

High School Sleep

Dominic Roca MD-PhD

Director of the Connecticut Center for
Sleep Medicine

Topics

- Basics of Sleep
- Phase Delay
- Impact of Sleep Deprivation
 - Athletics
 - School performance
 - Motor Vehicle Accidents
- Delayed School Start Times

How Much Do We Need?

Adults need on average 8 hours of sleep <10%
need \leq 6 hours

Adolescents ~ 9 hrs

Children ~ 10 hours

Infants ~ 14 hours

It can take two weeks before sleep requirements
stabilize

Sleep Deprivation

Students **Need About 9** hours of sleep

Students **Get 6.9** hours

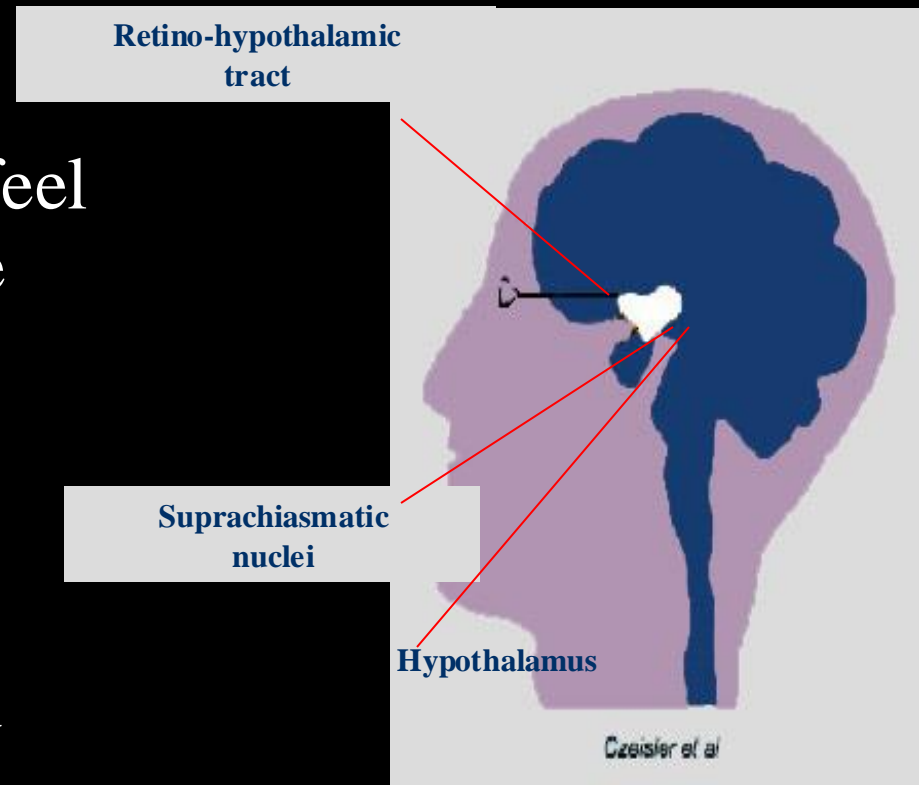
Why Does Sleep Deprivation Happen?

Life Style

Biological Clock

Circadian Biological Clock

- The internal mechanism that regulates when we feel sleepy and when we feel alert
- Resides in the brain and is affected by light, melatonin and activities



Teens Experience a Shift to a Later Sleep-Wake Cycle

The biological clock drives teenagers to a later bedtime and a natural tendency to wake later in the morning.

This delayed phase syndrome can place them in conflict with their schedules – particularly early school start times.

