



Adolescent Sleep Health

Stephanie J. Crowley, PhD | Rush University Medical Center

If you live with a teenager, you have likely noticed that their sleeping patterns have changed from when they were younger. Do they insist on staying up late at night? Do they struggle to wake up for school in the morning (even after many alarms)? Have Saturday morning cartoons been replaced with epic sleep-ins on the weekends? Decades of research tell us that these changes in sleep habits are common in teens around the world. This short essay will review the typical sleep habits of a teenager and explain the science behind *why* teenagers sleep the way they do. I will also discuss how procedures and policies could be changed to help improve sleep health in teens.

What does a typical teenager's sleep look like?

Let's begin by defining how much sleep a teenager *should* get. Well, this is hard to define and can vary from person to person. Some researchers define "sleep need" as how much a person sleeps when given ample opportunity. Others define it as how much sleep a person needs to be physically and mentally healthy. Scientists^{1,2} have recently agreed that:

- Younger adolescents (6- to 13-year olds) should sleep 9 to 11 or 12 hours each night.
- Older adolescents (14- to 17- or 18-year olds) should sleep between 8 and 10 hours each night.

Studies have shown that adolescents who get less sleep than this are more likely to experience injuries, depressive symptoms, substance use, and be overweight or obese. However, notice there is also an upper limit to these recommendations. This is because sleeping too much could be a sign that something else is wrong, such as a medical or mental health condition. For example, one study found that high school students who slept less than 5 hours *or* more than 10 hours each night had higher insulin resistance, a potential sign of diabetes. Another study found that teenagers who slept less than 5 hours *or* more than 10 hours per night had more suicide attempts than those who slept about 8 hours per night. So, you can think of these recommended ranges as the healthy "sweet spot."

Now that we know how much sleep a teenager *should* get, let's talk about how much sleep they *actually* get. Researchers asked high school students across the United States how much sleep they usually get on school nights. Most high school students (73%) said they get less than 8 hours of





sleep.³ Female students, Black students, and Asian students were more likely to get too little sleep than male students, white students, and Hispanic students. To figure out how much sleep teenagers actually get, researchers had teens wear watch-like devices. These watches tracked when the teens were active during the day. This allowed researchers to estimate when they were awake or asleep. These watches estimated that, on average, teenagers (12- to 18-year olds) only get 6.6 hours of sleep on school nights.⁴ In contrast, younger adolescents (9- to 11-year olds) get 8.3 hours of sleep, on average. This suggests that most teenagers are not getting healthy amounts of sleep on school nights!

However, *how long* a teen sleeps is not all that matters.⁵⁻⁷ *When* a teen sleeps is also important. You have probably noticed that your teenager goes to sleep and wakes up much later than when he/she was younger. Indeed, decades of research show that sleep times tend to shift later during adolescence. Young adolescents (9-10 year olds) usually fall asleep around 9:30 pm or 10:00 pm.⁸ Older teenagers usually fall asleep 1 to 2 hours later, around 11:00 pm.⁸ In other words, it is normal for teenagers to be night owls!⁹⁻¹¹

If teens go to sleep later, they are going to wake up later. When allowed to sleep in, older adolescents will usually sleep until 8:30 am or 9:00 am. When they have to wake up for school, many adolescents will set an alarm to wake up around 6:00 am or 6:30 am. In other words, teens are required to be awake for school when their bodies want to be sleeping! Dr. Till Roenneberg describes this mismatch as “social jetlag.”¹² He calls it this because the social pressures of waking up early for school create the situation of trying to be awake as if you were living in another time zone. Indeed, several studies have shown that social jetlag peaks during the teen years. Social jetlag is associated with poor academic performance, substance use, depressive symptoms, and obesity, especially for those who are already overweight. In controlled laboratory studies, scientists have found that being awake at the “wrong” time of day makes learning more difficult.¹³ It can also cause our bodies to function abnormally. Specifically, hormones that control appetite and glucose metabolism become altered¹⁴ and insulin sensitivity decreases.¹⁵ This suggests that forcing teens to wake up earlier can impair their brain and body’s ability to function.





