When was the last time you got eight hours of sleep? Has it been such a long time that you find it difficult to recall? It should come as no surprise to hear that college students do not get the recommended average of eight hours of sleep per night. Everyone knows that a lack of sleep is unhealthy; numerous studies have shown the detrimental effects sleep deprivation has on mental function. Yet realistically speaking, at an academically competitive university like Penn, rigorous studying often comes at the expense of adequate sleep. So what's a college student to do?

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FEATURES

Students across campuses are turning to alternative strategies, including energy drinks and prescription stimulants, to regain the energy lost from lack of sleep. Most of us can sympathize with the use of these energy boosters, since we too understand the consequences of sleepiness. Nonetheless, we must keep in mind the health effects of such alternatives when deciding how to tackle sleep deprivation.

To understand sleep deprivation and stimulants, we must first understand sleep. Sleep is divided into two stages: REM sleep and non-REM sleep.[1] During non-REM sleep, or "deep sleep", neurons are firing at their lowest rates, and body temperature and energy consumption are very low.[1] Experiments suggest that during this stage the brain cannot even process information coming from the five senses.[1] Essentially, the body and mind are in their most restful states.

REM sleep, however, is drastically different. The activity of the brain in REM sleep closely resembles the activity of the waking brain.[1] Vivid dreams occur during this stage, and the eyes will often move very quickly back and forth in the head. Such activity gives this stage of sleep its clinical name, Rapid Eye Movement sleep. The brain appears to be active and oxygen consumption is high.[1] Twenty-five percent of sleep time is spent in REM sleep.[1]

To us students, sleepiness can seem like an inconvenience, and we may question why we even need to sleep. Although the exact details of its role are unknown, sleep researchers agree on one thing – sleep is not expendable.[2] Most of the theories about the function of sleep come from cognitive science. For example, sleep can prepare the brain for encoding new memories and consolidating recently learned information.[3] Indeed, in sleep-deprived rats, there is decreased activity in the hippocampus, an area of the brain that forms long-term memories. It is very possible that a similar type of process occurs in humans. Sleep deprivation also reduces the brain's ability to form the new synaptic connections necessary to make lasting memories.[4]

Sleep may also serve as a time for the body and brain to replenish its energy stores. The brain's main energy source is glycogen, a complex sugar made up of long polymers of glucose. After extended wakefulness, these glycogen reserves become depleted. The brain replenishes these stores during sleep because doing so at any other time would interfere with daytime functioning.[5] The rest of the body also uses sleep to replenish its energy.[6] While sleeping, we consume less oxygen than we do while awake, and our heart rate and basal body temperature both decrease. Because we are using a minimal amount of energy, we are able to restore our depleted energy sources during sleep. For example, during sleep, protein concentration may increase, restoring both energy and the building blocks of life that the body needs.[6] Sleep is also a time for growth. Remember the doctor telling you as a kid to get enough sleep so you can grow big and strong? The doctors weren't pulling your leg. Growth hormone is released during sleep.[6]

While we can't posit the exact function of sleep, the effects of sleep deprivation are easily identifiable. For instance, the networks in our brain that allow us to pay attention are generally reduced, causing further memory deficits. Fully rested students are able to process memories of everyday experiences, whereas sleep-deprived students may have more difficulty. In other words, students running on less sleep may be so busy trying to focus on their professor that they leave no energy for their brain to remember the information on the board. Additionally, executive tasks related to planning, organization, multi-tasking, and managing behavior become more difficult for the sleep-deprived brain to perform.[7]

The truth is, the more sleep deprived we are, the harder it is for our brain to effectively learn and remember.[8] In a study where students were selected to sleep for three, five, or eight hours, the three-hour sleep group showed the most marked deficit of the central nervous system, and reported the greatest sleepiness. It also took the three-hour group the longest period of time to recover to a fully aroused state, meaning they were sleepier for the longest period of time.[8]

It is important to note that you should not compare your sleeping habits to your friend's, as not everyone requires the same amount of sleep to feel rested. Some sleep researchers believe that the amount of sleep an individual needs is determined by his or her genes and cannot be altered.[9] Therefore, as much as we may want to, we cannot train ourselves to be "short sleepers".

When we are sleep deprived, we collect "sleep debt", which is the difference between the amount of sleep we should be getting and the amount of sleep that we actually get.[9] Sleep debt accumulates and manifests itself in reduced cognitive function. This is one kind of debt that cannot be cheated, because the only way to eliminate it is to get more sleep.

Unfortunately, a full eight-hour night of sleep is wishful thinking for most college students. Many of us feel

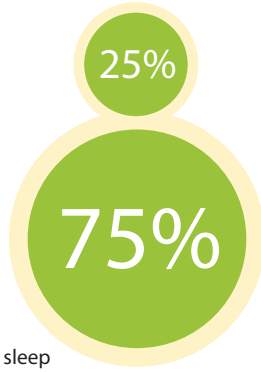
The two stages of sleep

REM

- state closely resembles that of an active, waking brain
- vivid dreams
- rapid eye movement

non-REM

- deep sleep
- neurons firing at their lowest rates
- body temperature and energy consumption are very low



% time spent in the stages during sleep

the repercussions of not getting enough sleep. Inability to focus and difficulty processing information are constant side effects. As a result, students employ many methods to boost their energy, including coffee, energy drinks, and even prescription stimulants, all of which are easily accessible on campus. As students begin to feel the pressure of academics, alternative and more dangerous sources of energy become more and more appealing. According to a recent study, 7% of US college students reported ever having used prescription stimulants for non-medical reasons.[10]