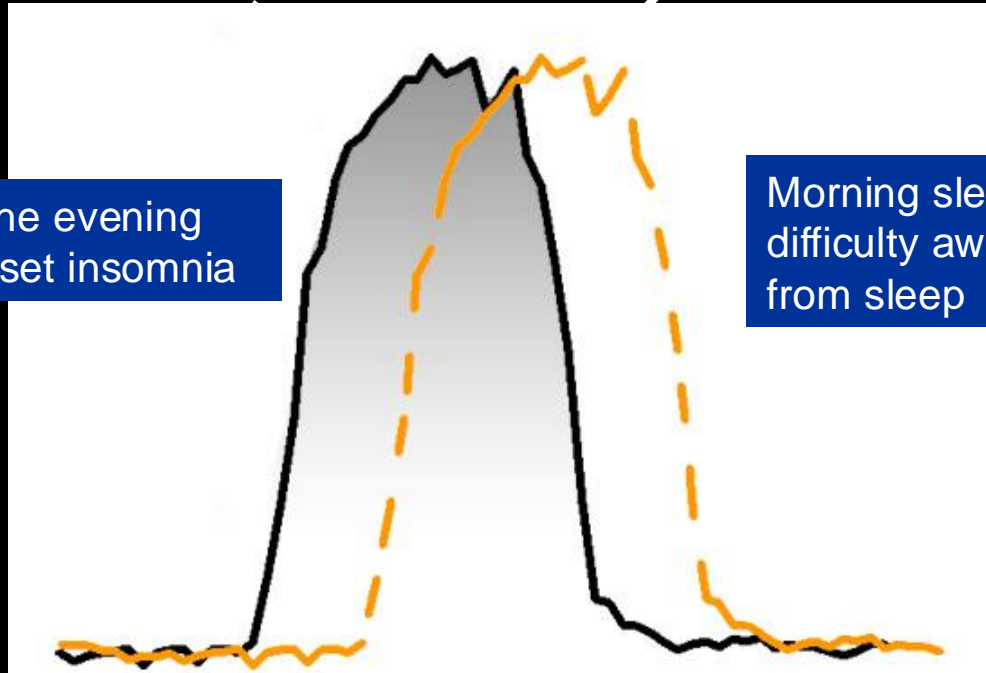
Delayed Sleep Phase Syndrome

Normal circadian melatonin phase

Later circadian melatonin phase

Alert in the evening
sleep onset insomnia

Morning sleepiness
difficulty awakening from sleep



Delayed sleep time and reduced sleep duration during the school week



← Normal sleep time



← Restricted sleep with delayed phase

Delayed Sleep Phase Sleep Schedule



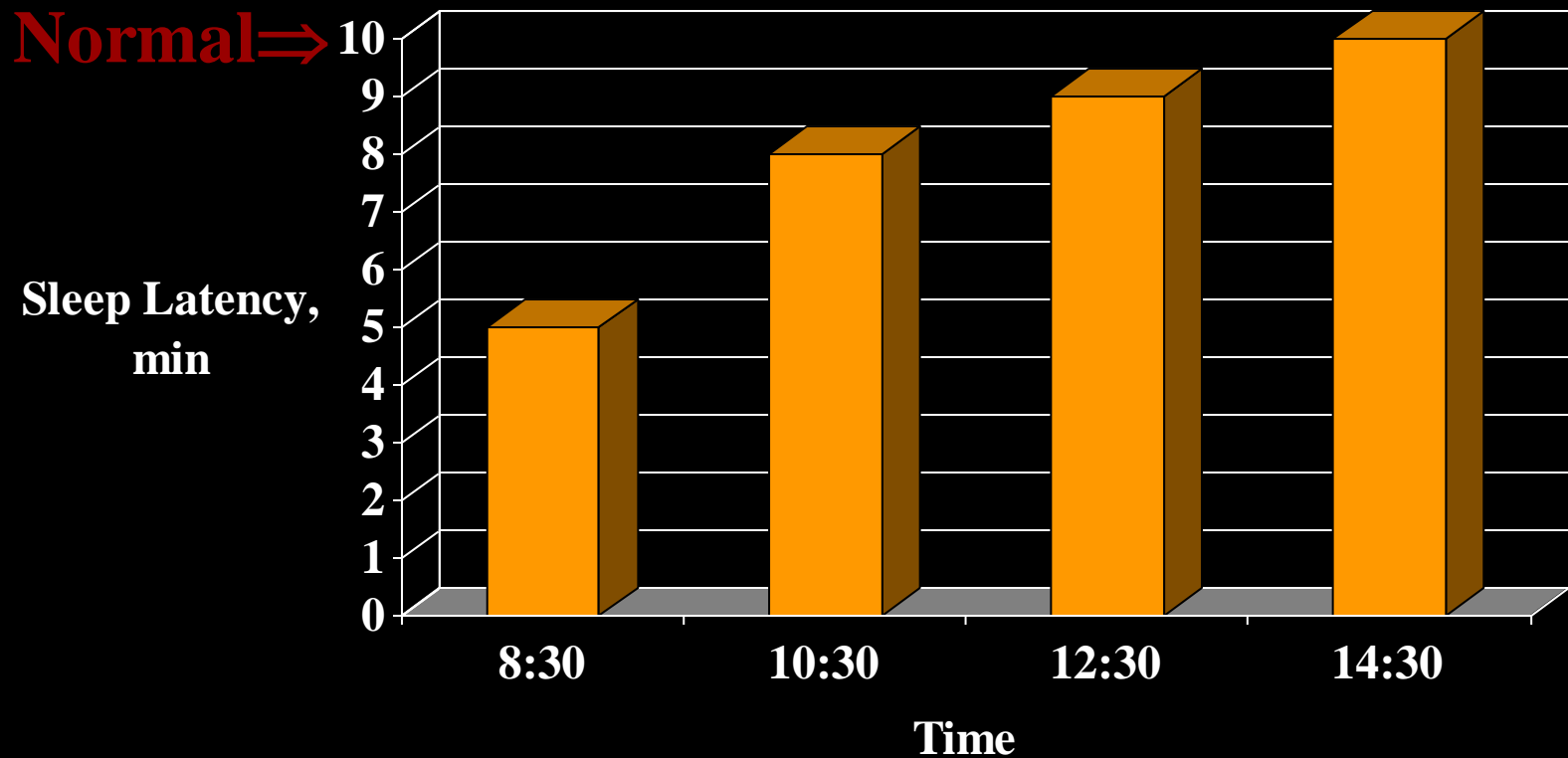
In order to get to school on time, many teens must wake before 6:30 am and shorten their sleep time.

