

# The Impact of School Start Times on Student Health and Performance

Judith Owens MD MPH  
Director of Sleep Medicine  
Boston Children's Hospital

# Myths and Misconceptions

- Teens would go to sleep earlier if their parents just made them do it
- Some teens might need 9 hours of sleep, but mine does just fine with 6 (and so do I!)
- Take the cell phones (TV, laptops, tablets) away and kids will fall asleep
- If school starts later, they'll just stay up later
  - And if school lets out later, they'll have to cram in the same amount of stuff in even less time
- Teens can just make up lost sleep by sleeping late on weekends or going to school later one day/wk
- Kids need to learn to get up early; that's real life
- They'll survive

# Adolescent Sleep: The “Perfect Storm”?



\*Includes middle and high school students

# Sleep in Adolescents: Later Bedtimes

- All adolescents experience a normal shift in circadian rhythms with age and in association with the onset of puberty
- This results in a biologically-based shift (delay) of up to several hours in both the natural fall sleep and morning wake times
- On a practical level, due to the “forbidden zone” this means that it’s almost impossible for the average adolescent to fall asleep much before 11pm on a regular basis
- Teens cannot “make” themselves fall asleep earlier

# Sleep in Adolescents: Later Bedtimes

- Environmental factors
  - Competing priorities for sleep: homework, activities, after-school employment, “screen time”, social networking
  - Circadian phase delay may be further exacerbated by evening light exposure
    - Suppresses brain release of melatonin



# Adolescents: Later Wake Times

- These biological changes are in direct conflict with earlier high school start times (before 8:30am) because adolescents are biologically programmed to wake at 8am or later
- As a result, students are required to wake for the day and function during the “circadian nadir” (the lowest level of alertness during the 24 hour day)
- Early wake times also selectively rob teens of REM (rapid eye movement) sleep, which is critical for learning (*of new information in particular*) and memory

# Adolescents: “Make-Up” Sleep

- Increasing discrepancy between bed and wake times weekday/end
  - Associated with learning deficits, behavior problems in school
- Adequate compensation for sleep loss?
  - Does not address compromised alertness on school days
  - Does not reverse performance impairments



# “Weekend Oversleep”

- Leads to “circadian misalignment”
  - Exacerbation circadian phase delay
  - Shift melatonin onset
- Prevents sufficient build-up of sleep drive
  - Difficulty falling asleep Sunday night
- Result: permanent state of “social jet lag”
  - Adjustment takes 1 day/time zone crossed
  - Effects persist up to 3 days
  - Associated daytime sleepiness, poor academic performance, depressed mood

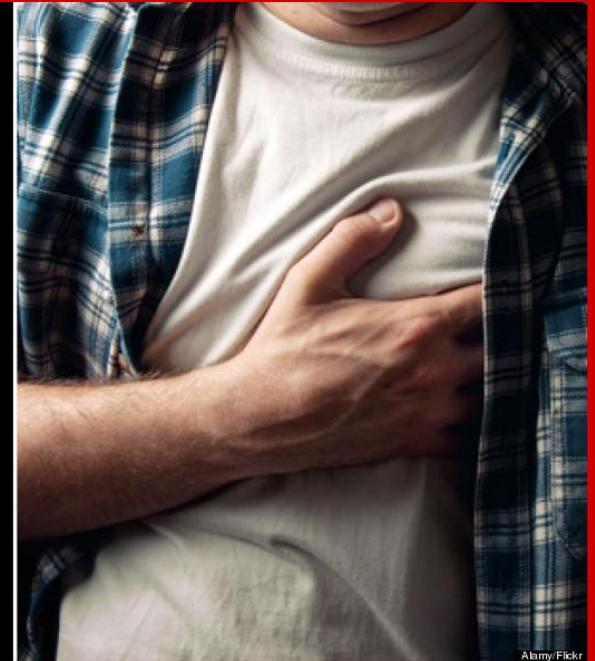
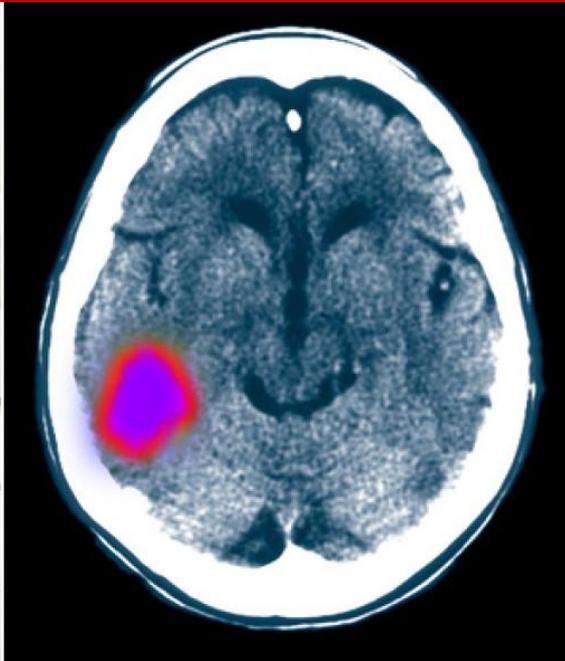