Why do teenagers struggle to get healthy sleep?

There are many reasons teenagers do not get enough sleep and prefer to sleep later. The “Perfect Storm Model”^{16,17} says there are 3 “pressures” that make healthy sleep difficult to get in the teenage years: biological, psychosocial, and societal pressures.

- **Biological pressures:** There are two systems that control when we sleep and wake. The first is the homeostatic sleep system. This system acts like a pressure system for sleep. When you wake up in the morning, the pressure for sleep begins to build across the day with every minute you’re awake. When you fall asleep, the pressure for sleep decreases with every minute you’re asleep. Studies suggest that sleep pressure builds more slowly in older adolescent brains compared with younger adolescents.¹⁸ This makes it easier for older adolescents to stay awake later into the night after they’ve been awake all day.¹⁹

The second system is the circadian system. This system is our body’s timekeeping system – or our internal clock. Our internal clock represents what time our body thinks it is. We can figure out what time our body thinks it is by measuring the hormone melatonin. In general, when melatonin levels are high, our body thinks it is nighttime. When melatonin levels are low, our body thinks it is daytime. Melatonin levels begin to increase about 1-3 hours before we go to sleep. This increase in melatonin indicates that the brain is getting ready for sleep. During adolescence, melatonin begins to rise later.²⁰ The combination of a slowed buildup of sleep pressure and a later circadian clock makes many older adolescents want to stay up later.

What does a teenager do at night when they aren’t ready to go to bed? They study, watch television, play video games, and socialize. Many of these activities occur on some sort of screen (even homework!). The greater access a teen has to media screens (TV, cell phone, computer, video games), the fewer hours of sleep they are likely to get.²¹⁻²³ Looking at the blue light from screens before bedtime can shift the circadian clock later. It can also increase alertness. However, this has only been seen when using a screen for a long time before bed. For example, 1 hour of tablet use before bed did not significantly change alertness and sleep.²⁴

- **Psychosocial pressures:** In addition to the blue light, the social component of screens encourages teens to stay up later. One study, for example, shows that interactive



activities (playing a video game or texting) impacts sleep more than watching television.²⁵

- **Societal pressures:** Late bedtimes on school nights are met with an early alarm clock on school mornings. As adolescents get older, the school bells rings earlier. Morning sports practice or 'zero hour' classes may cause the alarm clock to ring even earlier for some teens. Of course, the amount of time to get to school may vary, but this time must also be factored into how early a teen sets his or her alarm clock. All these things force the time for sleep to be squeezed into too small a space. Teens are not able to get the right amount of sleep!

In one study,²⁶ Dr. Mary Carskadon followed teenagers (14- to 16- year olds) during the transition from 9th grade to 10th grade. In 9th grade, they started school at 8:25 am. In 10th grade, they started at 7:20 am. From 9th to 10th grade, melatonin started to rise about 40 minutes later. The external alarm clock and internal body clock were moving in opposite directions! Teens were starting their day before their brains were ready. These teens were brought into the lab and allowed to take a nap in the morning. When allowed to sleep at 8:30 am, they fell asleep fast - in about 5 minutes! This indicates severe daytime sleepiness. This study showed us that their brains were wanting to sleep when they were expected to be focused and alert to start the school day. Sleeping in on the weekends is not enough to fix the problem. This may actually make the problem worse. Sleeping in on the weekends can shift the circadian clock later.²⁷ This will make it even harder to wake up on Monday mornings.

How can we improve sleep health of teenagers?

Many scientists are trying to figure out ways to help adolescents get better sleep. Here are a few strategies you can try at home:

- Keep a *consistent* sleep schedule.
 - In other words, go to bed and wake up at the same time every day, even on the weekends.
 - Parents can help with this by setting a bedtime and encouraging a 1-hour wind down routine before bed.
- Get exposure to light in the morning.



