



The Overlooked Element: Sleep and its Impact on Academic and Athletic Success

Bruhath Batla

Abstract

This paper reviews the impact of sleep on our lives, specifically in academic and athletic success, and emphasizes how its effects are often overlooked. A lack of sleep can negatively affect cognitive functions such as memory and attention, however, many students do not realize this. Sleep also affects one's mood and well-being throughout the day, causing them to lose focus and possibly decrease academic success. In terms of athletic success, studies have shown that a lack of sleep increases the injury rate among athletes, which can mean less playing time. However, solutions to this sleep dilemma among student-athletes include a delayed school start time, parents fostering healthy sleep habits, and coaches emphasizing the role of sleep.

Introduction

Sleep, an essential yet often ignored component of our daily lives, is important in keeping our physical and mental well-being. Imagine 15 year old Alex, an ambitious high school student, aiming for top grades while also being an active member of the school's cross-country team. He often juggles late-night study sessions, early morning cross country practices, and the pressures of maintaining a social life. Picture Alex having trouble staying awake during a crucial exam, with heavy eyes, mind unclear, and body sluggish. This common scenario details the importance of sleep, especially for adolescents in a principal growth and development period. The results of sleep deprivation are not just limited to feeling tired; they include significant cognitive, physical, and emotional impacts as well.

A lack of sleep has lasting effects on both the mind and body. Sleep deprivation can impair cognitive functions such as memory, attention, and decision-making, while also impacting physical health, mood, and overall well-being (Adriansen et al., 2017). In addition, the physical benefits of sleep such as muscle recovery and overall physical health are indeed crucial for athletes like Alex to perform well (Okano et al., 2019). Not only this, but sleep also influences behavior, mood, and decision-making. Sleep deprivation can lead to irritability, poor decision-making, and negative mood states (Haack et al., 2005). Furthermore, insufficient sleep, even for one night, weakens the immune system, increasing our susceptibility to illness and disease (Mishra et al., 2017). The implications of sleep deprivation "snowball effect" leading to a cycle of poor health that leads beyonds the short term (Pilcher et al., 2015). Chronic sleep deprivation in adolescents can lead to long term health impacts, such as an increased risk of developing long-term memory deficits, sleep disorders, mental health challenges, and obesity, which can have a lasting impact on one's quality of life (Jain & Verma, 2016). Clearly, sleep significantly impacts cognitive development, emotional regulation, and overall physical health during this critical period of growth and maturation. Thus it is crucial that research and education efforts target sleep hygiene. For Alex, this means better retention of studied material and improved performance in exams. In addition, the physical benefits of sleep such as muscle recovery and overall physical health are indeed crucial for athletes like Alex to perform well (Okano et al., 2019). Not only this, but sleep also influences behavior, mood, and decision-making. Sleep deprivation can lead to irritability, poor decision-making, and negative mood states (Haack et al., 2005). These effects The present paper aims to review the effects of

sleep on adolescents and explain how these outcomes influence academic and athletic performance. By examining various studies, the present review will provide insight into improving sleep habits among high school students and athletes.

Biology of Sleep

There are two main stages of sleep: non-rapid-eye-movement, or NREM, which is a light sleep stage, which is characterized by decreased brain activity, especially in the frontal cortex and thalamus. The second stage of sleep is Rapid-eye-movement, or REM sleep, which is a deep sleep stage (Falup-Percurari et al., 2021). These stages are delineated based on electroencephalography (EEG) measurements, by which brain activation fluctuates, with the lowest state occurring outside REM sleep. REM sleep, characterized by rapid eye movements, low-amplitude mixed-frequency brain waves similar to wakefulness, and high brain activity in areas involved in dreaming and memory consolidation, represents the stage with the highest brain activation. Figure 1 provides a visual representation of this principle.