Community Example of Phase Delay

Sleep Onset	Weeknights	Weekends
<10 minutes	27.6%	49.4%
10 – 20 minutes	44.1%	34%
> 20 minutes	28.4%	16.5%

Wahlstrom et al, 2014 UMN CAREI Studies, Minnesota

How Sleepy Are Students?



Carskadon, 1998

Sleepiness in Adolescents

Lower Limit of Normal 10 minutes

Narcoleptics usually less than 5 minutes

Teenagers 8 minutes

“In high school students, we found high sleepiness levels and an elevated rate of REM sleep in the daytime, a pattern that mimics narcolepsy.” M. Carskadon, 1998

Due to lifestyle and biological
clock students / young adults
are:

Sleep Deprived

- Athletic performance
- Learning
- **Motor vehicle accidents**

Sleep Deprivation and Injuries

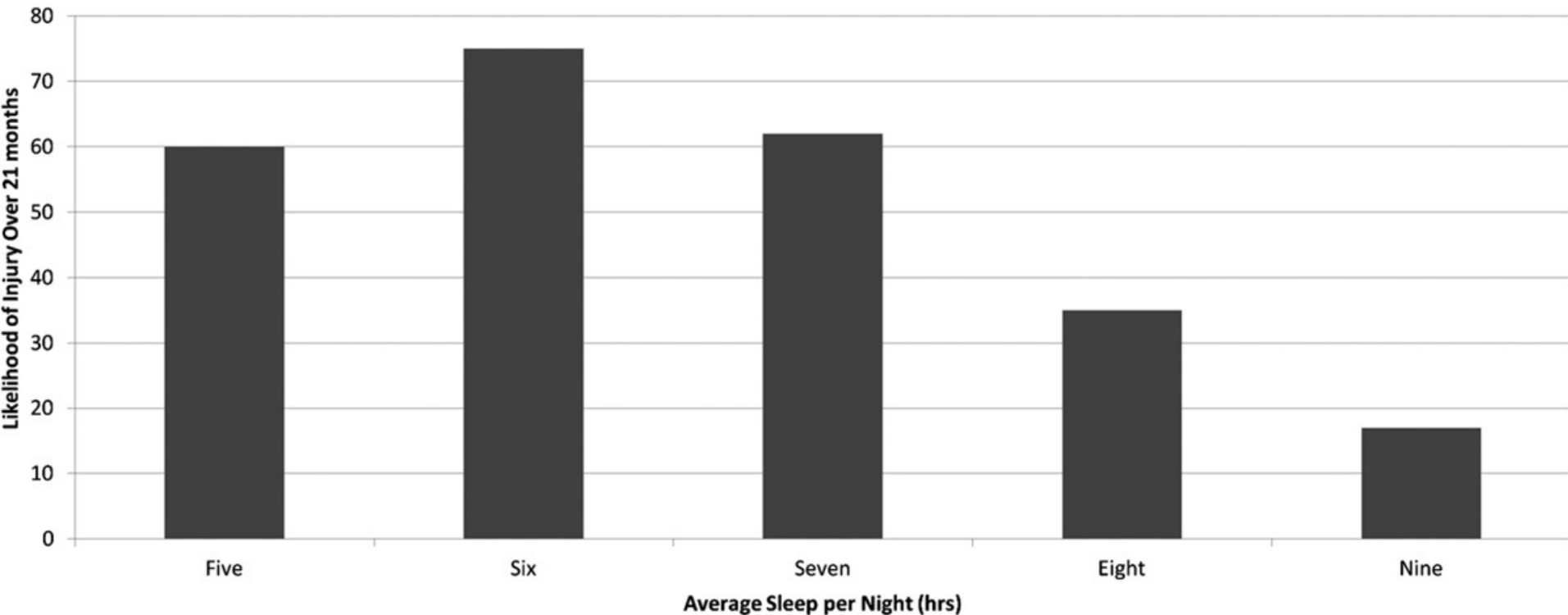
160 middle / high school students records were checked for injuries.

Age 12 – 18, average 15

Correlated a number of habits with the risk of injuries. Diet, grades, caffeine, drug use, sleep amongst some of the questions.