Although most of us, hopefully, aren't turning to non-prescribed stimulants to keep us awake, energy drinks and coffee are common components of the college diet. We may gulp these beverages down along with our morning bagel, but do we know what really goes into them? The active ingredients in energy drinks are taurine, caffeine, and glucuronolactone.[11] Caffeine blocks the effect of adenosine, a molecule that reduces the firing rate of neurons and causes the brain to crave sleep, while taurine and glucuronolactone enhance endurance and attention.[12] Energy drinks also contain an assortment of sugars and vitamins. Sugars such as glucose are metabolized for energy, and B-group vitamins, including Vitamin B12, are thought to facilitate mental performance.[12]

While caffeine may seem like a lifesaver during an all-nighter, it can actually have many harmful effects on the body. In fact, students may often unknowingly suffer from caffeine toxicity, which is characterized by nervousness, restlessness, tremors, upset stomach, and accelerated heart rate.[13] An accelerated heart rate is especially dangerous because the heart pumps less efficiently and provides less blood flow to the rest of the body. Over time, students may also become chemically addicted to caffeine. When they miss their daily caffeine dose, they may suffer from caffeine withdrawal, characterized by headache, fatigue, sleepiness, and difficulty concentrating. In extreme cases, seizures following an overdose of caffeine have been documented. In a recent study, four patients who self-reported consuming large amounts of energy drink suffered from seizures.[14] None of these patients had previous neurological abnormalities, suggesting that energy drinks, and not some inherent neurological deficit, was the cause of the seizure. Upon refraining from drinking energy drinks, none of the patients reported subsequent seizures. While this particular study is an extreme case with a small sample size, many of us are probably familiar with at least one of these withdrawal symptoms.

In a worst case scenario, students under high stress and pressure may be tempted to try prescription stimulants. Adderall and Ritalin, two drugs normally prescribed to individuals with ADHD, are common prescription stimulants used to boost focus. In one study, researchers found that non-medical use of prescription stimulants was most prevalent in more competitive universities and among students with below average GPAs.[10] Most students reported that their motivations for this use of prescription

There is high correlation between non-medical use of prescription stimulants in institutions with more competitive admissions, and amongst students with lower than average GPAs

University of Michigan, Substance Abuse Research Center : "Non-medical use of prescription stimulants among US college students: prevalence and correlates from a national study"

stimulants included improved concentration and enhanced alertness. However, because Adderall and Ritalin are only available by prescription, 90% of students who reported using them obtained the stimulants from peers and friends.[10] Since Adderall and Ritalin are not normally prescribed for combating sleep deprivation, these students are practicing drug misuse. Continual use of Adderall and Ritalin can have physiologically negative effects on the body, as epidemiological studies have found that a significant proportion of non-medical prescription stimulant users develop dependent behaviors.[10] Additionally, it is illegal to obtain prescription medications from a non-pharmaceutical provider. Uninformed students may even mix drugs, causing potentially fatal effects.

Being a student at a prestigious, competitive university is undeniably difficult. We all have been in a situation with a deadline, a midterm, a paper, and not enough time to get everything done *and* sleep. Time never seems to be on our side. However, we should always keep our health in mind and be aware of the consequences associated with everything we consume.

Feeling tired is your body's way of telling you to get some sleep, so just do it.

References

1 M.R. Bear, B.W. Connors, M.A. Paradiso. Neuroscience Exploring the Brain. (Lippincott Williams & Wilkins: Balitmore, 2007).
2 A.M. Gillis. Bioscience. 46: 6: 391-393. (1996).
3 D. Dobbs. Sleep, Attention, and Memory: Not (Maybe) What You Thought. Scientific American. (2007).
4 I. G. Campbell, M. J. Guinan, J. M. Horowitz. Sleep Deprivation Impairs Long-Temp Potentiation in Rat Hippocampal Slices. Journal of Neurophysiology. 88: 1073-1076. (2002)
5 J. Kong, et al. Brain Glycogen Decreases with Increased Periods of Wakefulness: Implications for Homeostatic Drive to Sleep. The Journal of Neuroscience. 22: 5581-5587. (2002)
6 C. M. Shapiro and M. J. Flanigan. Function of Sleep. BMJ: British Medical Journal. 306: 6874: 383-385. (1993).
7 J. P. Nilsson, et al. Journal of Sleep Research. 14:1: 1-6. (2005)
8 K.A. Cote, et.al. CNS arousal and neurobehavioral performance in a short-term sleep restriction paradigm. Journal of Sleep Research. 18: 3: 291-303. (2009).
9 M. Webster. Can You Catch Up on Lost Sleep? Scientific American. (2008).
10 S.E. McCabe, et.al. Non-medical use of prescription stimulants among US college students: prevalence and correlates from a national survey. Addiction. 100: 1: 96-106. (2005).
11 A.B. Scholey. D.O. Kennedy. Cognitive and physiological effects of an "energy drink": an evaluation of the whole drink and of glucose, caffeine and herbal flavouring fractions. Psychopharmacology. 176: 3-4. (2004).
12 C. Alford. H. Cox. R. Wescott. The effects of Red Bull Energy Drink on human performance and mood. Amino Acids. 21: 2: 139-150. (2001).
13 C. J. Reissig, et all. Caffeinated energy drinks—A growing problem. Drug and Alcohol Dependence. (2008). doi:10.1016/j.drugalcdep.2008.08.001.
14 S. T. Iyadurai. S. S. Chung. New-onset seizures in adults: Possible association with consumption of popular energy drinks. Epilepsy and Behavior. 10:3: 504-508. (2007).