



## Importance of Circadian Clocks:

How the Circadian Clock affects a student's sleep schedule

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## Abstract

This report provides an overview of the effects of sleep deprivation on college students. The purpose is to gain new information, which would inform the students at the University of California, Merced about the importance of routinely obtaining the recommended 7-8 hours of sleep.

## Introduction

While sleep is central to sustaining life and normal human function, not every individual can adhere to a consistent sleep schedule. Undergraduate students have commitments that exceed their physical capacities, leaving sleep to be neglected. From the grueling demands of regularly assigned homework coupled with major projects assigned from a full schedule of classes, sleep and college life often seem mutually exclusive. All-night study sessions, stress, socializing and the freedom to choose when to sleep; all work together to disrupt sleep in college.

Sleep is essential to the body and its functions, and promotes bodily rest and rejuvenation in the neurons and other cells that are replaced or repaired during times of sleep. Sleep has also been proposed to conserve energy, and control the circadian clock, which generates a 24-hour biochemical rhythm. The circadian clock, a biochemical electric device that cycles with solar time, is the central mechanism that drives sleep pathways. The clock is used to observe the sleep schedule and academic schedule of college students. When these sleep and wake cycles exhibit an imbalance, it can lead to detrimental effects on students' learning processes and memory consolidations. The imbalance is caused due to the college student receiving less than 8 hours of sleep.

Ultimately, since sleep is so essential to the human body, scientists recommend approximately eight hours of sleep a night to promote efficient performance and thinking. Unfortunately, within this fast-paced society, few people receive the sleep that the body needs, and ultimately sleep deprivation affects a significant portion of the population. Lack of adequate sleep not only reduces productivity at work, but personal well-being and safety. It is important in this respect to understand the effects of sleep deprivation on the body.

By conducting further research, the University will then have a clearer assessment of their student populations' struggle with sleep. The data collected from the questionnaire will allow the University to interpret students' sleep patterns. The University will be able to create programs that will help aid students with managing their circadian clock and teach them about the negative effects of sleep deprivation. It would be expected that a college student who obtains between seven to eight hours of sleep each night will achieve a higher score on the tests administered than those who receive six or less, or nine or more hours of sleep per night.

## Literature Review

### **Circadian Clock**

The circadian clock is the central mechanism that drives sleep pathways, and are “found in most species and allow the organism to anticipate reoccurring daily variations in environmental conditions” (Bollinger A. & Thomas, 2010). The clock is used to generate a 24 hour biochemical rhythm that has a profound influence on the sleep and wake cycles that college students experience during their academic years. It is essential to understand why a student's clock is out of balance and this could only be understood with a closer analysis of their circadian clock. The student's circadian clocks can be scrutinized via their sleep and their academic schedule. When these sleep and wake cycles exhibit an imbalance, it can lead to detrimental effects on student's learning processes and memory consolidations.

### **Causes of sleep deprivation**

Just like other problems that humanity faces, there is no single cause for sleep deprivation. If a person suffers from a sleep disorder, it is very likely that the individual will become sleep deprived, the issue is determining which disorder the person suffers from so that help can be sought after to assist in receiving enough sleep. This is a common sleep problem among college students with sleep deprivation in result to daytime sleepiness or EDS. Both biological and social factors contribute to deprivation. Many college students are

still dealing with adolescent physiology such as a biologically driven delayed sleep phase. In addition, sleep may be voluntarily sacrificed due to social factors or involuntarily situations because of living in a noisy residence hall or apartment (Gaultney J, 2010).

Along with officially diagnosable sleep disorders, it has been observed through empirical studies, such as Hershner and Chervin's, that colleges and public schools that set students' schedules are partially responsible for students becoming afflicted with sleep deprivation. The article examines the common occurrence of sleepiness and sleep deprivation among college students. It also considers the contributing factors for sleep deprivation, and how lack of sleep can impact one's learning and memory. With class times being set early in the morning and late in the evening as well as work-loads being increased outside of the classroom, individuals' circadian rhythms can become unbalanced, causing them to have an inadequate sleep cycle (Hershner, & Chervin, 2014).