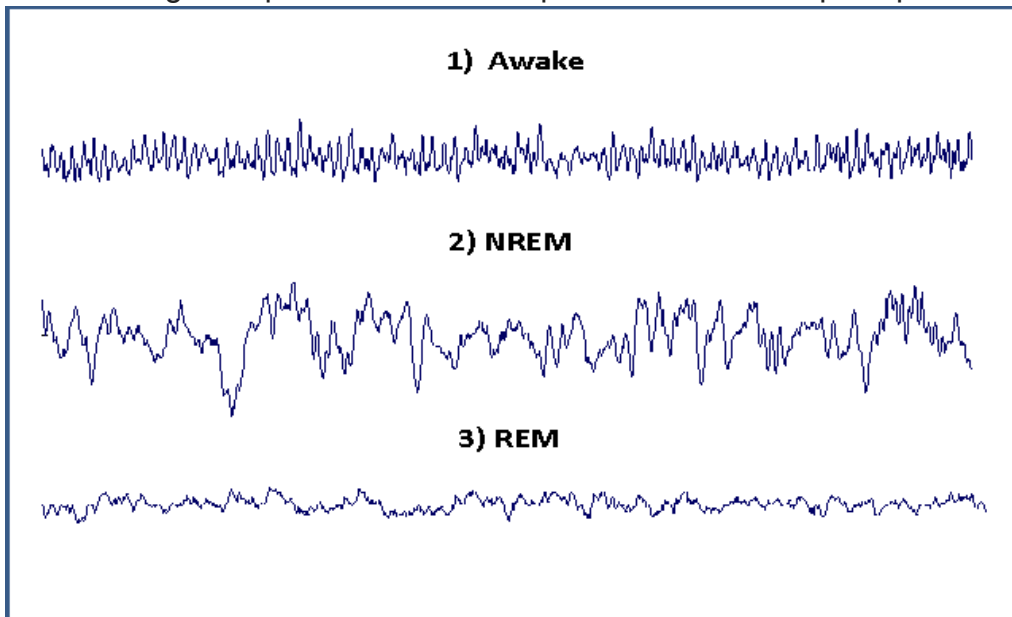


Figure 1. EEG measurements in the brain during sleep and wakefulness (Mohammadi et al., 2015)

During the sleep stage of REM, sleep regulation happens at genetic, biological, and cellular levels involving several areas of the brain such as the thalamus and hypothalamus (Falup-Pecurariu et al., 2021). In addition, neurotransmitters typically released throughout the day are limited as one transitions in a cycle between sleep stages. This cycle repeats from wakefulness, to NREM, and to REM. These neurotransmitters, such as serotonin, play a role in keeping us awake. NREM sleep is a period of restfulness where the body's systems, such as heartbeat and neural activity, start to slow down. Differences in chronotypes, or an individual's inclination to sleep timing, also influence sleep patterns and behaviors. For example, evening chronotypes, or people who prefer later bedtimes and wake times, could have trouble dealing with early school start times. This can result in unwanted daytime sleepiness and an impairment in cognitive functions (Wheaton AG et al., 2016).

Sleep also serves as the brain’s “save button” for new memories or ideas created throughout the day. A good night’s sleep transfers new thoughts from short-term to long-term memory and builds on existing thoughts through a process called synaptic consolidation (Blechner et al., 2021). Similar to one improving a skill over time, this process enables synaptic remodeling for optimal efficiency. This is crucial for both declarative memories, which are consciously recalled and remembered and stored in the temporal lobe, and non-declarative memories, such as muscle memory, which are stored in the cerebellum (Blechner et al., 2021).