- Getting exposure to light in the morning tells the circadian clock that it is time to be awake. If you do this at about the same time every day, you will “train” the circadian clock that it is time to be awake at that time.
- If possible, get outside. Sunlight is most effective at setting the body clock (even if it’s overcast).
- Parents can help with this by turning on the lights and opening curtains at wake-up time.
- Avoid caffeine (coffee, tea, soda, energy drinks, etc.).
 - If you consume caffeine, try to in the morning. Avoid caffeine in the afternoon.
- Start a bedtime routine.
 - A bedtime routine should help you wind down, so your brain can prepare for sleep.
 - Avoid stimulating activities, such as video games or social media.
 - Try relaxing activities, such as reading, stretching, or meditating.
 - Some teens like to shower at the end of the day.
- Leave phones in another room before and during sleep.
 - This will help reduce alertness before bedtime.
 - This will also prevent disruption to sleep from alerts and text messages that come in overnight.
 - Parents can model this by leaving their phones outside the bedroom too.
- Use a traditional alarm clock instead of a phone alarm.
 - Try putting the alarm clock on the other side of the room.
 - Try using a sunrise alarm clock that slowly brightens as wake-time nears.
- Teenagers struggling with sleep should seek help from their primary care physician or a sleep specialist.

In addition to teens and their parents, there are people outside the household who could help improve teenagers’ sleep. Decision-makers at the community level (e.g., educators, medical professionals, policy makers, government agencies) should be a part of the discussion and the solution. For example, they could help delay school start times. This recently happened in California. California SB328 prevents middle and high schools from starting before 8:00 am and 8:30 am, respectively. Other spaces in which sleep health discussions are needed are juvenile justice systems, immigration detention systems, and foster care systems. The environments and schedules of these facilities should be examined to determine if they are suitable for children and adolescent sleep.





Additional Reading

Carskadon, MA (2011). Sleep in Adolescents: The Perfect Storm. *Pediatr Clin North Am Jun*;58(3):637-47. doi: 10.1016/j.pcl.2011.03.003.

Crowley SJ, Wolfson AR, Tarokh L, Carskadon MA (2018). An update on adolescent sleep: New evidence informing the Perfect Storm Model. *J Adolesc* 67:55-65.

<https://doi.org/10.1016/j.adolescence.2018.06.001>

Cited References

1. Hirshkowitz M, Whiton K, Albert SM, et al. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep Health*. 2015; 1 (1): 40-43.
2. Paruthi S, Brooks LJ, D'Ambrosio C, et al. Consensus Statement of the American Academy of Sleep Medicine on the Recommended Amount of Sleep for Healthy Children: Methodology and Discussion. *J Clin Sleep Med*. 2016; 12 (11): 1549-1561.
3. Wheaton AGP, Jones S, PhD, Cooper ACM, MEd, Croft JBP. Short Sleep Duration Among Middle School and High School Students - United States. Centers for Disease Control and Prevention. 2018; 67 (3): 6.
4. Galland BC, Short MA, Terrill P, et al. Establishing normal values for pediatric nighttime sleep measured by actigraphy: a systematic review and meta-analysis. *Sleep*. 2018; 41 (4).
5. Blunden S, Galland B. The complexities of defining optimal sleep: Empirical and theoretical considerations with a special emphasis on children. *Sleep Medicine Reviews*. 2014; 18 (5): 371-378.
6. Carskadon MA, Short MA. Measuring sleep need. *Sleep Medicine Reviews*. 2014; 18 (5): 369-370.
7. Lewin DS, Wolfson AR, Bixler EO, Carskadon MA. Duration Isn't Everything. Healthy Sleep in Children and Teens: Duration, Individual Need and Timing. *Journal of Clinical Sleep Medicine*. 2016; 12 (11): 1439-1441.
8. Crowley SJ, Van Reen E, LeBourgeois MK, et al. A Longitudinal Assessment of Sleep Timing, Circadian Phase, and Phase Angle of Entrainment across Human Adolescence. *PLoS One*. 2014; 9 (11): e112199.
9. Carskadon MA, Vieira C, Acebo C. Association between puberty and delayed phase preference. *Sleep*. 1993; 16 (3): 258-262.
10. Roenneberg T, Kuehnle T, Pramstaller PP, et al. A marker for the end of adolescence. *Curr Biol*. 2004; 14 (24): R1038-1039.
11. Fischer D, Lombardi DA, Marucci-Wellman H, Roenneberg T. Chronotypes in the US - Influence of age and sex. *PLoS One*. 2017; 12 (6): 1-17.
12. Wittmann M, Dinich J, Mellow M, Roenneberg T. Social jetlag: misalignment of biological and social time. *Chronobiol Int*. 2006; 23 (1): 497-509.



