7-2019

The Effects of Sleep Deprivation Among College Students

CeCe Madison

THE EFFECTS OF SLEEP DEPRIVATION AMONG COLLEGE STUDENTS

By
CeCe Madison

A Senior Paper Submitted to the
Department of Health, Leisure, and Sport Sciences
Oral Roberts University
In Partial Fulfilment of the Requirements for the Degree
Of Bachelor of Science

Tulsa, Oklahoma
July 2019

This Senior Paper is approved as a credible and independent investigation by a candidate for the degree, Bachelor of Science, and is acceptable as meeting the research requirements for this degree.

Senior Paper Advisor **Date**

Chairman of Health,
Leisure and Sports
Sciences Department **Date**

Defense Committee Member **Date**

Abstract

Madison, CeCe R Consequences of sleep deprivation among college students. Oral Roberts University, 2019.

The purpose of this study was to examine the possible consequences of sleep deprivation among college students.

Literature from thirty-two professional journal articles, and twelve professional websites were reviewed. The resulting information was organized into categories as described in the purpose of the study.

Currently, college students only receive 6-6.9 hours of sleep on average per night (University Health Center, 2019). Seven or more hours of sleep a night has been recommended by the American Academy of Sleep Medicine and Sleep Research Society to avoid the health risks shown to be associated with chronic inadequate sleep (AASM, 2017). Lack of sleep showed an increased risk of experiencing mental health symptoms by more than 20% on average (AASM, 2019). Without enough sleep, executive function, academics, work, and daily life is impaired (National Sleep Foundation, 2019). Sleep also plays a vital role in the recovery process in student-athletes as exercise depletes energy, fluids, and breaks down muscle (National Sleep Foundation, 2019). Chen found students who suffered sleeplessness during their senior year were 40% less likely to graduate, and those sleep deprived their freshman and senior year were 25% less likely to graduate (Chen, 2019). Similarly, Heijden found greater chronic sleep reduction and worse sleep quality were significant in the association with worse academic achievement and study concentration (Heijden, 2017). Another study found that sleeping patterns that slept twice every 24 hours, rather than sleeping once throughout the night or taking multiple naps throughout the day, showed an increased pass percentage (87%) during midterms (Saeed, 2015). Slutsky found that sleep deprivation negatively affected simple tasks and decreased brain activity

(Slutsky, 2017). In another study, athletes were found to be poor sleepers with mean PSQI scores of 5.38 ± 2.45, which affected their daily routines and activities (Mah, 2018). Schwartz found an increase in tennis serving accuracy after a week of sleep extension (41.8%) vs. during a week of sleep deprivation (35.7%) (Schwartz, 2015). A review found collegiate basketball players following sleep extension, had an increase in scoring during free-throw shots (9%) and 3-point field goals (9.2%). However, one night of sleep deprivation did not significantly affect collegiate weightlifters lifting performance (Watson, 2017). A study found poor sleep was significantly associated with increased suicide risks (Becker, 2018). Another study found global sleep quality (39% in externalizing problems), nighttime sleep disruptions (45% in somatic problems), and sleep latency (37% in anxiety problems) all had significant effects on mental health greatly related to symptoms of psychological distress (Milojevich, 2016). Similarly, Becker found anxiety (significance of 46%), depression (significance of 64%), and ADHD uniquely associated with poor sleep status (Becker, 2018). Zhang found that poor sleep quality was closely associated with depressive symptoms, and that coping styles were able to reduce the strength of this association (Zhang, 2018).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FIGURES PAGE

Chapter 1

Introduction

Sleep plays a vital role in an individual's health and well-being. Enough quality sleep has shown to protect one's mental health, physical health, quality of life, and safety (NHLBI, 2019). The lack of sleep can affect mood, memory, and health in many ways. Sleep deprivation has shown a 3x increased risk for Type 2 Diabetes, a 48% increase in developing heart disease, a less active immune system, and has the ability to age the brain from 3-5 years (John Hopkins Medicine, 2019). The CDC has reported more than a third of American adults do not get enough sleep regularly (CDC, 2016). Seven or more hours of sleep a night has been recommended by the American Academy of Sleep Medicine and Sleep Research Society to avoid the health risks shown to be associated with chronic inadequate sleep. However, the benefits of healthy sleep are not shown solely from adequate sleep duration, but also appropriate timing, regularity, good sleep quality, and the absence of sleep disorders (AASM, 2017).

