The Role of Sleep in Adolescent Health

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Infants can’t stop it......

.....Toddlers and preschoolers don’t want it

School aged children think it’s cool not to get it.....

.....Adolescents don’t care if they get it

Adults want more of it but can’t get it.....

......Elderly have time for it but often can’t do it.

SO HOW MUCH DO WE NEED?
Healthy Sleep Duration

The American Academy of Sleep Medicine recommends that you get the following hours of sleep on a regular basis for optimal health at each stage of life.

Range of Recommended Amount of Sleep

<table>
<thead>
<tr>
<th>Age</th>
<th>4 - 12 months</th>
<th>1 - 2 years</th>
<th>3 - 5 years</th>
<th>6 - 12 years</th>
<th>13 - 18 years</th>
<th>18+ years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of Sleep</td>
<td>12 - 16</td>
<td>11 - 14</td>
<td>10 - 13</td>
<td>9 - 12</td>
<td>8 - 10</td>
<td>7+</td>
</tr>
</tbody>
</table>

Suggested sleep duration includes time spent napping.

SleepEducation.org

A sleep health information resource by the American Academy of Sleep Medicine
Why is Sleep Important?

Key to health, performance, safety and quality of life

Sleep is NOT the absence of wakefulness
- Active, complex, and highly regulated
- Involves different areas of the brain
- Duration and timing are important
- Essential for life
- We all need it!

Sleep consumes 1/3 of human existence; unhealthy sleep can severely impair the other 2/3.
The Sleep Cycle

Alternating states of sleep across the night:

- **NREM**: Non-Rapid Eye Movement; Stages 1-3; 75% of the night
- **REM**: Rapid Eye Movement; Dreams occur; 25% of the night

Sleep is important for learning and storage of knowledge.
During the Sleep Cycle:

- Body temperature lowers
- Hormone levels rise and fall
• Biological changes occur with the onset of puberty

• **Average age of puberty onset**
  - Girls age 10
  - Boys age 12

• **Sleep changes are often noticed before the physical changes**

The sleep/wake pattern undergoes a biological delay in the timing of sleep.
Melatonin (sleep hormone) starts secreting about here in childhood.
The adolescent sleep pattern typically runs from about 11 p.m. to 8 a.m. Changes to this biological clock can be difficult.

Adolescent lifestyle:
- Academics
- Sports and Extracurricular activities
- Socializing
- Computer/Internet/cell phone use
- Social media
- Watching TV

Why do **SCREENS** keep you awake?
SLEEP VS. SMARTPHONES

DISPLAYS

Displays emit blue light

SMARTPHONE USE AT NIGHT

Blue light suppresses production of melatonin

PINEAL GLAND

Pineal gland can't produce melatonin

LACK OF SLEEP

MELATONIN

Melatonin can't regulate your sleep cycle

SLEEP

THE LIGHT FROM THIS SCREEN IS RUINING YOUR SLEEP.
Consequence of Weekend Sleep-ins

Brain thinks forward $\rightarrow$ calculates bedtime from time you wake up +15-16 hours, then makes you sleepy again

Late sleep-ins reset the circadian clock LATER

Weekend wake-up time more than 2 hours later than weekday wake-up time is a sign of sleep deprivation
ADOLESCENTS ARE THE MOST SLEEP DEPRIVED AGE GROUP IN THE UNITED STATES
Adolescent’s brains are often still on the pillow when school starts.
The Sleep Cycle: Why It Matters

“We are killing their dreams”
A reduction in sleep can reduce the ability to consolidate recently formed memories.

Lack of sleep can lead to poor concentration and shortened attention span.

66% of students have pulled an all-nighter.

Lack of sleep causes your brain to slow down or shut down completely.

- **Parietal Lobe**: Slower thought processes and difficulty forming logical conclusions to problems.
- **Frontal Lobe**: Lack of imagination or originality, lack of focus, stuttering, use of cliches in speech.
- **Neocortex**: Difficulty learning new tasks and making novel connections.
- **Prefrontal Cortex**: Blurred vision and hallucinations.
- **Temporal Lobe**: Slurred speech.
Why we should care: **ACADEMICS**

- Short sleep duration is linked with lower GPA
- 20% of poor sleepers are behind in grade level by one or more years
- Sleep problems predict students dropping a class

**Students with Cs, Ds, and F’s:**
- Obtain less sleep on school nights
- Have later bedtimes on school nights
- Sleep later on weekends

**Early start times reduce performance among disadvantaged students by an amount equivalent to having a highly ineffective teacher**
College students

- Later wake-up times associated with lower average grades
  Trockel, et al, 2000

- Compared to those with the lowest academic performance, students with the highest performance had significantly earlier bedtimes and wake times.

