



Teenagers: sleep patterns and school performance

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Introduction

Sleep patterns in teenagers have been extensively studied and have revealed considerable variations between school nights and non-school nights. Total sleep time tends to be less on school nights when compared with non-school nights. Bedtime and wake times appear to be influenced by external factors such as school start times and changes during puberty to later sleep onset time resulting in a diminished total sleep time and possible resultant daytime sleepiness.

What is a normal sleep pattern?

Sleep is classified into two types: NREM (non-rapid eye movement) sleep and REM (rapid eye movement) sleep. Cycling through all of the sleep stages for an adequate amount of time is essential to achieving a good night's sleep for adequate functioning the next day. These sleep stages are defined by distinct polysomnographic features of electroencephalographic (EEG) patterns, eye movements and muscle tone.

NREM sleep is characterized by distinct EEG patterns including sleep spindles, K complexes and slow wave (delta) activity. The respiratory and cardiovascular parameters are relatively regular. In contrast, REM sleep is characterized by asynchronized cortical activity with a high brain metabolic rate, dreaming, lack of normal thermoregulation, and irregular respiratory and cardiac rhythms. The hallmark features of REM sleep include absence of skeletal muscle tone with the exception of the diaphragm, middle ear muscles, erectile muscles, and episodic bursts of extraocular muscles.

Why is sleep important?

There are many theories concerning the need for sleep. However, what we know has primarily evolved from research studies conducted in animals and humans examining the impact of sleep deprivation on the physiological and neurobehavioral systems. During sleep, important body functions and brain activity occur to create new pathways for learning and memory.

Insufficient sleep alters activity in some parts of the brain that may interfere with the ability of making decisions, maintaining alertness, solving problems, controlling emotions and behavior, and coping with change.

What is considered an appropriate sleep duration for teenagers?

The American Academy of Sleep Medicine recommends that school-aged adolescents (14 to 17 years) should obtain at least 8 to 10 hours of sleep per night. However, on average the amount of sleep that teenagers actually achieve is about 7 hours, particularly on school nights. The amount of sleep varies by grade, with teenagers tending to get less sleep as they get older. Thus, teenagers are constantly coping with “sleep debt” during the school year. The amount of sleep reported by adolescents varies across countries and regions; but overall patterns of later sleep time and diminished sleep across adolescence are reported by most investigators. If this sleep debt is cumulative, subjective and objective evidence of increased daytime sleepiness are likely to appear.

This is of particular concern because chronic sleep deprivation, also known as sleep loss, insufficient or deficient sleep, can lead to a myriad of health deficits. Disrupted sleep-wake cycles and sleep restriction contribute to significant negative effects on the renal, cardiovascular, thermoregulatory, digestive, and endocrine systems. For example, sleep loss can contribute to insulin resistance and the development of metabolic abnormalities, obesity, and diabetes mellitus.

Furthermore, inadequate sleep has also been associated with mental health disorders and safety deficits. Sleep deprived teenagers have less interest to participate in physical activities or sports. They are more likely to be depressed, anxious, irritable, defiant, and impulsive than teenagers who achieve optimal sleep durations. They are at increased risk for suicidal ideation, substance use, as well as motor vehicle accidents related to drowsy driving.

Sleep restriction has been linked to cognitive and behavioral problems that adversely impact academic performance and functioning. For example, teenagers who are chronically sleep deprived have worse academic performance. Teenagers achieving inadequate amounts of sleep have increased absenteeism and tardiness, decreased ability to learn and retain material, and diminished ability to actively participate in the classroom and perform decision-making tasks.

How does puberty alter the sleep-wake cycle?

There are changes in the biological clock or circadian rhythms of teenagers. At about the time of puberty onset, most teenagers begin to experience a sleep-wake “phase delay” (later sleep onset time and later wake up time), manifest as a shift of sleepiness up to 2 hours later relative to bedtimes and wake times from earlier childhood.

The onset of sleep is triggered by the release and accumulation of melatonin, a natural brain hormone. Toward dawn, melatonin shuts off, cortisol increases and also core body temperature rises, signaling the individual to wake up. Two biological changes in sleep regulation are thought to occur during puberty. First, there is a delayed timing of nocturnal melatonin secretion that parallels a shift in circadian phase preference. Therefore, teenagers have a biological tendency to fall asleep later in the evening and to wake up later in the morning. Second, sleep drive is altered across adolescence. Even those teenagers who have experienced sleep deprivation (and therefore accumulated a sleep debt) tend to feel more alert in the evening, thus making it more difficult to go to bed at a time that parents consider a reasonable hour. There is a further “mismatch” in that early school start times for teens do not allow them to achieve their biological need for adequate sleep for optimal daytime functioning.

Are there other factors that contribute to sleep deprivation in adolescents?

There are others reasons why teenagers do not get enough sleep. For example, caffeine consumption is increasing among adolescents to fight against daytime sleepiness, resulting from sleep deprivation. More worrisome is the increasing consumption of energy drinks and “super caffeinated” products like caffeine pills, energy drinks, and gum to promote alertness. Daytime and evening caffeine consumption may further disrupt nighttime sleep. The ability to achieve an appropriate sleep onset time and adequate amounts of sleep may be further impaired by after- school activities (part-time work), socializing and electronic devices.

Erratic sleep schedules, primarily during non-school nights, in an attempt to compensate for the lack of sleep during school nights, may initially seem to be a good idea, but can make sleep schedules worse. For example, if a teenager sleeps in till noon on Sunday morning, then they may be too alert to sleep at their usual bedtime Sunday night. Later school start times, even as little as 30 minutes later have been associated with improved academic performance and reduced vehicle accidents among teens.

What sleep disorders should be evaluated in a sleepy adolescent?

Among adolescents and teenagers, common sleep problems include sleep disordered breathing, insomnia, and hypersomnolence. They may also experience other sleep disorders such as restless leg syndrome and parasomnias such as sleepwalking. Sleep problems occur very frequently in this age group. It is important that all adolescents and teenagers be screened for sleep problems including questions regarding nighttime sleep, daytime sleepiness, and snoring.

How to get a good night’s sleep?

According to leading sleep researchers, there are techniques that may be implemented in order to decrease common sleep problems. These include: keep a regular sleep-wake schedule that allows for a developmentally appropriate amount of sleep; avoid caffeine beverages four to six hours before bed and minimize daytime use; avoid alcohol and heavy meals before sleep; practice regular exercise; minimize noise, light and excessive hot or cold temperatures during sleep; establish a regular bed time and go to bed at the same time each night; and early morning bright light exposure to promote an earlier bedtime/sleep time.

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