There has been a suggested dose-response relationship between the lack of sleep and mental health symptoms in college students (AASM, 2019). Every additional night of insufficient sleep showed an increased risk of experiencing mental health symptoms by more than 20% on average. Specifically, an increased risk of 21% for depressive symptoms, 24% for hopelessness, 24% for anger, 25% for anxiety, 25% for the desire to self-harm, and 28% of an increase was in thoughts of suicide (AASM, 2019).

Fifty percent of college students compared to 36% of adolescents and adults have reported daytime sleepiness, and 60% of students reported at least three days a week of feeling tired, or sleepy. Most college students are sleep deprived and get 6-6.9 hours of sleep on average (University Health Center, 2019). Seventy-one percent of students reported less than 8 hours of sleep (Hershner, 2014). Fitbit showed that the average user was in bed for 7 hours and 33 minutes, yet with restlessness or being awake accounted for, that same Fitbit user was shown to receive only 6 hours and 38 minutes of sleep each night (Kosecki, 2017). Though different people's bodies require different amounts of sleep to feel rested, most adults require somewhere between 6-10 hours (University Health Center, 2019).

Many people, including student-athletes, do not get the necessary amount of sleep their bodies need due to balancing time given to sports and academics or a sleep disorder. A survey done by the American College Health Association found that most student-athletes reported having four nights a week of insufficient sleep. To confirm sleep loss in athletes, an NCAA study showed one-third of student-athletes got less than 7 hours of sleep each night (Grandner, 2018). Exercise depletes energy, fluids, and breaks down muscle, and sleep plays a role in the recovery process. Research indicated that less sleep increased the possibility of fatigue, low energy, and poor focus during athletic performance (National Sleep Foundation, 2019). Good sleep habits help a person to think, remember information, and make decisions. Without enough sleep, executive function is impaired, and academics, work, and daily life suffer the consequences (National Sleep Foundation, 2019). Studies showed that sleep loss led to learning and memory impairment, as well as a decrease in attention and vigilance. Sleeping 6 or fewer hours a night for two weeks left students feeling as poorly as an individual who had not slept in 48 hours (AASM, 2017).

Statement of the Problem

The purpose of this study was to examine the consequences of sleep deprivation among college students.

Significance of the study

More than one-third of Americans do not get enough sleep (CDC, 2016). It is crucial to be aware of the benefits sleep has on mental health, physical health and quality of life (NHLBI, 2019). Sleep deprivation can lead to impaired executive function, academics, work, and daily life (National Sleep Foundation, 2019). Sleep loss increased the risk of mental health issues; with every additional night of insufficient sleep there was a 20% increased risk of experiencing mental health symptoms (AASM, 2019). Student-athletes were also found to be sleep deprived, which affected their performance (Grandner, 2018).

Hypothesis

It was hypothesized that sleep deprivation among college students would negatively affect their cognitive and athletic performances, as well as their mental well-being.

Limitations and Delimitations

The information and materials gathered for this study were acquired from various databases available to Oral Roberts University. This study was limited in that it had to be completed within the course's allotted time frame. This study relied on other professional studies and focused on the association between sleep deprivation and an overall healthy lifestyle.

Definitions of Terms

Adult Self Report Form (ASR): The ASR asks participants to report on their general behaviors and substance use over the past six months (Milojevich, 2016).

Biphasic Sleeping Pattern: An individual who sleeps twice every 24 hours (Saeed, 2015).
Center for Epidemiologic Studies Depression (CESD-10) scale: The CESD-10 is a questionnaire used to measure depressive symptoms in the general population (Wallace, 2017).