- Napping tended to be more common among high performers
  Eliasson, et al, 2010

“Strikingly, 70% of our sample had clinically poor sleep quality... Not only are many, perhaps most, college students not sleeping well, over half of our subjects were sleeping as badly or worse than samples of individuals with diagnosed sleep disorders.”

Gilbert and Weaver, 2010
College Student Reported Factors Affecting Academic Performance

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stress</td>
<td>28.4%</td>
</tr>
<tr>
<td>Sleep difficulties</td>
<td>19.6%</td>
</tr>
<tr>
<td>Anxiety</td>
<td>19.3%</td>
</tr>
<tr>
<td>Cold/sore throat/flu</td>
<td>13.9%</td>
</tr>
<tr>
<td>Work</td>
<td>13.5%</td>
</tr>
<tr>
<td>Internet use/gaming</td>
<td>11.4%</td>
</tr>
<tr>
<td>Depression</td>
<td>11.3%</td>
</tr>
<tr>
<td>Concern for troubled friend/family</td>
<td>10.4%</td>
</tr>
<tr>
<td>Extracurricular activities</td>
<td>10.0%</td>
</tr>
</tbody>
</table>

American College Health Association Survey, 2012
College Students and Sleep Quality

- 37% of undergrads did not sleep enough to feel rested on 5 or more days/week

- 20% of undergrads reported that sleep difficulties affected their academic performance

- Poor sleep quality more common among:
  - Females, younger students, those with lower GPA, minorities/internationals

- Poor sleep quality correlated with:
  - Increased instances of emotional disturbance
  - Victimization
  - Higher blood alcohol content at last time “partied or socialized”
  - Fewer days of vigorous exercise in the past week
  - Increased stress levels

2014 National College Health Assessment,
The All-Nighter: Dumb and Doesn't Know It

- 24 hour sleep-deprivation vs. no sleep deprivation

Sleep deprivation group perceived that they had better performance and better effort and concentration.

- ↑ fatigue and confusion in sleep deprived group

REM (dream) sleep is required for memory consolidation so it is critical for learning!

- If studying for tests you NEED to have REM sleep
- REM-deprived people have poor memory recall

“This makes it hard to convince students that all-nighters are not beneficial.”

Prof Russell Foster, University of Oxford

Pilchner 1997
## Healthy Campus Information

<table>
<thead>
<tr>
<th>Topic:</th>
<th>Ever Received Information</th>
<th>Interested In Receiving Information</th>
<th>Healthy Campus 2020 Goal</th>
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</thead>
<tbody>
<tr>
<td>Suicide Prevention</td>
<td>30%</td>
<td>38%</td>
<td>32%</td>
</tr>
<tr>
<td>Violence Prevention</td>
<td>27%</td>
<td>43%</td>
<td>42%</td>
</tr>
<tr>
<td>Pregnancy Prevention</td>
<td>21%</td>
<td>48%</td>
<td>48%</td>
</tr>
<tr>
<td>STI Prevention</td>
<td>36%</td>
<td>63%</td>
<td>68%</td>
</tr>
<tr>
<td>Alcohol and Other Drug Use</td>
<td>50%</td>
<td>91%</td>
<td>89%</td>
</tr>
<tr>
<td>Injury and Violence Prevention</td>
<td>22%</td>
<td>27%</td>
<td>26%</td>
</tr>
<tr>
<td>Tobacco Use</td>
<td>27%</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>Nutrition</td>
<td>38%</td>
<td>55%</td>
<td>65%</td>
</tr>
<tr>
<td>Physical Activity</td>
<td>58%</td>
<td>60%</td>
<td>62%</td>
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<tr>
<td>Cold/Flu/Sore Throat</td>
<td>61%</td>
<td>67%</td>
<td>84%</td>
</tr>
<tr>
<td>Sexual Assault/Relationship Violence Prevention</td>
<td>59%</td>
<td>85%</td>
<td>84%</td>
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<tr>
<td>Depression/Anxiety</td>
<td>67%</td>
<td>73%</td>
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<tr>
<td>Stress Reduction</td>
<td>60%</td>
<td>65%</td>
<td>67%</td>
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<tr>
<td>Eating Disorders</td>
<td>23%</td>
<td>37%</td>
<td>40%</td>
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<tr>
<td>How to Help Others in Distress</td>
<td>23%</td>
<td>37%</td>
<td>36%</td>
</tr>
<tr>
<td>Grief and Loss</td>
<td>22%</td>
<td>27%</td>
<td>31%</td>
</tr>
<tr>
<td>Relationship Difficulties</td>
<td>24%</td>
<td>49%</td>
<td>27%</td>
</tr>
<tr>
<td>Problem Use of Internet/Computer Games</td>
<td>12%</td>
<td>12%</td>
<td>23%</td>
</tr>
<tr>
<td>Sleep Difficulties</td>
<td>19%</td>
<td>19%</td>
<td>21%</td>
</tr>
</tbody>
</table>

