



High Schools Find Later Start Time Helps Students' Health and Performance

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HIGH SCHOOL WILL START AT 8:15 AM this September in Duxbury, Mass, a Boston suburb, instead of at 7:30 AM, as it did last year. School officials hope the 45-minute delay will allow the 1000 students in grades 9 through 12 to sleep longer and arrive at school more alert and ready to learn.

In the past decade, at least 80 US school districts have delayed their high school start times, and perhaps double that number are weighing such a change, according to informal reports to the National Sleep Foundation (NSF). While some parents worry students may stay up later, that has not happened in other school systems that have made such schedule changes. Studies show that when school starts later, students not only get more sleep but also contribute more to class discussions, doze in class less often, arrive tardy less often, miss fewer days, visit nurses and counselors less often, report less depression and irritability, and have fewer driving crashes.

Kyla Wahlstrom, PhD, director of the University of Minnesota's Center for Applied Research and Educational Improvement (<http://cehd.umn.edu/carei/>), said she knows of no schools that have returned to an earlier start time after trying a later one.

Wahlstrom, who led a multiyear study assessing the impact of delayed high school opening on 50 000 students in the Minneapolis Public Schools, is careful not to state that later start times directly improve student grades and test scores. "A change in start time is only one of many variables in a school setting that affects grades. We cannot study it in isolation," Wahlstrom said. Still, she added, "trend lines show grades rise when schools open later. We never see trend lines suggesting grades go down."

Changing school start times requires adjusting schedules not only for classes and bus operation, but also for athletics and other extracurricular activities. It affects not only students, but also teachers, parents who need to transport children and arrange child care, after-school employers of high school students, and other community groups.

Despite the challenges, once the Duxbury school committee concluded that a later start time would be in students' best interest, "we had to find a way to make it happen," said Susan Skeiber, superintendent of Duxbury public schools. Duxbury flipped its bus schedule to bring older students to school later and younger ones earlier. Research shows younger children are ready for school earlier than adolescents are, Skeiber said. School officials are exploring after-school programs for families that now depend on older students to babysit younger ones in the afternoon. They plan to assess sleep and other behavior after the schedule change.

FIGHTING BIOLOGY

When parents of today's adolescents were in high school, classes typically began after 8 AM. Most high schools in the United States now open around 7:30 AM, Wahlstrom said, too early for most teenagers.

According to research conducted by Mary Carskadon, PhD, now professor of psychiatry and human behavior at the Alpert Medical School of Brown University and director of chronobiology and sleep research at E. P. Bradley Hospital, Providence, RI, the impetus for opening high schools later grew out of research in the 1970s at Stanford University showing that students aged 10 to 17 years need 9.25 hours of sleep per night on average for optimal alertness, the same amount required by children of elementary school age (Carskadon MA et al. *Sleep*. 1980;2[4]:453-460; Carskadon MA, Acebo C. *Sleep*. 2002; 25[6]:606-614). In subsequent studies, Carskadon showed that puberty alters the biological clock, programming teenagers to fall asleep about an hour later than they did earlier in life and to sleep later in the morning. Melatonin secretion, which starts about 9:30 PM in prepubescents, begins at roughly 10:30 PM in adolescents, Carskadon found. Melatonin serves as a marker of circadian time. While it does not induce sleep, it signals readiness to sleep. Its onset typically precedes bedtime by about an hour, so many teenagers are not physiologically ready to sleep until 11:30 PM or later. (In the early 20s, the biological clock drifts back earlier.)



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Because many adolescents are not physiologically ready to sleep until 11:30 PM or later, the early start times of most high schools in the United States can contribute to sleep deprivation that takes a toll on students' health and performance.



In a study that yielded what Carskadon called “jaw-dropping findings,” she and colleagues evaluated adolescents in ninth grade, when they attended a middle school with an 8:25 AM opening, and in 10th grade, when they attended a high school with a 7:20 AM opening. The students wore activity monitors and kept sleep diaries for 2 weeks at home. They then spent 22 hours in the sleep laboratory, where researchers assessed their sleep, daytime sleepiness, and melatonin onset. The earlier start time was associated with significant sleep deprivation and daytime sleepiness. The ninth-graders averaged 7.15 hours of sleep and the 10th-graders, 6.8 hours. “At 8:30 AM, high school students were in school,” Carskadon said, “but their brains still were in bed.” (Carskadon MA et al. *Sleep*. 1998;21[8]:871-881.)