# Adolescent Sleep: The Bottom Line

- For optimal health, safety and achievement the average middle and high school student needs: 8-10 hours of sleep\*
- In Massachusetts:
  - At Algonquin Regional High School, 52% of students surveyed got < 6 hours of sleep/school night (2014)
  - 82% of Masconomet Regional students surveyed get  $\leq 7$  hrs of sleep (2016):
    - 41%  $\leq 6$ hrs
    - 18.2% recommended 8-10 hrs

*\*2016 AASM recommendations based on 10 month review by 13 sleep experts of published scientific evidence addressing the relationship between sleep duration and health (total of 864 scientific articles)*

# Effects on Performance, Health and Safety



# Impact on the Brain

- “Deficient” sleep (insufficient sleep for sleep needs and circadian mis-timing) negatively impacts:
  - Cognitive function (decision-making, problem solving, planning, organization and other “executive functions”)
  - Attention
  - Memory
  - Learning of new tasks
  - Emotional regulation
  - Risk-taking behaviors and misinterpretation of relative rewards/consequences

# Impact on Health

- “Deficient” sleep (insufficient sleep for sleep needs and circadian mis-timing) is associated with:
  - Risk of obesity
  - Poor cardiovascular health
  - Metabolic dysfunction (eg, type 2 diabetes)
  - Accidental injuries
    - Sports-related
    - Work-related
    - MVAs
    - Pedestrian accidents
    - Lower use of seatbelts, bicycle helmets, increased texting and driving, drinking and driving
  - Depression and suicidal thoughts
  - Alcohol and substance use

# Impact on Performance

- Academic performance
  - GPA
    - Especially first period classes
  - Standardized test scores
  - Tardiness and attendance rates
  - Graduation rates

# AAP Recommendation: Delay School Start Time until 8:30 am or Later

American Academy  
of Pediatrics



DEDICATED TO THE HEALTH OF ALL CHILDREN™

## Let Them Sleep: AAP Recommends Delaying Start Times of Middle and High Schools to Combat Teen Sleep Deprivation

8/25/2014

For Release: August 25, 2014

Studies show that adolescents who don't get enough sleep often suffer physical and mental health problems, an increased risk of automobile accidents and a decline in academic performance. But getting enough sleep each night can be hard for teens whose natural sleep cycles make it difficult for them to fall asleep before 11 p.m. — and who face a first-period class at 7:30 a.m. or earlier the next day.

*Pediatrics* 2014;134:642-649.