- = Met/Exceeded Goal
- = Have Not Met Goal
- = No "Healthy Campus Goal Established
Why we should care: School Attendance

Lack of sleep is related to....

↑ tardiness
↑ absenteeism
↑ truancy
↑ school drop-out
Why we should care: **BEHAVIOR**

Lack of sleep results in......

**DISINHIBITION**  **HYPERACTIVITY**  **FORGETFULNESS**  **INATTENTION**  **DISORGANIZATION**  **Distractedness**

Effects of insufficient sleep mimic ADHD behaviors
Why we should care: BEHAVIOR

Lack of sleep results in.....

- Poor stress management
- Reduced ability to recognize emotions in others (empathy)
- Inability to process social cues
- Increase in aggressive behaviors
- Increase in bullying behaviors
- Increased tendency to blame others
- Decreased ability to be accountable for behaviors

Importantly, lack of sleep in early childhood can predict the development of these behaviors later in childhood.
Why we should care: **RISK TAKING**

Adolescent brain still developing and is particularly vulnerable to risk taking behaviors.

Increased risk taking most likely related to reduced metabolic activity in the pre-frontal cortex (executive function: judgements, impulses, planning, emotional control).

Adolescents with < 8hrs sleep/night engage in more:

- Violence
- Unsafe behaviors
- Drug use
- Sexual activities
Why we should care: **RISK TAKING**

In a study of about 15,000 high-schoolers, boys with less than 8 hours sleep on school nights were more likely to carry a weapon on school property.

In a study of more than 3,000 8th and 10th graders, girls and boys with sleep deprivation were more likely to carry a weapon to school and be involved in a fight - with higher risk for boys.

In both male and female adolescents, those who are sleep deprived are up to 40% more likely to engage in sexual activity.
Why we should care: SUBSTANCE ABUSE

Lack of sleep results in.....
- Increase in tobacco use
- Increase in marijuana use
- Increase in alcohol use

In middle school students who had never used alcohol or marijuana, lack of sleep at age 12 years was associated with increased risk of alcohol and marijuana by age 16 years.

For every hour of lost sleep, the chance of marijuana use increased by 14%.
For each hour of lost sleep there is a 38% increase in feeling sad/hopeless.

Rates of depression in adolescents aged 12-18 years increased from 9% to 13% between 2005 to 2015.

Lack of sleep results in feelings of anxiety and being “on the edge.”

Adolescents who stay up after midnight on school nights are 25% more likely to suffer from depression than those with parent-set bedtimes before 10pm.

Sleepy adolescents are 3 times more likely to have depressive symptoms.

Why we should care: MENTAL HEALTH

1 out of 5 adolescents has a diagnosable mental health disorder. Only 50% ever receive the help they need.
Why we should care: SUICIDE

In a study of 28,000 middle and high school students, for each hour of lost sleep:
- 42% increase in suicide ideation
- 58% increase in suicide attempts

In college students, even after accounting for depression, those with sleep problems are almost 3 times more likely to have suicide risk.
Why we should care: ILLNESS

Lack of sleep results in....

Poor immune function:
- increase in colds
- increase in flu
- increase in headaches
- increase in tummy troubles

Poor antibody response to flu vaccine in people who are sleep deprived (vaccine only has about a 50% effect)
Why we should care: OBESITY

Lack of sleep alters appetite hormones.....