Sleep Deprivation and Injuries

Likelihood of Injury Based on Hours of Sleep per Night



J Pediatr Orthop. 2014 Mar;34(2):129-33.
Milewski MD1 et al.

Sleep Deprivation on Learning

- Experimental - Limited Data - ? Parental concerns. Small and limited duration
- Both 5 nights, 6 – 6.5 hrs vs 8- 8.5 hrs
- Slower processing speed, less attentive, poorer cognition – due to sample size not significantly different
- Reported sleep correlated with better math scores

Jiang J Clin Exp Neuro 2011 40 students; Beebe J Adol Health 2010 16 students; Perez Chada PloS One2023, 1257 students

Driving Drowsy

In a study of
10,000,000
people. Allen
Pack, U. Penn,
1995

>60% of accidents
involve adults
< 25 yrs old

>60% of accidents
occur between
11PM and 8 AM



Sleep Deprivation and Driving

Powell (ENT) et al ' 01 Studied effects of sleep deprivation vs alcohol.

16 subjects. 8 ETOH (0.09 gm/dl); 4 subjects - 0 sleep 24hrs; 4 subjects 5-6 hrs of sleep for 7 days. Subjects were then tested on an actual driving course and reaction time test before and after

Reaction increased ~ 25% in all three groups

3x more cones hit with sleep deprivation

3.4 X more cones hit with alcohol

Effect of sleep deprivation was equal to the legal limit of intoxication.

Delayed School Start Times

Minneapolis

- Minneapolis: 1997-1998 school year 7 HS start times changed from 7:15am to 8:45am
Examined the academic impact on 51,000 students
- Increased sleep by 50 minutes
- Improved attendance
- Improved alertness
- Improved mood

Sustained Benefit of Delayed Start Times

Wahlstrom et al 2002 assessed 18,000 high school students in Minneapolis before and after the district school start times changed from 7:15 to 8:40 (1997-98).

Bedtimes stayed the same

4 years later the high school students were still getting 50 minutes more sleep a night!

Graduation Rates

Year	All Students		African-American Students		Economically Disadvantaged Students		White Students	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Predelay year 0	79.93	11.77	79.35	12.07	73.00	11.21	81.83	12.24
Postdelay year 1	86.57	8.32	79.13	13.28	72.40	9.08	84.20	9.54
Postdelay year 2	87.93	8.98	80.11	13.00	77.46	11.22	85.52	10.95
Postdelay year 3	87.43	9.39	78.41	11.48	75.19	13.01	86.81	9.43
Postdelay year 4	89.75	6.88	82.46	10.23	80.44	8.50	88.89	9.42

SD = standard deviation.

Data from 28 schools in 8 school districts from 7 states, Va, Fla, NY, Mn, NC, Ark, Ore. J Clin Sleep Med, 2022 Nov 1; 18(11): 2537–2543, avg delay ~1 hour

Air Force Study

- Study of 6,165 US Air Force Academy cadets over 4 years. (Carrell et al, 2011)
- Class start times were delayed from 7 AM to 7:50 AM
- Cadets with 7:50 am classes courses performed better in their first period courses compared to cadets with 7:00 am classes

Teen Motor Vehicle Crashes, Virginia

Two Central Virginia Counties

Henrico County beginning at 8:45 AM

Chesterfield County beginning at 7:20 AM

Studied teen crashes ages 16 – 18

Years 2009 – 2010 and 2010 – 2011

Corrected for per capita income and ethnicity

Teen Motor Vehicle Crashes, Virginia

Chesterfield, early start time

48.8 crashes/1000 licensed drivers

Henrico, later start times

37.9 crashes / 1000 licensed drivers

Similar results were found when Virginia Beach, early start times 65/1000 was compared to Chesapeake, Virginia 46/1000

Community MVA Studies

- 2014 Kyla Wahlstrom PhD studied 8 counties in 3 states. All the counties had changed start times from 30 min to 80 minutes. The average sleep time increased from 7.5 hours to 8.2 hours.

Community MVA Studies

County	Before	After	%	Details
S. Washington, MN	144	135	6 decrease	2008-2010, 60 min
St. Louis Park, MN	56	61	9 increase (all on the weekend)	2009-2011, 30min
Mahtomedi, MN	17	6	65 decrease	2004-2006, 30 min
Jackson Hole, WY	23	7	70 decrease	2011-2013, 80 min

Limited Study Types

- These studies are not randomized, often historical controls or different schools.
 - JClinSleepMed Sept 2020; Barlaan
- Ok 90 min delay in start times to 9:15!
- 2015 – 2017 vs 2017 – 2019
- 42 MVA/1000 drivers vs 44 MVA/1000 drivers
- No difference

Summary

- High School Students are sleep deprived because of social and biological factors
- Sleep Deprivation is associated with increased MVAs and numerous other negative effects
- Delaying school start times appears to have a positive impact that maybe sustained

Questions??