Adolescent Sleep and Community Impacts

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Claremont University Club
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Adolescent sleep has attracted international press.
The scientific literature surged in adolescent sleep studies

Publications on PubMed Retrieved with the Search Term: "Adolescent sleep"
Sleep Health objectives of Healthy People 2020

**Students getting sufficient sleep on school nights (percent, grades 9–12)**

**By Total**


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**Data Source:** Youth Risk Behavior Surveillance System (YRBS); Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (CDC/NCHHSTP)

**Error Bar (↑) represents the 95% confidence interval**

Additional footnotes may apply to these data. Please refer to footnotes below the data table for further information.
Sleep Health objectives of Healthy People 2020

State-level Data
Students getting sufficient sleep on school nights (percent, grades 9–12)

2015

29.0%

Data Source: Youth Risk Behavior Surveillance System (YRBSS); Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (CDC/NCHHSTP)
In 2014, the American Academy of Pediatrics issued a policy statement recommending high school start times at 8:30 am or later.
Adults are getting less sleep than they used to.
What are the detrimental effects of sleep deprivation?

Fatigue

Mental Health Effects (Depression)

Decision-making Impairment

Reaction Time Slowing

Attention Deficits

Metabolic Health (Obesity, Metabolic Syndromes)

Neurodegenerative Diseases

Exacerbate Other Health Conditions

Irritability

Cancer?

Motor Vehicle Accidents

<table>
<thead>
<tr>
<th>Impact of Chronic Sleep Loss in Adolescents</th>
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<tbody>
<tr>
<td>Physical health and safety</td>
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<tr>
<td>Increased obesity risk</td>
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<tr>
<td>Metabolic dysfunction (hypercholesterolemia, type 2 diabetes mellitus)</td>
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<td>Increased cardiovascular morbidity (hypertension, increased risk of stroke)</td>
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<tr>
<td>Increased rates of motor vehicle crashes (“drowsy driving”)</td>
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<tr>
<td>Higher rates of caffeine consumption; increased risk of toxicity/overdose</td>
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<tr>
<td>Nonmedical use of stimulant medications; diversion</td>
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<td>Lower levels of physical activity</td>
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<tr>
<td>Mental health and behavior</td>
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<tr>
<td>Increased risk for anxiety, depression, suicidal ideation</td>
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<tr>
<td>Poor impulse control and self-regulation; increased risk-taking behaviors</td>
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<tr>
<td>Emotional dysregulation; decreased positive affect</td>
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<tr>
<td>Impaired interpretation of social/emotional cues in self and others</td>
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<tr>
<td>Decreased motivation</td>
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<tr>
<td>Increased vulnerability to stress</td>
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<tr>
<td>Academics and school performance</td>
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<tr>
<td>Cognitive deficits, especially with more complex tasks</td>
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<tr>
<td>Impairments in executive function (working memory, organization, time management, sustained effort)</td>
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<tr>
<td>Impairments in attention and memory</td>
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<tr>
<td>Deficits in abstract thinking, verbal creativity</td>
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<tr>
<td>Decreased performance efficiency and output</td>
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<td>Lower academic achievement</td>
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<tr>
<td>Poor school attendance</td>
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<tr>
<td>Increased dropout rates</td>
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</table>
What are the detrimental effects of sleep deprivation?

- Fatigue
- Mental Health Effects (Depression)
- Decision-making Impairment
- Reaction Time Slowing
- Attention Deficits
- Metabolic Health (Obesity, Metabolic Syndromes)
- Neurodegenerative Diseases
- Exacerbate Other Health Conditions
- Irritability
- Cancer?
- Motor Vehicle Accidents

**Figure 3.** This figure shows the rate of (A) motor vehicle crashes, (B) near-miss motor vehicle accidents and (C) percutaneous injuries reported by postgraduate year (PGY)-1 residents nationwide (n = 2,737) in 17,007 monthly reports between June 2002 and May 2003 relative to the duration of work shifts. Residents reported a significantly higher rate of motor vehicle crashes and near misses on the commute following an extended-duration work shift (> 24 hours; Figures A and B, ■) as compared with the same residents’ commute following a nonextended shift (< 24 hours, ■). The Mantel–Haenszel odds ratios (OR ± 95% confidence interval) for having an accident or near miss on the commute home were 2.3 (1.6–3.3) and 5.9 (3.4–6.3), respectively (see text). Residents also reported a significantly higher rate of percutaneous injuries when on duty during the day after being on-call overnight (6:30–17:30; Figure C, ■) as compared with the day before on-call (■: OR 1.61, 1.46–1.78).


Figure C: Data replotted with permission from Ayas N.T., et al.: Extended work duration and the risk of self-reported percutaneous injuries in interns. JAMA 296:1055–1062, Sep. 6, 2006. Copyright ©2006 American Medical Association.
Are teens just bad at making healthy decisions for themselves?
What are the factors affecting ‘unhealthy’ adolescent sleep behaviors?

- **Biological**
  - 2 Process Model
  - Environmental Light
  - Puberty and Hormones

- **Social**
  - Autonomy, social activities, weekend warriors, caffeine consumption
  - *School Start Times*
Modeling the biological control of sleep: The two-process model
Circa + dia
Sample Actigraph showing human rhythms

- Two types of rhythms
- Entrained v. Free running

http://www.sleepsources.org/uploads/sleepsyllabus/g.html
What’s your chronotype?

- Each of us is genetically predisposed to be somewhere on the spectrum of larks and owls.

- Larks and Owls each have their own personality traits.

- You can take the isolated skin cells of a lark or owl and be able to tell what that person’s sleep habits are.
Comparison of subject chronotype with fibroblast period length
Chronotype changes across the lifespan: A delay during adolescent years

Biological clocks delay, but school starts earlier
Why does the school start time remain misaligned with adolescent chronotypes?