- leptin (“fullness hormone”) is DECREASED
- ghrelin (“hunger hormone”) is INCREASED
Why we should care: OBESITY

Food choices and weight:

Adolescents who sleep less than 8 hours a night
- More likely to consume fast food two or more times per week
- Get more of their calories from fat
- Less likely to consume fruits and vegetables

Adolescents with later bed and wake times more likely to be overweight than those with earlier (even when total sleep is similar)

Adolescents who sleep less than 6 hours a night are twice as likely to be obese as their peers

*Despite race, gender, SES, physical activity, TV habits, and family structure
Why we should care: **CAFFEINE**

18-30% of adolescents use energy drinks.

Daytime sleepiness is a major reason for use of caffeine/energy drinks.

Diagram:
- **Daytime sleepiness**
  - Caffeine intake/daytime napping
  - Late bedtime
  - Late "catch up sleep" on weekends
  - Short sleep during school week

Illustrations of energy drinks (e.g., Red Bull, Monster, Rockstar) are shown alongside the diagram.
THE COST OF SLEEP DEPRIVATION

Sugar can not replace sleep. Sugar will give you a temporary lift, but when it wears off you’re likely to be even more tired than before. The combination of sleep loss and added sugars can result in insulin resistance and diabetes, and increased risk of obesity. A soda, energy drink and large candy bar costs $6.97 at City Convenience. Eat that every day for one meal and you are spending over $200 a month. It cost money and your health to mask the symptoms of sleep deprivation. Sleep for health, because sleep is always free.

SLEEP FOR HEALTH
Why we should care: SPORTS

Lack of sleep.....

- Decreases overall sports performance
- Worse reaction times
- Slower muscle recovery and growth
- Increases risk of injury

Lack of sleep is the **single best predictor** of sports injuries in adolescents

Students with less than 9 hours sleep are about 2 times more likely to get injured than those with more than 9 hours
Michael Phelps is the most decorated Olympian in history.

He spent countless hours in the pool training.

He said that the secret to his success is the one most people overlook: He also spent countless hours in bed sleeping.

"I really can't say it enough. I don't think people really pay attention to how important sleep is."

"Monitoring his sleep helped his training and ultimately was part of why he swam so strongly. By tracking sleep, Phelps could more accurately predict how capable he would be to perform certain workouts in the pool."

— trainer Keenan Robinson
Lack of sleep is related to:
- decreased alertness
- slowed thinking
- clouded judgments
- lack of focus
- delayed responses

68% of teens drive drowsy
15% admit to falling asleep at the wheel

Teens who get less than 7 hours sleep are at DOUBLE the risk of a crash

Being awake for 22 hours = equivalent of a blood alcohol level of 0.08

Teen Drivers Need a Full Tank of Z-Z-Z-Z-Zs
Auto accidents from drowsy driving are a big killer in the U.S.

- high school track star
- driving home from a track meet that ended late at night
- She fell asleep behind the wheel
- She crashed into a dirt embankment and was killed
- Katie had been losing sleep over the previous nights deciding which college track scholarship to accept

Katie had everything going for her...

Katie had just accepted a college scholarship. She fell asleep at the wheel and crashed. Katie was killed instantly.

National Sleep Foundation
www.DrowsyDriving.org

Katie Drentlaw
February 4, 1980 – April 25, 1998
...except enough SLEEP.
Why we should care: BRAIN HEALTH

The brain uses sleep to wash away the toxic waste built up during a hard day's thinking.

This waste removal system only works during sleep.

Failing to clear away some toxic proteins may play a role in brain disorders such as Alzheimer's Disease.
Why should we care? **LONG TERM HEALTH**

Lack of sleep results in significantly increased risk for:
- Metabolic syndrome
- Diabetes
- High blood pressure
- Stroke
- Cancer
- Alzheimer's Disease
Youth Discussion
Prompts for the discussion (this slide will not be shown to the audience):

• Can you tell us a little about your own schedules
  – when do you go to bed/wake up?

• Why do you go to bed at that time?
  – Homework/assignments due at midnight
  – Social media
  – Socializing with friends
  – Part-time job

• How do you feel on that amount of sleep?