### **Effects of sleep deprivation**

The effects of poor sleep behaviors are overwhelmingly negative. Research has shown that inconsistent sleep patterns, lack of efficient sleep, late bed times, and other sleep schedule problems negatively affect the quality of life (Lund, H. & B. Redier, 2010). In 2006, the National Sleep Foundation had proven that the majority of college students show negative

consequences from sleep deficiencies in their academic performance, such as being drowsy at school, falling asleep in class, and not being prepared and alert for school. The study found that 68% of students reported being so stressed that they had difficulty falling asleep at night. Thus, more than 60% of the students with irregular sleep patterns resort to drugs or alcohol to help them sleep (Lund, H. & B. Redier). Students that reported themselves as poor-quality sleepers typically identified themselves as having significantly more problems with physical and psychological health than those who did not identify as poor-quality sleepers (Lund, H. & B. Redier). It also turns out that these students claimed emotional and academic stress were the main sources of their altered sleeping habits.

### **Effect on memory, problem solving, and critical thinking**

An individual's physical and mental health and abilities have been shown to have direct correlation with sleep deprivation. Research has shown that people who suffer from sleep deprivation are more likely to have issues with their cognitive abilities, such as memory and problem-solving skills when the individual also suffers from hypertension, but the relationship does not end there. Professors and university officials should play an active role in educating college students on the effects of sleep deprivation and provide support for improving sleep quality (Jensen, & Dallas R., 2003).

By failing to obtain an adequate amount of sleep each night, there is an increased possibility of there being one or more adverse effects on the individual's

cognitive capabilities. Sleep loss has been shown to be inversely proportional to academic performance. An increasing amount of scientific data explains that sleep deprivation has detrimental effects on immune function. Conversely, immune response feedback on sleep phase has a detrimental effect on the student's architecture. Bollinger A. and Thomas had found a few studies that addressed the impact of short-term sleep deprivation on different immune parameters due to consequences of disrupted endocrine and physiological circadian rhythms. Little is known about the mechanisms underlying the circadian regulation of immunity, but recent studies have suggested that local as well as central circadian clocks drive the rhythms of immune function (Bollinger A. & Thomas).

### **Overcoming sleep deprivation**

There are multiple ways in which individuals can work to overcome their sleep deprivation and return to functioning at an appropriate efficiency. For example, The Institute of Medicine Committee on Sleep Medicine and Research concludes that clinical activates and scientific opportunities in the field are expanding, awareness among the public and healthcare professionals is low. However, given the finding the few people are aware of treatment opportunities for these disorders, they go widely untreated. A sleep evaluation is essential in finding and treating sleep disorders, and thus decreasing the prevalence of related facts such as heart attack, stroke, and obesity (Colten, & Harvery R. et al, 2006)

## **Proposal**

The aim of this research project is to gather information on the behaviors and opinions of college students concerning their sleep patterns and the effects of those sleep patterns on their academic performance. It is crucial to be aware of one's circadian rhythm, since it can improve a person's productivity and even their quality of life. A way to perform this study is through the conducting of a questionnaire distributed to the University of California, Merced students. These questionnaires will be given to the students at the beginning of every school year, using a variety of questionnaires that are formatted in multiple choice, likert scales, semantic differentials, and rankings. These questionnaires will be assigned to students with similar course loads to ensure that there are no confounding outliers. The data will be analyzed by gender, major and age. The data collected will allow the University to interpret students' sleep patterns, which enables them to create programs that inform students about their sleep patterns. These programs will provide students with insight on how to manage their daily and academic schedule based on their circadian clock.

The questionnaires can be used to give the students the concise information necessary to determine their circadian rhythm. College students have a circadian rhythm that operates in 24 hours, students are in a need of a circadian clock that enables them to be less sleep deprived. It can benefit the University and students because it compares first year students and seniors. This will enable the campus to come up with a better solution to cure sleep deprivation. Since individual students have different

circadian rhythms, the observed effects of sleep deprivation will be different.