Chronic Sleep Deprivation: Individuals who obtain less than 7 hours of sleep on average during most days of the week (Norbury, 2019).

Chronic Sleep Reduction Questionnaire (CSRQ): The CSRQ is a questionnaire that measures symptoms of chronic sleep reduction, such as shortness of sleep, loss of energy, sleepiness, and irritation during the previous two weeks (Heijden, 2018).

Cognitive Emotion Regulation Questionnaire (CERQ): Measures an individual's coping strategies after a negative event (Amaral, 2018).

Cognitive Performance: The way a person learns and performs (Patrick, 2017).

Cohen's Perceived Stress Scale: Assesses the current level of stress the participant is experiencing (Wallace, 2017).

Depression Anxiety Stress Scales-21 (DASS-21): A 7-item questionnaire asking about depressive symptoms within the past week (Becker, 2018).

Difficulties in Emotion Regulation Scale (DERS): The DERS is a 36-item, questionnaire that assesses difficulties in emotion regulation across nonacceptance of emotional experiences, difficulty engaging in goal-directed behavior, limited access to strategies for emotion regulation, lack of emotional clarity, lack of awareness of emotions, and impulse control difficulties (Pickett, 2016).

Disengaged-Coping: An attempt to distance oneself both physically and emotionally from a stressor (Zhang, 2018).

Distressing Events Questionnaire (DEQ): The DEQ is a 17-item questionnaire that assesses Post Traumatic Stress Syndrome within the past 30 days (Pickett, 2016).

Emotional-Coping: An individual able to reduce the negative emotional response towards stress, in order to better manage the stressor (Zhang, 2018).

Engaged-Coping: When an individual directly tries to take charge and manage a stressor (Zhang, 2018).

Epworth Sleepiness Scale (ESS): An 8-item questionnaire that assesses current sleepiness by asking participants to indicate the odds of dozing off in particular situations, including those in which most people would be expected to fall asleep (lying down to rest) (Milojevich, 2016).

Executive Functioning Problems: When an individual has difficulty maintaining focus and attention (Rosen, 2016).

Externalizing Problems: Not being able to maintain focus, breaking the rules, or having physical aggression (Milojevich, 2016).

Global Sleep Quality: How a participant would describe their sleep, such as a good or poor night's sleep (Milojevich, 2016).

Globally Perceived Stress: How an individual handles and views a stressor (Amaral, 2018).

Goal-Directed Learning: When an individual is taught or the process of learning something new, based on a goal that has been set (Jei Chen, 2017).

Insomnia: A sleeping disorder where one has difficulty falling asleep, staying asleep, and waking up too early (Nardoff, 2014).

Internalizing Problems: When an individual is having emotional issues such as depression or anxiety (Milojevich, 2016).

Monophasic Sleeping Pattern: An individual who sleeps once for more than 6 hours every 24 hours (Saeed, 2015).

Munich Chronotype Questionnaire: A questionnaire that measures the participants sleep duration (Norbury, 2019).

Pittsburgh Sleep Quality Index (PSQI): A 19-item questionnaire that measures an individual's sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of medication and daytime dysfunction. The PSQI measures poor sleep quality with a score >5, and a score <5 indicates good sleep quality (Kloss, 2016).

Polyphasic Sleeping Pattern: An individual who takes multiple naps per day (Saeed, 2015).

Problem-Coping: When an individual reduces a stressor by coming up with a solution/problem-solving (Zhang, 2018).

Profile of Mood States (PoMS): A questionnaire that assesses individual's negative thinking, such as worry or rumination (Amaral, 2018).

Psychomotor Vigilance Task (PVT): A timed reaction test that measures mental alertness and reaction time (Chen, 2017).

Sleep Beliefs Scale (SBS): The SBS is a questionnaire that looks at the participants' knowledge on the influence of specific factors on sleep, such as consumption behaviors (alcohol, caffeine, nicotine, sleep medication), diurnal behaviors (physical exercise and naps), and activities and thoughts prior to sleep (eating, studying, relaxing, worries) (Heijden, 2018).