In 2007, the Youth Risk Behavior Survey of the Centers for Disease Control and Prevention (CDC) asked students, “On an average school night, how many hours of sleep do you get?” Only 31.1% of US students reported 8 or more hours of sleep; 42% of ninth-graders did so vs only 22% of 12th-graders (Table 95 in Eaton DK et al. *MMWR Surveillance Summaries*. 2008; 57[SS04]:1-131).

“Scientists from CDC and its sleep promotion partners are very concerned about the inadequate sleep being reported by high school students,” said Janet Croft, PhD, chief of CDC’s Emerging Investigations and Analytic Methods Branch. “CDC is exploring the possibility of encouraging school administrators to consider later school start times for high school students.”

Six in 10 US students in grades 9 to 12 reported less than 8 hours sleep on school nights in the NSF’s 2006 *Sleep in America Poll* (<http://www.sleepfoundation.org>). Researchers conducted a telephone survey of a randomly selected sample of the US population, including 1602 adult caregivers of teenagers and their children aged 11 to 17 years in grades 6 through 12. Students in grade 12 averaged only 6.9 hours on school nights; ninth-graders averaged

7.6 hours. Students slept 1.3 hours more on weekends—not an adequate replacement for missed weeknight sleep, said Carskadon, who chaired the poll task force.

The poll found that 97% of adolescents had at least 1 electronic item in their bedroom, such as a cell phone with text messaging, television, or computer with video games and Internet access. Twelfth-graders had 4 such devices; sixth-graders had 2. Teenagers with 4 or more items slept about 30 minutes less than those with fewer devices.

As students progress through school, parents loosen bedtime control. Homework, extracurricular activities, and socializing push bedtimes later. So do jobs; students who work 10 or more hours a week sleep less than their peers.

“I see younger and younger children in public places late in the evening,” Carskadon said. “Even at home, children have increased evening exposure to light and stimulating activities. Parents who work late or have long commutes sometimes let children stay up later to spend time with them. There’s a shift at every age to staying up later.”

CURBING DROWSY DRIVING

Later school hours may help address another crucial issue: student safety on the road. Drowsy drivers aged 15 to 24 years cause more than 1500 fatalities each year, the National Highway Traffic Safety Administration estimates.

Researchers at the University of Kentucky, Lexington, surveyed about 10 000 students from grades 6 through 12 in an entire countywide school district before and after a 1-hour delay in high school and middle school start times. Before the change, 38% of the students reported sleeping at least 8 hours on school nights. After the change, 50% did. Beforehand, 6% of students slept at least 9 hours per night; afterward, 11% did so. After the change, weekend catch-up sleep fell.

In the 2 years after the change, auto collision rates in the county for drivers aged 17 years and 18 years fell 17%. Elsewhere in the state, crash rates in this age group rose nearly 8% (Danner F and

Phillips B. *J Clin Sleep Med*. 2008;4[6]:533-535).

Sleep deprivation amplifies vulnerabilities of the still-developing adolescent brain, noted Ronald Dahl, MD, professor of psychiatry and pediatrics at the University of Pittsburgh School of Medicine and medical director of the child and adolescent sleep/neurobehavioral laboratory at Western Psychiatric Institute and Clinic. It induces dozing, lapses in attention, and flawed judgment and decision making. Moreover, he added, adolescents learn to drive when they are prone to risk-taking and impulsivity and also often are experimenting with alcohol and drugs. In sleep-deprived individuals, even low doses of alcohol (less than 40 mg/100 mL) can impair performance. The teenager who builds up a sleep debt over the school week and drinks at a party Friday evening becomes “a potent cauldron of driving risks,” he said (Dahl R. *Am J Prev Med*. 2008;35[3 suppl]:S278-S284).

Focusing on sleep deprivation and driving offers physicians a practical way to connect with adolescents, Dahl said. Encouraging adolescents to regularize sleep/wake schedules may boost their awareness of benefits of good health practices.

Recent research by Dahl and colleagues shows sleep loss is also associated with overweight in children and adolescents, adding more urgency to efforts to improve sleep. Reduced rapid eye movement sleep in particular, the researchers suggest, may disrupt endocrine and metabolic regulation (Liu X et al. *Arch Gen Psychiatry*. 2008;65[8]:924-932).

“At a minimum, adolescents and young adults need to be counseled about normal age-appropriate sleep needs and the detrimental effects of sleep loss on performance and overall health,” a report from the American Academy of Pediatrics’ Working Group on Sleepiness in Adolescents/Young Adults and Committee on Adolescence advises practitioners (Millman RP et al. *Pediatrics*. 2005;115[6]:1774-1786; <http://aappolicy.aappublications.org/cgi/content/full/pediatrics;115/6/1774>). □