nap</td>
<td>12 to 14 hours</td>
</tr>
</tbody>
</table>

- △ structure = maturation
- △ temporal & order
- ↓ total sleep duration
- at nighttime
- ↑ sleep cycle
- △ sleep architecture
  - Proportion NREM/REM
  - NREM onset
  - ↑ NREM/REM cycle length

Pre-term/Neonate

Table 1: States (CA 36-44 weeks)

<table>
<thead>
<tr>
<th>A. Based on behavioral features [9, 6]</th>
<th>Awake</th>
<th>Drowsy</th>
<th>Active Sleep</th>
<th>Quiet Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>State 1: Eyes closed, regular respiration, no movements</td>
<td>Open, blink</td>
<td>Open/closed</td>
<td>Closed</td>
<td>Closed</td>
</tr>
<tr>
<td>State 2: Eyes closed, irregular respiration, no gross movements</td>
<td>Pursuit</td>
<td>Searching</td>
<td>“Dreaming”</td>
<td>Sleep</td>
</tr>
<tr>
<td>State 3: Eyes open, no gross movements</td>
<td>Bright</td>
<td>Slow/rapid</td>
<td>Slow</td>
<td>Stories</td>
</tr>
<tr>
<td>State 4: Eyes open, gross movements, no crying</td>
<td>Starred</td>
<td>Starred</td>
<td>Twitches</td>
<td>Starled</td>
</tr>
<tr>
<td>State 5: Eyes open, air, crying</td>
<td>Proven</td>
<td>Proven</td>
<td>Proven</td>
<td>Relaxed</td>
</tr>
<tr>
<td>Other</td>
<td>Vocalizations</td>
<td>Vocalizations</td>
<td>Vocalizations</td>
<td>Pediatrik anesthetics</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Based on behavioral and polygraphic features [9, 12, 13]</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
</tr>
</tbody>
</table>

* Sometimes continuous slow activity (0x206 μV) “high-voltage” sleep.

Infant

Table 3: The transition from neonatal to infantile sleep

A. Development of sleep patterns during the first 3 months

Conceptional Age (weeks)

Disappearing patterns (no recording contains the pattern)

<table>
<thead>
<tr>
<th>Track</th>
<th>Alternation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Sleep onset</td>
<td>—</td>
</tr>
<tr>
<td>Breaches Frequent</td>
<td></td>
</tr>
<tr>
<td>Emerging patterns (all recordings show the pattern)</td>
<td></td>
</tr>
<tr>
<td>Sleep spindles</td>
<td></td>
</tr>
<tr>
<td>[From: 25, 43, 46]</td>
<td></td>
</tr>
</tbody>
</table>

B. Development of sleep patterns 3-4 months

Background pattern:

The trends of the first 4 months persist:

- no desynchrony
- no Active Sleep onset
- Transitions—no occurrence of Breaches Frequent
- sleep spindles in every record
- vascular waves in every record
- K complexes in 54% of all records

* There is a negative correlation between maximum spindle duration (MSD) and age in weeks (r): MSD = -0.07x + 7.4 (P = 0.01).

The amount of worse waves/sleep time (MSD) increases with age: MSD = 0.49x - 0.06 (P = 0.01).

de Weerd A.W., van den Bossche R.A.S. The development of sleep during the first months of life. Sleep Medicine Reviews. 2003;7: 179-191

![Figure 1: Developmental model of infant sleep problems.](image-url)
Children

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>n</th>
<th>Total Sleep Duration</th>
<th>Nighttime Sleep Duration</th>
<th>Daytime Sleep Duration</th>
<th>Daytime Napping Children (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>2%</td>
<td>98%</td>
</tr>
<tr>
<td>0.5</td>
<td>456</td>
<td>14.2</td>
<td>1.9</td>
<td>10.4</td>
<td>18.1</td>
</tr>
<tr>
<td>0.75</td>
<td>458</td>
<td>13.9</td>
<td>1.7</td>
<td>10.5</td>
<td>17.4</td>
</tr>
<tr>
<td>1</td>
<td>452</td>
<td>13.9</td>
<td>1.2</td>
<td>11.4</td>
<td>16.5</td>
</tr>
<tr>
<td>1.5</td>
<td>452</td>
<td>13.6</td>
<td>1.2</td>
<td>11.1</td>
<td>16.0</td>
</tr>
<tr>
<td>2</td>
<td>460</td>
<td>13.2</td>
<td>1.2</td>
<td>10.8</td>
<td>15.6</td>
</tr>
<tr>
<td>3</td>
<td>450</td>
<td>12.5</td>
<td>1.1</td>
<td>10.3</td>
<td>14.8</td>
</tr>
<tr>
<td>4</td>
<td>464</td>
<td>11.9</td>
<td>1.0</td>
<td>9.7</td>
<td>14.0</td>
</tr>
<tr>
<td>5</td>
<td>471</td>
<td>11.4</td>
<td>0.9</td>
<td>9.5</td>
<td>13.3</td>
</tr>
<tr>
<td>6</td>
<td>452</td>
<td>11.0</td>
<td>0.8</td>
<td>9.3</td>
<td>12.6</td>
</tr>
<tr>
<td>7</td>
<td>448</td>
<td>10.6</td>
<td>0.7</td>
<td>9.2</td>
<td>12.1</td>
</tr>
</tbody>
</table>

- ↓ REM sleep = fading of napping
- ~90 min.
- SWS!