Sleep Deprivation: An individual who does not get the recommended 7 hours of sleep (Schwartz, 2015).

Sleep Extension: When an individual gets more than the recommended 7 hours of sleep (Schwartz, 2015).

Sleep Hygiene Awareness and Practice Scale: A self-report questionnaire that assesses individual's knowledge and practice of sleep hygiene. It also assesses the knowledge participants do or do not have regarding different behaviors that affect sleep, such as caffeine or naps (Kloss, 2016).

Sleep Hygiene: An individual's knowledge about healthy sleep practices, such as the effects of caffeine, alcohol, exercise, napping, etc., on sleep (Kloss, 2016).

Sleep Onset Latency: Length of time that it takes to fall asleep after going to bed (Kloss, 2016).

Somatic Problems: A physical symptom, such as pain/fatigue that causes problems when functioning and causes emotional distress (Milojevich, 2016).

Spielberger Trait Anxiety Index (STAI): A 20-item questionnaire that measures individual's anxiety proneness (Norbury, 2019).

Stanford Sleepiness Scale (SSS): The SSS is a questionnaire that records the number of hours slept each night, and rated feelings of tiredness (Famodu, 2017).

Subjective Sleep Quality: How participants viewed their own sleep (Norbury, 2019).

Subjective Well-Being: A measure of how one views him/herself in terms of relationships, achieved goals, and how he/she views self (Peach, 2016).

The Barkley Adult ADHD Rating Scale-IV: An 18-item questionnaire that assesses participants current ADHD symptoms, with each item representing a behavior and asking how often the participant felt that way within the past six months (Becker, 2018).

The Suicidal Behaviors Questionnaire–Revised (SBQ-R): The SBQ-R is a 4-item questionnaire that assesses aspects of suicidal behavior, such as lifetime ideation/attempt, frequency of ideation within the past 12 months, talking about ideation with someone, and the likelihood of a future suicide attempt (Becker, 2018).

Traumatic Life Events Questionnaire (TLEQ): A list of 22 potentially traumatic events (physical and sexual assault, military combat, motor vehicle accident) presented, where participants select how often that event happens (Pickett, 2016).

Ventromedial Prefrontal Cortex (vmPFC): The vmPFC is involved in many cognitive processes, such as decision making, emotional regulation, and learning and memory (Chen, 2017).

Wingate Anaerobic Test: Commonly performed on a cycle ergometer and is primarily used to measure an individual's anaerobic capacity and anaerobic power outputs (Famodu, 2017).

Wrist Actigraphy: A small device that is wrapped around participants' wrists in order to monitor sleep patterns (Jei Chen, 2017).

Chapter 2

Introduction

Chapter two is a summary of the effects of sleep deprivation among college students. The summary is organized into the following subdivisions: 1.) Prevalence, Causes, and Awareness of Sleep Deprivation, 2.) Consequences of Cognitive Performance Following Sleep Deprivation, 3.) The Effects of Sleep Deprivation on Athletic and Physical Performance, and 4.) Mental Health Effects of Sleep Deprivation.

Prevalence, Causes, and Awareness of Sleep Deprivation

Prevalence

Barone studied 19 participants enrolled as full-time undergraduates and worked at least ten hours a week. His study focused on how working college students both experienced and thought about sleep through open-ended interviews. With each of the participants keeping up with a sleep diary the week previous to their interviews, the authors were able to explore how the participants viewed and prioritized sleep. The average amount of self-reported sleep before the interview was seven hours and twenty-eight minutes, with 20% of participants who reported at least one night out of four weekdays sleeping ≤ 6 hours, 89% reported sleeping ≤ 7 hours on at least one of four weekdays, and 47% reported a short sleep night three or four times during the weekdays. Though the study did not show consistently poor sleep habits, this study was done towards the beginning of the semester. The participants admitted that as the semester continued, class loads became heavier, which was when sleep tended to be lost. In conclusion, the authors found that due to the small sample size, statistical tests to examine relationships between hours worked and hours slept were not possible. The authors found that if the study's goal was to understand working university students and their sleep, data should be collected throughout the entire semester, as sleep loss rises and falls depending on students' course calendar (Barone, 2017).