13. Wright KP, Jr., Hull JT, Hughes RJ, Ronda JM, Czeisler CA. Sleep and wakefulness out of phase with internal biological time impairs learning in humans. *J Cogn Neurosci*. 2006; 18 (4): 508-521.
14. Scheer FA, Hilton MF, Mantzoros CS, Shea SA. Adverse metabolic and cardiovascular consequences of circadian misalignment. *Proc Natl Acad Sci U S A*. 2009; 106 (11): 4453-4458.
15. Eckel RH, Depner CM, Perreault L, et al. Morning Circadian Misalignment during Short Sleep Duration Impacts Insulin Sensitivity. *Curr Biol*. 2015; 25 (22): 3004-3010.
16. Carskadon MA. Sleep in adolescents: the perfect storm. *Pediatr Clin North Am*. 2011; 58 (3): 637-647.
17. Crowley SJ, Wolfson AR, Tarokh L, Carskadon MA. An update on adolescent sleep: New evidence informing the perfect storm model. *J Adolesc*. 2018; 67: 55-65.
18. Jenni OG, Achermann P, Carskadon MA. Homeostatic sleep regulation in adolescents. *Sleep*. 2005; 28 (11): 1446-1454.
19. Taylor DJ, Jenni OG, Acebo C, Carskadon MA. Sleep tendency during extended wakefulness: insights into adolescent sleep regulation and behavior. *J Sleep Res*. 2005; 14 (3): 239-244.
20. Carskadon MA, Acebo C, Jenni OG. Regulation of adolescent sleep: Implications for behavior. *Annals of the New York Academy of Sciences*. 2004; 1021: 276-291.
21. Van den Bulck J. Television viewing, computer game playing, and Internet use and self-reported time to bed and time out of bed in secondary-school children. *Sleep*. 2004; 27 (1): 101-104.
22. Carter B, Rees P, Hale L, Bhattacharjee D, Paradkar MS. Association Between Portable Screen-Based Media Device Access or Use and Sleep Outcomes: A Systematic Review and Meta-analysis. *JAMA Pediatr*. 2016; 170 (12): 1202-1208.
23. Munezawa T, Kaneita Y, Osaki Y, et al. The Association between Use of Mobile Phones after Lights Out and Sleep Disturbances among Japanese Adolescents: A Nationwide Cross-Sectional Survey. *Sleep*. 2011; 34 (8): 1013-1020.
24. Heath M, Sutherland C, Bartel K, et al. Does one hour of bright or short-wavelength filtered tablet screenlight have a meaningful effect on adolescents' pre-bedtime alertness, sleep, and daytime functioning? *Chronobiol Int*. 2014; 31 (4): 496-505.
25. Hale L, Kirschen GW, LeBourgeois MK, et al. Youth Screen Media Habits and Sleep: Sleep-Friendly Screen Behavior Recommendations for Clinicians, Educators, and Parents. *Child Adolesc Psychiatr Clin N Am*. 2018; 27 (2): 229-245.
26. Carskadon MA, Wolfson AR, Acebo C, Tzischinsky O, Seifer R. Adolescent sleep patterns, circadian timing, and sleepiness at a transition to early school days. *Sleep*. 1998; 21 (8): 871-881.
27. Crowley SJ, Carskadon MA. Modifications to weekend recovery sleep delay circadian phase in older adolescents. *Chronobiol Int*. 2010; 27 (7): 1469-1492.