• What are your barriers to getting optimal sleep?
  – Have to wake up early for school/job
  – Have to stay up late on screens doing homework then can’t sleep
  – Part-time job so homework is done late
  – Want to keep connected with friends
  – Too many things to do and not enough time
Barriers to Sleep for Adolescents

#1 Lack of Awareness

- approximately 90% of parents think that 7-7.5 hours is sufficient
- only about 15% of teens get enough sleep

The first step towards change is awareness

Recognize that adolescent sleep needs are different from children and adults

The AASM recommends that adolescents get a little more than NINE HOURS of nightly sleep.
#1 Lack of Awareness

In a large group of college students, those who took an 8-week online sleep education module:

- Significantly improved sleep knowledge

- Made improvements in sleep behaviors
  - Stopped electronics earlier
  - More regular sleep schedule
  - Earlier wake up times
  - Less caffeine

- Significantly improved sleep quality

- Significantly improved depressive symptoms

What if you want to be more alert and study better?

Hershner & O’Brien 2018
Barriers to Sleep for Adolescents

#2 Evening Stimulation

- homework
- screens
- caffeine (or stimulant meds)
- late sports events
- socializing
#2 Evening Stimulation - solutions

- Stay away from caffeine for at least six hours before bedtime.

- Do not use stimulant medications that are not prescribed for you; unprescribed stimulants can result in anxiety, nervousness, loss of appetite, sleep deprivation, psychosis, and addiction.

- Don’t exercise right before bedtime. Exercise a few hours before getting ready for sleep.

- Build decompression time into your schedule. Have downtime before bedtime that involves minimal activity, including studies.

- Try to follow a regular bedtime schedule, and follow it on weekends, too.

- Get exposure to bright light in the mornings.
#2 Evening Stimulation - solutions

- Meet your teen where they’re at….
  - What are their perception about sleep?
  - Bite sized improvements; what can you set limits for? (screens/bedtimes/wake times etc)
  - Select something you can enforce
  - Baby steps: screen-free zones; no-screens after 10pm; no screen time after 9pm

- Keep the electronics out of your sleep space
  - Turn off all screens 1 hour before bed
  - Dim light – no bright light
  - No TVs/computers/video games in bedroom
  - Phones can be switched to airplane mode
  - Wifi can be turned off (via apps or power cord)
Barriers to Sleep for Adolescents

#3 Homework

- Time management; do not procrastinate!
- no all-nighters
- Can you get 3 hours of sleep before the exam rather than pulling an all-nighter?
- by the way, some studies show that might increase your grade by 20%.

- For colleges: no midnight deadlines!
Barriers to Sleep for Adolescents

#4 Early school start times (middle and high school)

American Academy of Sleep Medicine
American Academy of Pediatrics
American Medical Association
Centers for Disease Control
......plus over 20 other national societies support school start times after 8:30am

#5 Clinical sleep disorders

The majority of sleep problems in adolescents have behavioral foundations but there can be medical issues affecting sleep:

- **Obstructive sleep apnea**: snoring, gasping, mouth breathing, sweaty sleep, morning headaches, daytime sleepiness despite adequate nighttime sleep

- **Insomnia**: difficulty falling asleep, difficulty staying asleep, waking up too early

- **Restless leg syndrome**: restless sleep, uncomfortable and irresistible urge to move legs, growing pains

- **Narcolepsy**: excessive daytime sleepiness, overwhelming urge to sleep during the day despite adequate nighttime sleep, “sleep attacks”
Thank you!
Suggested Bedtimes for Middle and High School Students*

<table>
<thead>
<tr>
<th>Age</th>
<th>4:30AM</th>
<th>4:45AM</th>
<th>5AM</th>
<th>5:15AM</th>
<th>5:30AM</th>
<th>5:45AM</th>
<th>6AM</th>
<th>6:15AM</th>
<th>6:30AM</th>
<th>6:45AM</th>
<th>7AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-13</td>
<td>6:30PM</td>
<td>6:45PM</td>
<td>7PM</td>
<td>7:15PM</td>
<td>7:30PM</td>
<td>7:45PM</td>
<td>8PM</td>
<td>8:15PM</td>
<td>8:30PM</td>
<td>8:45PM</td>
<td>9PM</td>
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<td>14-17</td>
<td>7:30PM</td>
<td>7:45PM</td>
<td>8PM</td>
<td>8:15PM</td>
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<td>9:15PM</td>
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<td>9:45PM</td>
<td>10PM</td>
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<td>18-19</td>
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<td>8:45PM</td>
<td>9PM</td>
<td>9:15PM</td>
<td>9:30PM</td>
<td>9:45PM</td>
<td>10PM</td>
<td>10:15PM</td>
<td>10:30PM</td>
<td>10:45PM</td>
<td>11PM</td>
</tr>
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</table>

*Based on average hours of sleep per night recommended by the National Sleep Foundation, 2015.