It is expected to find that results will show a correlation between the numbers of hours of sleep the subjects obtained the night prior to experimentation and how well they performed on the questionnaire. Results should show the individuals who receive fewer hours of sleep, and are therefore more sleep deprived, would have less success on the tests than individuals who are well rested. It is possible, however, due to individual ability in certain aspects of the exam, that some subjects will do inherently better than others which could skew the correlation. It is also possible that the data could be skewed due to the other limitations, which may arise, whether be from the large confidence interval or confounds that arise during administration of the assessment. This methodology will provide insight to college students about the effects their sleep schedule may have on their memory, problem solving, and crucial thinking skills; which would, as a result, influence their grades. The collected data will assist college students with the necessary information for them to alter their daily schedule to ensure they routinely receive enough sleep-in order to function at peak efficiency each day.

### **Benefits**

The collected data will give the students the concise information needed to determine their circadian rhythm, as well as give the University comprehensive information to develop programs. These programs will help aid students with

managing their circadian clock and teach them about the negative effects of sleep deprivation. Research is being conducted on the causes and effects of sleep deprivation among college students. This is done to educate the community of the true importance of getting enough sleep. Questionnaires containing the college data about sleep deprivation will help the University clarify the causes of deprivation and how it affects the way we think and react.

The University of California, Merced will be able to implement programs such as workshops that assist students with time management, stress relief, and personal development. The workshops implemented by the University will include the benefits of creating supplementary courses for freshman on time management. The students will form a better understanding and practice on time management to improve their sleeping patterns, and participate in workshops that aid in stress relief. Seniors will be required to participate in surveys that will be collected for data analysis to improve their approach on tackling the causes of sleep deprivation. Based on the data received from the senior class the surveys will help give an overview of a student's personal development.

## **Methods and Approach**

The questionnaires will assist the University of California in forming concise information about the cause and effect of sleep deprivation among college freshman and seniors. The students at the university will be given questionnaires at the beginning of every school year. These questionnaires will be formatted as multiple choice, Likert

scales, semantic differentials, and rankings.

The questionnaires will address three major key components: what time do you sleep, how much caffeine do you consume, and how many times do you nap a day. The data collected will be obtained through the completion of three assessments, being completed by students with similar course loads to ensure the data will not experience outliers. The goal of this assessment is to gain a better understanding of the correlation between an individual's amount of sleep and their memory. Another key component of this assessment is to better understand the student problem solving plus critical thinking skills.

All participants partaking in this research experiment will remain anonymous throughout the testing procedures and will not be required to state any personal information other than providing their age and gender for documentation. Each individual will be monitored to ensure proper effort is being put forth during the completion of the assessment, which will aid in the accrual of accurate results. (Figure 1).

Results will be calculated based on the ability to answer questions accurately and compare scores to the number of hours of sleep in an attempt to determine a correlation between sleep deprivation and their memory. By limiting the amount of time allotted for individuals to complete the questionnaires forces them to feel rushed and causing them to make careless mistakes also they do put in the appropriate amount of effort. Another error can occur when participants provide false information about themselves such as age, the number of hours they sleep per night. The false information they provide affect the results and play a huge role in having accurate data.



## Conclusion

Without sleep humans are prone to having detrimental side effects that can cause serious damage to the mind and body.

Sleeping regularly helps the mind relax and grow while healing the body. When the mind and body are able to function properly the student is able to perform efficiently in the questionnaire. As a person becomes more sleep deprived, their attention span shortens and their working memory begins to deteriorate. If a student does not get enough sleep they perform horribly which leads to a decline in their skills and learning ability. Majority of college students do not realize the effects of sleep deprivation has on them.

Students receive minimal sleep, but with midterms and finals the pressure is higher which forces students to receive little to no sleep. This common behavioral pattern has turned into a tradition throughout the years. This tradition has shown an endless cycle of students sacrificing their sleep-in order to continue their work and studying in

an attempt to finish their work on time in order to receive a good grade. Past studies have shown that students are setting themselves up for failure and are not achieving the highest grade possible.

Many researchers have taken the time to focus on the different aspects of the sleep deprivation and how it can affect each person. Though this particular research project is lacking a few key aspects there is still a wide range of research on the subject, and even more will be conducted in the future to help the University of California, Merced to fully understand why sleep is so important and help lead to a healthier future.

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