Allow earlier commutes
Transportation limitations
Time for homework
Time for extra-curricular activities
Childcare needs
Part-time work
How does chronotype misalignment affect performance?

![Graph showing the performance curve for early types and late types throughout the day. The blue line represents early types with a peak at 8:00 a.m. and the red line represents late types with a peak at 4:00 p.m.]

Many biological and social factors exacerbate this misalignment and sleep deprivation.

Strategies to address this misalignment...

A

Actual school day
8:00 a.m. - 3:00 p.m.
Optimal school day
10:00 a.m. - 5:00 p.m.
Mismatch

B

Actual school day
8:00 a.m. - 3:00 p.m.
Optimal school day
9:00 a.m. - 4:00 p.m.
Advance phase of entrainment with light

C

Actual school day
9:00 a.m. - 4:00 p.m.
Optimal school day
9:00 a.m. - 4:00 p.m.
Delay school starting times

Scientific Evidence and Delaying School Start Times

Most evidence to date is in the form of expert opinion and observational studies.

*These data largely support that delaying school start times is related to improvement in weekday sleep, daytime sleepiness, attendance, mood and performance at school.*

But there is very little evidence in the form of systematic reviews, longitudinal studies, experimental data.
Scientific Evidence and Delaying School Start Times

High School Start Times and the Impact on High School Students: What We Know, and What We Hope to Learn

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Center for Sleep Medicine, Mayo Clinic, Rochester, MN; American Academy of Sleep Medicine, Dorien, IL; Centers for Disease Control and Prevention, Atlanta, GA; University of Calgary, Calgary, Alberta, Canada; Beth Israel Deaconess Medical Center, Boston, MA

Study Objectives: Several organizations have provided recommendations to ensure high school starts no sooner than 8:30. However, although there are plausible biological reasons to support such recommendations, published recommendations have been based largely on expert opinion and a few observational studies. We sought to perform a critical review of published evidence regarding the effect of high school start times on sleep and other relevant outcomes.

Methods: We performed a broad literature search to identify 287 candidate publications for inclusion in our review, which focused on studies offering direct comparison of sleep time, academic or physical performance, behavioral health measures, or motor vehicular accidents in high school students. Where possible, outcomes were combined for meta-analysis.

Results: After application of study criteria, only 18 studies were suitable for review. Eight studies were amenable to meta-analysis for some outcomes. We found that later school start times, particularly when compared with start times more than 60 min earlier, are associated with longer weekday sleep durations, lower weekday-weekend sleep duration differences, reduced vehicle accident rates, and reduced subjective daytime sleepiness. Improvement in academic performance and behavioral issues is less established.

Conclusions: The literature regarding effect of school start time delays on important aspects of high school life suggests some salutary effects, but often the evidence is indirect, imprecise, or derived from cohorts of convenience, making the overall quality of evidence weak or very weak. This review highlights a need for higher-quality data upon which to base important and complex public health decisions.

Keywords: high school, sleep start time, timing


CLINICAL REVIEW

Delayed school start times and adolescent sleep: A systematic review of the experimental evidence

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SUMMARY

Many schools have instituted later morning start times to improve sleep, academic, and other outcomes in response to the mismatch between youth circadian rhythms and early morning start times. However, there has been no systematic synthesis of the evidence on the effects of this practice. To examine the impact of delayed school start time on students’ sleep, health, and academic outcomes, electronic databases were systematically searched and data were extracted using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. Six studies satisfied selection criteria and used pre-post, no control (n = 3), randomized controlled trial (n = 2), and quasi-experimental (n = 1) designs. School start times were delayed 25–60 min, and correspondingly, total sleep time increased from 25 to 77 min per weeknight. Some studies revealed reduced daytime sleepiness, depression, caffeine use, tardiness to class, and trouble staying awake. Overall, the evidence supports recent non-experimental study findings and calls for policy that advocates for delayed school start time to improve sleep. This presents a potential long-term solution to chronic sleep restriction during adolescence. However, there is a need for rigorous randomized study designs and reporting of consistent outcomes, including objective sleep measures and consistent measures of health and academic performance.

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Data supports that delaying school start times improved weekday sleep and reduced daytime sleepiness. Some studies also support decreases in depression and caffeine use. Some studies support large decreases in vehicular accident rates.

*For some parameters, effect size is small
Resource for case studies on school start times

http://www.startschoollater.net/case-studies.html

How have schools managed to delay bell times? Many ways!

Find out more from these reports and case studies of districts that have moved to later, healthier, safer schedules.
Why not just delay start times?

Allow earlier commutes
Transportation limitations
Time for homework
Time for extra-curricular activities
Childcare needs
Part-time work
But delaying start times as the only means to address this is limiting

- **Biological**
  - 2 Process Model
  - Environmental Light
  - Puberty and Hormones

- **Social**
  - Autonomy, social activities, weekend warriors, caffeine consumption
  - School Start Times

Change practices at home, include sleep hygiene education in health class, change high stakes testing times at schools.
Take away messages:

1) Increased interest and attention around adolescent sleep health is part of a trend as we learn more about the importance of sleep, although there is still much we don’t know.

2) Adolescents are not getting enough sleep according to national guidelines. Chronic sleep deprivation has many detrimental effects.

3) There are both biological and social reasons why adolescents go to bed and wake up later.

4) Misaligning chronotype to environment creates cognitive, mood and behavioral challenges.

5) The data that we do have, albeit limited, supports delaying school start times for better sleep (still not clear on performance), safety.

6) But there are important considerations if delaying start times. This is a luxury for many.
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Thank You!