Causes

Ranasinghe studied 100 college students to highlight the prevalence and contributing factors of sleep deprivation. A survey conducted for each participant assessed routine time to sleep at night, factors that played a role in a sleepless night, and whether or not sleep deprivation led to dozing off during the day.

Figure 1. Routine time to sleep at night (Ranasinghe, 2018)

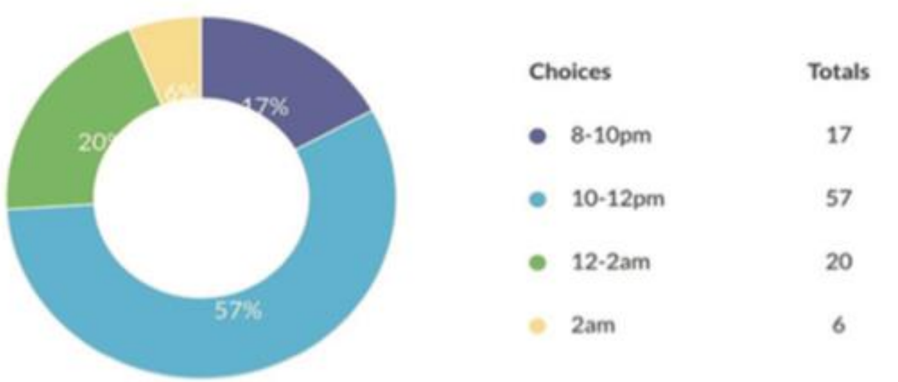
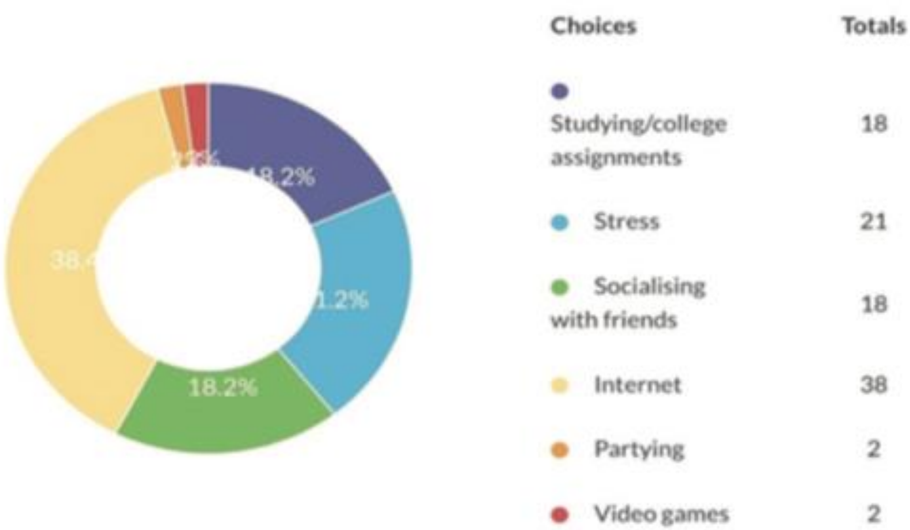


Figure 2. Indicate which of the following cause you to lose sleep? (Ranasinghe, 2018)



The results shown in Figure 1 represents the participants' routine time to go to bed at night, whereas Figure 2 shows what caused college participants to sacrifice sleep. The first major cause of sleep deprivation was shown in 38% of participants who gave up their sleep for the internet. Another major cause was due to stress shown in 21% of participants in an attempt to balance studies and social life.