Sleep problems

- tired when waking up
- sleep paralysis
- 'repetitive' limb movements
- breathing problems + snores loudly
- falling asleep sweating + night sweating
- sleeping with snoring
- light, noise

• Period of CHANGE
• Quantitatively & qualitatively
• melatonin
• Awareness (↓ parental control)
### Intrinsic Dysomnias - Primary Hypersomnias

<table>
<thead>
<tr>
<th>Intrinsic Dysomnias - Primary Hypersomnias</th>
<th>Prevalence</th>
<th>age characteristics</th>
<th>diagnosis</th>
<th>differential</th>
<th>treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSAS</td>
<td>7-9% - snore</td>
<td>preschool</td>
<td>snoring sweats &gt;5 apneas or 10 apnea hypopneas</td>
<td>PSG O₂ saturation pulmonary/cardiac monitoring</td>
<td>primary snoring failure to thrive ADHD neuro/ENT dx</td>
</tr>
<tr>
<td>narcolepsy</td>
<td>0.4%</td>
<td>early adolescence</td>
<td>irresistible REM sleep attacks EEG cataplexy hypnagogic hallucinations sleep paralysis</td>
<td>PSIG = family history MSLT</td>
<td>other hypersomnias sleep loss ADHD seizures</td>
</tr>
</tbody>
</table>

### Extrinsic Dysomnias - Primary Insomnias

Some estimates:
- • infants: 10-44% night awakenings
- • 2-5 yrs: 8% bedtime struggles
  - 22% night wakings
  - 30% @ 3 yrs awake at night
  - 10% @ 5 yrs awake at night
- • 15m-4yrs: 42% at least 1 sleep disturbance
- • 5-12 yrs¹: 37% sleep disturbance
  - 11.8% daytime sleepiness
  - 15.1% bedtime resistance
  - 10.7% anxiety around sleep
  - 9.9% shortened sleep
  - 8.1% sleep onset delay
  - 6.7% night wakings
- • adolescents: 11-33% sleep disturbance (! chronicity) (!girls)
- • common in children with special needs

### Circadian Dysomnias

<table>
<thead>
<tr>
<th>Circadian Dysomnias</th>
<th>Prevalence</th>
<th>age characteristics</th>
<th>diagnosis</th>
<th>differential</th>
<th>treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circadian rhythm disorder unknown</td>
<td>late sleep onset (&gt;12AM) difficult to awaken (in AM) sleep ins on WE normal sleep quality resistant to change</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7% adolescents</td>
<td></td>
<td>log</td>
<td>hyperomnia other circadian dx</td>
<td>behavioral chronotherapy</td>
<td></td>
</tr>
</tbody>
</table>

### Parasomnias

<table>
<thead>
<tr>
<th>Arousal Disorders</th>
<th>Sleep-Wake Transition Disorders</th>
<th>REM Parasomnias</th>
<th>Miscellaneous Parasomnias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep terror disorder (307.46)</td>
<td>Head banging</td>
<td>Nightmare disorder (307.47)</td>
<td>Bruxism</td>
</tr>
<tr>
<td>Sleepwalking disorder (307.46) Confusional arousals</td>
<td>Sleep starts Body rocking Sleep talking Nocturnal leg cramps</td>
<td>REM behavior disorder</td>
<td>Sleep enurexia</td>
</tr>
</tbody>
</table>

*Note: REM = rapid eye movement.*
CHILDHOOD

20-to-25% of all children -- 15% negative impact\(^1\)
80% chronic medical – neurodevelopmental – psychiatric\(^1\)
3.7% (0-18yrs) – ICD9 diagnosis for a sleep disorder\(^2\)
6.1% - sleep-related medications\(^2\)

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\(^1\)National Institute of Health Research & Grant Website, 2001

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Adults

TRUE!

by Daryl Cagle

- lighter & shorter
- ↑ tiredness (↓ S4)
- initiating & maintaining
- LIFESTYLE
  - ↓ exercise
  - ↑ coffee
  - ↑ alcohol
  - ↑ drugs
  - ↑ stress
  - kids’ sleep problems

- ↓ sleep duration
- SLEEPSTYLE
  - Lark – owl
  - Short-sleeper – long-sleeper
**Adults**

45+
- LIFESTYLE modifications
- = hormonal
- subjective & objective lighter

65+
- Illness/health
- drugs
- Δ social life
- ↓ physical activities
- night ≡ loneliness

**Older Adults**

![Graph showing sleep stages across different age groups.]

Fig. 3. Prevalence of sleep-related complaints in older adults (≥ 65 years), n = 9282, mean age 74 years [9].

Sonia Ancoli-Israel, Sleep and its disorders in aging populations, Sleep Medicine, Volume 10, Supplement 1, September 2009, Pages S7-S11
Summary

Take home bullet points

- developmental changes
  - quantity  -  quality  -  regularity
- complainant ≠ sufferer ≠ observant
- child  -  family  -  societal concern

references

- de Weerd A.W., van den Bossche R.A.S. The development of sleep during the first months of life. Sleep Medicine Reviews. 2003;7: 179-191
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