Sleep and Academic Outcomes in High School Students

Sleep disturbances such as insufficient duration and quality can significantly affect high school students’ academic performance by negatively impacting their ability to process and store new information (Mitru et al., 2002). Teens who do not get enough sleep also face problems such as behavioral issues, poor mental and physical health, and lower academic performance (Wheaton et al., 2016). Sleep deprivation can impair cognitive functions such as attention, memory, and decision-making—three important elements of academic success (Fonseca et al., 2020).. A lack of sleep reduces the brain’s ability to consolidate and retain new information, directly impacting school performance (Hysing et al., 2016). The time students go to sleep on the weekdays also shows a strong association with GPA, as students who go to bed between 10 and 11 PM on weekdays perform the best academically. This is because going to bed between 10 and 11 PM ensures that students can get at least eight hours of sleep, the recommended amount for adolescents.

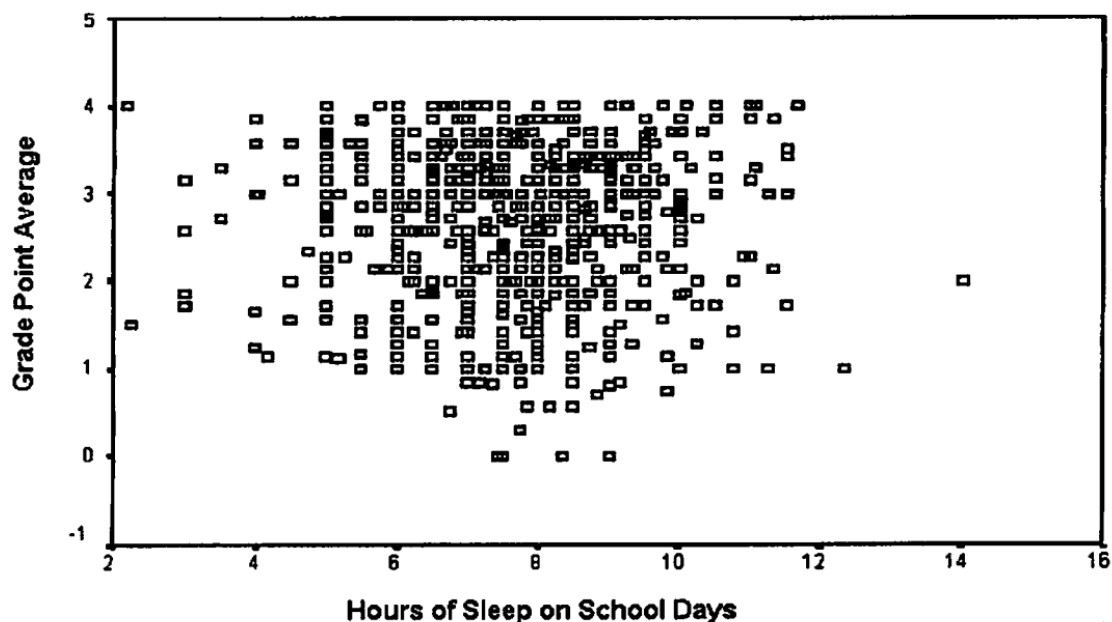


Figure 2. Grade point average plotted against hours of sleep on school days (Eliasson et al., 2002)

One approach to addressing sleep issues in high school students is delaying school start times. Studies have shown that delays as minimal as 30 minutes increase the sleep duration of teens (Wheaton et al., 2016). Delayed school start times were associated with less falling

asleep in class, improved attendance, and higher grades. Another suggested approach is to reduce after-school activities and workloads (Mitru et al., 2002). Additionally, minimizing the use of electronic devices before bedtime can potentially improve sleep quality and quantity, which can help with students' cognitive functioning throughout the day (Fuller et al., 2017).

Sleep and Athletic Performance in High School Students

A study of young athletes found that regardless of the time spent on the sport or their academic performance, a lack of sleep still led to higher injury rates among the students. As such, coaches should prioritize their player's sleep prior to practices and games to minimize risk of injury (Milewski et al., 2014). A study by Frohm et al. (2017) found that an increase in training intensity along with an inconsistent sleep schedule resulted in a higher risk for injury. This was in comparison to a lower training intensity. A balanced sleep schedule improves athletic motor skills irrespective of practice time. In addition to this, a study by Mah et al. (2011) found that an increase in sleep among collegiate basketball players increased their performance. This included faster sprint times, higher shooting accuracy, and faster reaction times.