Figure 3. What activities have you hooked to cause you to sacrifice your sleep? (Ranasinghe, 2018)

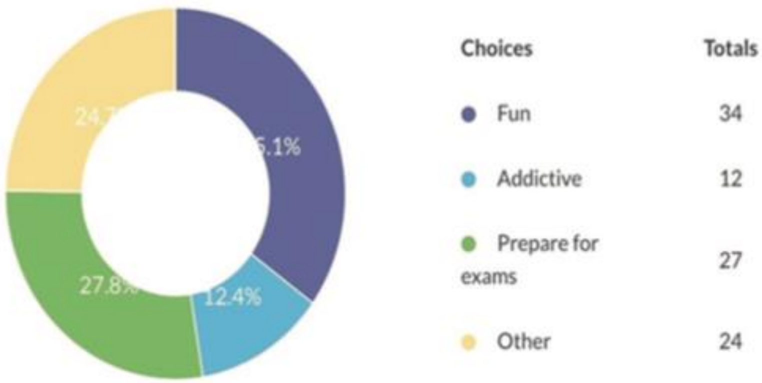
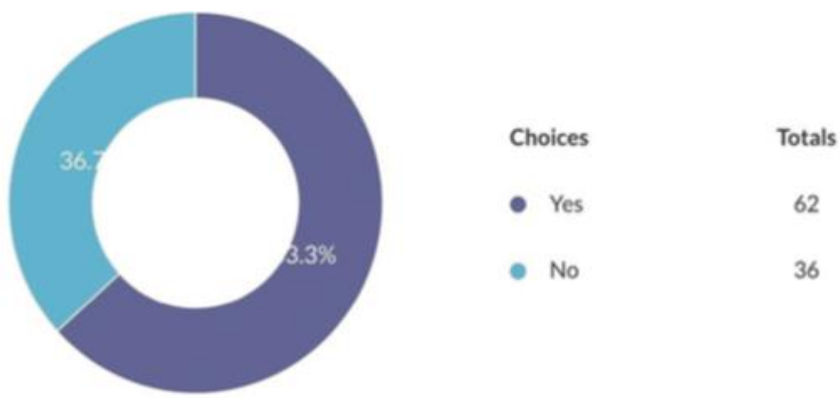


Figure 4. Do you doze during the day following sleep deprivation? (Ranasinghe, 2018)



Continuing to conclude the study's results, Figure 3 shows 27% of participants stayed up late to prepare for examinations, another major cause of sleep deprivation; 34% of participants chose fun over sleep, and 63% percent of those sleep-deprived reported dozing off during the day following a sleepless night. In conclusion, this study acknowledged how common inadequate sleep hygiene within the participants was, as students often sacrificed sleep for technology, their social environment, and/or academic purposes (Ranasinghe, 2018).

Lichuan Ye studied 440 undergraduate students to examine napping habits college students had and the relationship of these variables with nighttime sleep. Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI), and participants were asked questions regarding nap frequency, how long the nap would last, and the time participants took naps. A correlation analysis was performed to determine the relationship between individuals napping habits and sleep quality. A PSQI score higher than 5 reported poor sleep quality and was the score in 58.7% of participants. Higher PSQI scores were correlated with shorter sleep duration at night and an increased difference in sleep hours between school days and weekends. Participants who reported napping at least three times per week the month before the survey showed the highest PSQI scores, indicating the poorest sleep quality (7 ± 2.5), which was 1.2 points higher than students who reported no napping (5.8 ± 3.3; $p = .052$). Frequent napping described 77.6% of the participants. Sixty-three percent of participants reported missing or being late for school due to oversleeping, and 25.4% of frequent nappers were found to be the least likely to feel satisfied with the amount of sleep they got on nights before class. The study found that 23% of participants napped between 12 and 3 pm and 67% between 3 and 6 pm. Compared to students who napped at other times during the day, those who napped between 6 and 9 pm reported fewer hours of sleep (5.7 ± 1.2 hours) on school nights and also showed more of a tendency to be late or miss class due to oversleeping. In conclusion, this study found that the participants showed a higher risk of poor nighttime sleep quality and sleep deprivation after long, frequent, and late night naps (Lichuan Ye, 2015).

