Poor self-regulation in teens associated with circadian rhythms and daytime sleepiness

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Chronic insufficient sleep is at epidemic levels in U.S. teens and has been associated with depression, substance use, accidents, and academic failure. Poor self-regulation or an inability to alter thinking, emotions, and behaviors to meet varying social demands is thought to be a key link between inadequate sleep in teens and poor health and school-related outcomes. However, a study led by Judith Owens, MD, MPH, at Boston Children's Hospital and Robert Whitaker, MD, MPH, at Temple University found that the number of hours teens sleep on school nights may not be the main problem. Instead, daytime sleepiness and a tendency to be a "night owl," referred to as an evening chronotype, appear to be more strongly associated with poor self-regulation. Findings were published online November 3 by *Pediatrics*.

"The results of this study suggest it's not how long you sleep that has the biggest impact on self-regulation, but when you sleep in relation to the body's natural circadian rhythms and how impaired you are by sleepiness," says Owens, director of the Sleep Center at Boston Children's and first author on the paper.

Owens, Whitaker and colleagues analyzed 2,017 online surveys completed by 7th— to 12th-graders from 19 middle and high schools in Fairfax County, VA. Each student completed questionnaires about sleep along with questions about self-regulation, including cognitive aspects (for example, "I forget instructions easily"), behavioral aspect (e.g., "I am impulsive") and emotional aspects (e.g., "It bothers me when I have to deal with changes.").

Nearly 22 percent of the students reported sleeping fewer than seven hours on school nights. (In contrast, the American Academy of Sleep Medicine recommends eight to 10 hours for 13- to 18-year-olds for optimal health and functioning.) Sleep duration, daytime sleepiness and chronotype were clearly interconnected; night owls slept less on school nights and were sleepier in the daytime, as were those who slept fewer hours.

But when the researchers examined all three aspects of sleep together and adjusted for age, sociodemographic factors and mental health conditions like ADHD, depression and anxiety, it was daytime sleepiness and "night owl" tendencies that independently predicted impaired self-regulation—while sleep duration did not.

Sleepier adolescents reported significantly worse self-regulation, as did teens who tended to be "night owls" rather than "morning larks." The findings held for all types of self-regulation but were most robust for cognitive and emotional aspects.

Owens believes her data support later start times for middle school and high school, to match the natural shift in adolescents' circadian pattern toward the eveningness chronotype. The American Academy of Pediatrics issued recommendations in 2014 calling for a school start time of 8:30 a.m. or later for middle and high schools.

"The 'misalignment' or mismatch between early school start times and teens' circadian rhythms—which normally shift later with puberty—may worsen self-regulation or so-called 'executive functioning,'" says Owens. "However, a recent report from the Centers for Disease Control and Prevention found that fewer than 20 percent of public middle and high schools in the U.S. start at the recommended time," Owens says. "We hope the results of this study will add to the mounting scientific evidence supporting healthy school start times."

The researchers note that being out of biological sync with school schedules forces adolescents to wake up when they are at their lowest level of alertness (the equivalent of 3 a.m. for adults). They also miss out on rapid-eye-movement (REM) sleep, which is concentrated in the early morning hours and is critical for forming memories and learning

new information. On weekends, late bedtimes and late wake times become even more extreme, contributing to the phenomenon termed "social jet lag" and exacerbating sleepiness on school days.

"Children and adolescents with better self-regulation have better physical health, mental health and financial security as adults," says Whitaker, a co-author on the study and a professor of public health and pediatrics at Temple. "So we need to understand how sleep and other factors optimize the development of self-regulation."

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