Injuries that result from excessive fatigue can take a psychological toll. Injured athletes are at a higher risk for depression, and also may struggle from anxiety related to rehabilitation and potential reinjury. Additionally, athletes who get injured easily and who have less playing time can experience skill degradation. This is crucial as it can decrease a player's performance. While there is strong indication that optimal sleep can result in maximized athletic performance, in reality, many athletes at the highest level do not get adequate sleep because of tight training schedules, and traveling. This results in athletes not being able to reach their full potential (Watson, 2017).

Proper sleep is important for recovery, as it gives the body a chance to repair and rebuild tissues. Adequate sleep also supports muscle recovery and growth. Sleep deprivation can increase the time it takes to recover and exacerbate the effects of physical effort which leads to a longer time of soreness and a delay in the healing of injuries (Haack et al., 2005). This delay in recovery can prevent athletes from training effectively and competing to their full potential.

Now, to lessen the negative effects of sleep deprivation on athletes, several strategies can be carried out. Coaches should emphasize the importance of sleep hygiene and educate athletes on keeping a consistent sleep schedule. Adjusting training schedules to let athletes get adequate rest and recovery can help them balance their physical exertions with their need for sleep (Samuels, 2008). Other ways to improve sleep quality for athletes, as with students generally, can be creating a sleep-favored environment for bedtime, minimizing caffeine and electronic devices before bedtime, and implementing relaxation techniques (Watson, 2017).

Conclusion

Sleep is vital for maintaining both physical and psychological health in adolescents. Consistent adequate sleep increases cognitive function by improving the retention of newly learned information and preventing memory decay. Sleep also positively affects behavior and mood, making individuals feel better both emotionally and physically. It also helps in physical recovery and reduces the risk for injury. However, with insufficient sleep, one can potentially have detrimental effects on psychological performance. There is also a strong correlation between adequate sleep and academic performance, as proper sleep improves memory

retention, new information processing, and classroom performance, ultimately leading to higher GPAs.

Students should be encouraged to take their sleep seriously, while coaches need to help athletes manage their time to protect their sleep, creating a culture where sleep is prioritized. Parents also play an important role in the promotion of sleep, where they can set rules in the household to protect sleep, setting a good example, and creating a comfortable sleeping environment. Teachers can also play a role in promoting sleep culture, as they can create a supportive environment that emphasizes the importance of sleep. Additionally, teachers can teach time management skills to help students balance their daily activities. Promoting good sleep practices, such as maintaining a consistent sleep schedule, minimizing the use of electronic devices before bed, and creating a sleep-favored environment, is essential as well. By prioritizing sleep, students, parents, coaches, and teachers can ensure that adolescents achieve optimal health, academic success, and athletic performance.

Furthermore, to contribute to our understanding of sleep and its connection with the brain, further research can explore how different stages of sleep apply to the consolidation and storage of new information. Inquiring the specific neurochemical processes involved in memory formation during sleep could provide insight. For instance, recognizing key neurotransmitters or hormones released through sleep stages might reveal targets for enhancing cognitive functions. This can lead to potential interventions or therapies to optimize sleep and to improve learning and memory retention.

References:

Adriansen, R. C., Childers, A., Yoder, T., & Abraham, S. (2017). Sleeping habits and perception of its health effects among college students. *International Journal of Studies in Nursing*, 2(2), 28.

Blechner, M. (2021). Neurobiology of memory and sleep. *Sleep Neurology: A Comprehensive Guide to Basic and Clinical Aspects*, 81-89.

Eliasson, A., Eliasson, A., King, J., Gould, B., & Eliasson, A. (2002). Association of sleep and academic performance. *Sleep and Breathing*, 6(01), 045-048.