# Brief History of School Start Times

- BUT less than 1 in 5 middle and high schools in the US (N=40,000) start at the recommended 8:30am or later\*
- In **MA**, average SST in 2015 for public middle and high schools was 7:37am (from 7:53am 2011-12) and only 2 schools (1%) of start at 8:30am or later\*
  - >80% start before 8am
- Students in earlier starting schools more likely to belong to an ethnic minority, be eligible for free lunches and have less educated parents

\*MMWR 2015

# Outcomes: Sleep\*

- Bedtimes remain the same or in some studies actually shift earlier
- Students obtain significantly more sleep
  - More morning sleep
  - The later the start time, the greater the sleep amounts
  - But even a 30 minute delay results in improvements
- Students report less daytime sleepiness (falling asleep in class, doing homework)
- ≥8:30am the sleep and circadian “sweet spot”?

\*Wheaton AG et al. *J School Health* 2016

Review of 38 reports examining the association between school start times, sleep, and behavioral, health and academic outcomes among adolescent students

# Outcomes: School Performance\*

- Attendance improves
- Tardiness rates drop
- Drop-out rates decline
- Standardized test scores improve
  - In one study SAT scores for the top 10% of students increased by more than 200 points
- Grades improve
  - 5/6 schools showed significant increase in GPA pre-post in English, math, science and SS
  - Disadvantaged students may benefit more
    - Larger effects of start times at lower end grade distribution\*\*
    - Effects of 1<sup>st</sup> period classes larger for black students\*\*\*

*\*Wheaton AG et al 2016 \*\*Edwards 2012 \*\*\*Cortes et al 2012*

# Outcomes: Health & Safety

- Delayed SST are associated with improvements in:
  - Mood (fewer report feeling unhappy, depressed)
  - Health (decreased health center visits)
  - Safety
    - Kentucky: 7:30 to 8:40a start time; teens involved in car crashes down by 16% (vs 9% increase in the rest of the state)
    - Virginia: Adolescent crash rates VA Beach (7:20a) vs Chesapeake (8:40a) 40% higher and peak 1 hour earlier
    - CDC study (2014): Reduction crash rates in 16-18yo by as much as 65-70% (Minnesota, Colorado, Wyoming)

# Outcomes: \$\$\$

- Brookings Institute Report: “Organizing Schools to Improve Student Achievement: Start Times, Grade Configurations, and Teacher Assignments” (2011)
- Moving school start times one hour later would have a substantial benefit: cost ratio (9:1)
  - Based on a conservative estimate of both costs per student (\$0-\$1950; largely related to transportation), and the increase in projected future earnings per student in present value due to test score gains (approximately \$17,500)
- “A later start time of 50 minutes in our sample has the equivalent benefit as raising teacher quality by roughly one standard deviation”

# Outcomes: \$\$\$

- RAND Corporation report (2017)\*
  - Potential *significant economic gains of a state-wide shift in start times to  $\geq 8:30am$*  related to improved academic performance of students resulting in increased lifetime earning potential and reduced car crashes
  - Economic gain [modeled across 47 US states] estimated annual gain of  $\sim$  \$9.3 billion
    - Roughly the annual revenue of MLB
  - Report estimates that MA would see one of the highest cost-benefit ratios in the nation
    - *At minimum breaking even after just 2 years*
    - *Achieving a cost-benefit ratio of 4.5 after 10 years, meaning that for every dollar spent, the return is more than four-fold the cost*

\*Hafner, Marco, Martin Stepanek and Wendy M. Troxel. *Later school start times in the U.S.: An economic analysis.* [https://www.rand.org/pubs/research\\_reports/RR2109.html](https://www.rand.org/pubs/research_reports/RR2109.html).