Falup-Pecurariu, C., Diaconu, Ș., Țînt, D., & Falup-Pecurariu, O. (2021). Neurobiology of sleep. *Experimental and Therapeutic Medicine*, 21(3), 1-1.

Fonseca, A. G., & Genzel, L. (2020). Sleep and academic performance: Considering amount, quality, and timing. *Current Opinion in Behavioral Sciences*, 33, 65-71.

Fuller, C., Lehman, E., Hicks, S., & Novick, M. B. (2017). Bedtime use of technology and associated sleep problems in children. *Global Pediatric Health*, 4, 2333794X17736972.
<https://doi.org/10.1177/2333794X17736972>

Haack, M., & Mullington, J. M. (2005). Sustained sleep restriction reduces emotional and physical well-being. *Pain*, 119(1-3), 56-64.

Hysing, M., Harvey, A. G., Linton, S. J., Askeland, K. G., & Sivertsen, B. (2016). Sleep and academic performance in later adolescence: Results from a large population-based study. *Journal of Sleep Research, 25*(3), 318-324.

Jain, A., & Verma, S. (2016). Prevalence of sleep disorders among college students: a clinical study. *Journal of Advanced Medical and Dental Sciences Research, 4*(6), 103.

Mah, C. D., Mah, K. E., Kezirian, E. J., et al. (2011). The effects of sleep extension on the athletic performance of collegiate basketball players. *Sleep, 34*, 943–950.

Milewski, M. D., Skaggs, D. L., Bishop, G. A., Pace, J. L., Ibrahim, D. A., Wren, T. A., & Barzdukas, A. (2014). Chronic lack of sleep is associated with increased sports injuries in adolescent athletes. *Journal of pediatric orthopedics, 34*(2), 129–133.
<https://doi.org/10.1097/BPO.0000000000000151>

Mishra, A., Pandey, R. K., Minz, A., & Arora, V. (2017). Sleeping habits among school children and their effects on sleep patterns. *Journal of caring sciences, 6*(4), 315.

Mitru, G., Millrood, D. L., & Mateika, J. H. (2002). The impact of sleep on learning and behavior in adolescents. *Teachers College Record, 104*(4), 704-726.

Mohammadi, S. M., Enshaeifar, S., Ghavami, M., & Sanei, S. (2015). Classification of awake, REM, and NREM from EEG via singular spectrum analysis. *2015 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 4769-4772.*

Okano, K., Kaczmarzyk, J. R., Dave, N., Gabrieli, J. D., & Grossman, J. C. (2019). Sleep quality, duration, and consistency are associated with better academic performance in college students. *NPJ science of learning, 4*(1), 16.

Pilcher, J. J., Morris, D. M., Donnelly, J., & Feigl, H. B. (2015). Interactions between sleep habits and self-control. *Frontiers in Human Neuroscience, 9*, 133557.

Samuels, C. (2008). Sleep, recovery, and performance: The new frontier in high-performance athletics. *Neurologic Clinics, 26*(1), 169-180.

von Rosen, P., Frohm, A., Kottorp, A., Fridén, C., & Heijne, A. (2017). Multiple factors explain injury risk in adolescent elite athletes: Applying a biopsychosocial perspective. *Scandinavian Journal of Medicine & Science in Sports, 27*, 2059–2069. <https://doi.org/10.1111/sms.12855>

Watson, A. M. (2017). Sleep and athletic performance. *Current sports medicine reports, 16*(6), 413-418.

Wells, M. E., & Vaughn, B. V. (2012). Poor sleep challenges the health of a nation. *The Neurodiagnostic Journal, 52*(3), 233-249.



Wheaton, A. G., Chapman, D. P., & Croft, J. B. (2016). School start times, sleep, behavioral, health, and academic outcomes: A review of the literature. *Journal of School Health, 86*(5), 363-381.