# Elementary School Start Times

- Sleep needs: 9-12 hrs\*
- Circadian preference (chronotype): owl vs lark\*\*
- School, activities, electronic media, later bedtimes, earlier rise times, irregular sleep/wake schedules contribute to deficient sleep
- However, as opposed to adolescents, they are biologically, environmentally and socially more amenable to manipulation of bedtimes (ie, to move sleep onset earlier) if required
- Is there a sweet spot?
  - Data is mixed but suggest 7:30-9am
  - Earlier start times more impact on academics, behavior
  - Issues of civil twilight, safety concerns

\*AASM 2016

\*\*But most school-aged (pre-pubertal) children have a “morningness preference”



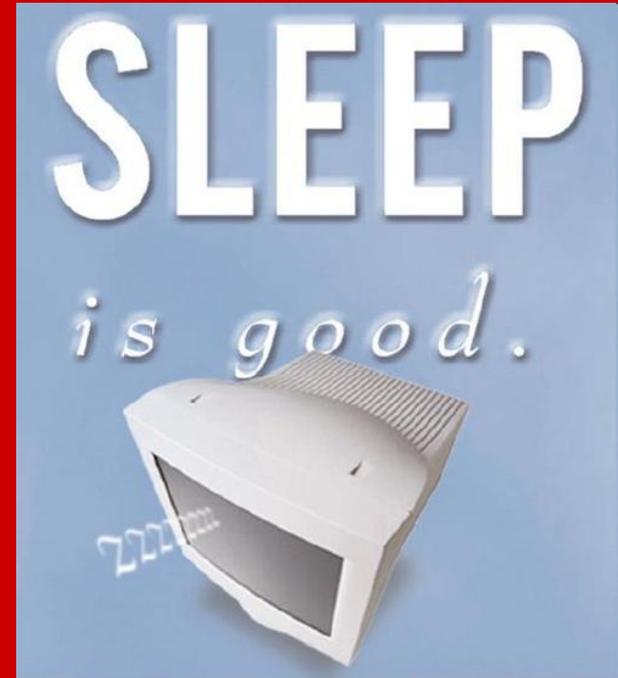
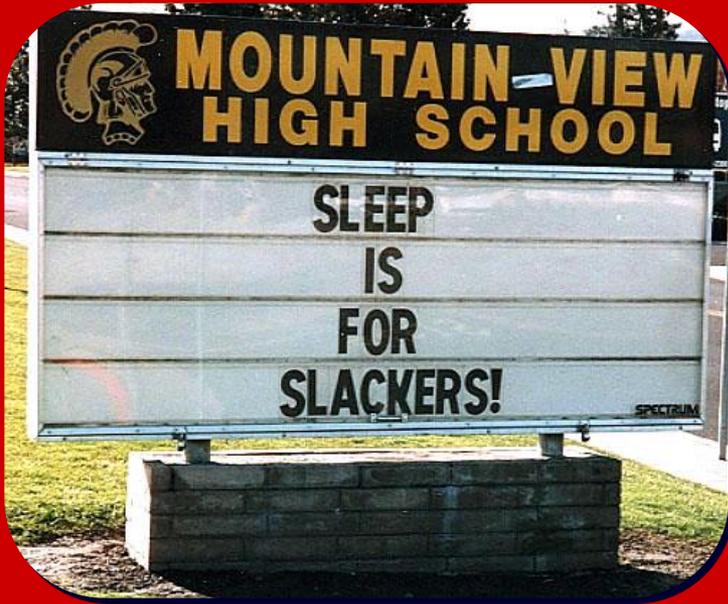
# Lessons Learned

- District superintendent support and leadership critical
- School board involvement key
- School leadership (ie, principals) and teacher support vital
- Importance of middle/elementary school principal, teacher, parent involvement
- Importance of student engagement
- Critical role of community *education*
  - Health, safety *and* academics
- Critical role of community *engagement*
  - Identification and involvement of key stakeholders

# Lessons Learned

- Critical to allow adequate time for families to become informed and make sufficient plans prior to implementation
- Each community faces different, unique challenges
  - But you don't have to "reinvent the wheel"
- Not all students will benefit equally
  - The goal is to provide "the greatest good for the greatest number of students"
- Anticipation often worse than reality (impact on athletics, teacher retention, after-school programs, childcare issues)
- Initial challenges reduced over time

What is your vote?



Thanks for your attention!