Rosen studied more than 734 college students sleep problems related to technology. Participants filled out questionnaires to assess daily smartphone use and anxiety without technology, and how dependent participants felt towards technology. The study found 50% of participants kept their phone near them when they slept, 49% checked it once a night, and 32% checked it at least twice a night. The average amount of sleep the students showed was 6.68 hours, with 33.5% getting less than 7 hours a night, and 32% getting exactly 7 hours of sleep a night.

Figure 5. Proposed path model for sleep problems in college students (Rosen, 2016)

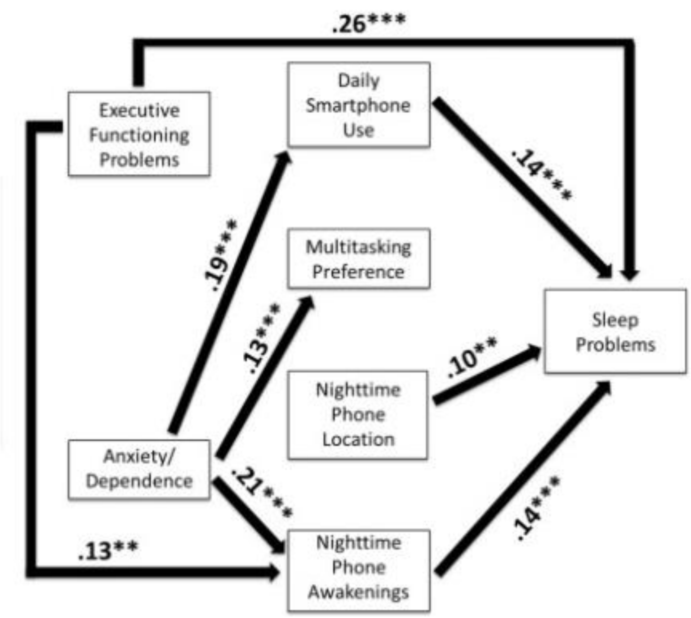


Figure 5 shows executive functioning problems (maintaining focus and attention) predicted more nighttime phone awakenings with a significance of 13%, which led to sleep problems (significance of 14%). Figure 5 also shows the direct relationship, with a significance of 26%, between executive functioning problems and sleep problems. With a significance of 19%, students that were more anxious about and dependent on technology predicted more daily smartphone use, which then predicted sleep problems. Anxiety/dependence also predicted nighttime phone awakenings with a significance of 21%, which also led to sleep problems. In conclusion, this study found participants with executive functioning problems and were anxious about and dependent on technology, had a compromised state of sleep (Rosen, 2016).

Awareness

Kloss conducted a “Sleep 101” program aimed to educate 120 undergraduate students about healthy sleep practices, helpful thoughts about sleep, and ways to improve sleep. A series of questionnaires (Dysfunctional Beliefs about Sleep (DBAS-SF), Pittsburgh Sleep Quality Index, Sleep Hygiene Awareness and Practice Scale, etc.) were used to grasp an individual's sleep quality and quantity and were taken by each participant. For the study, participants were given sleep logs to complete over the two week study period and were divided randomly into a sleep education (SE) and sleep monitoring (SM) group. At the end of the two week baseline period, participants in the SE condition returned for two, 90-minute Sleep 101 workshops, where participants were given a presentation on the benefits of sleep, daytime consequences of poor sleep, and tips for good hygiene sleep practices. During this time, participants in the SM condition continued to monitor their sleep onset latency regularly. After the two week period passed, participants were asked to follow up with the same questionnaires initially taken. The results showed significant improvements in SE DBAS-SF scores. With higher scores indicating more dysfunctional beliefs and attitudes, the SE group showed a mean score of 42.24, SD = 17.95, whereas the SM group showed a mean score of 53.63, SD = 14.87. Participants in the SE group also showed to have significantly better sleep hygiene knowledge scores. With lower scores indicating better sleep hygiene, the SE group showed a mean score of 16.66, SD = 3.33, whereas the SM group showed a mean score of 19.98, SD = 3.97. Lastly, participants in the SE group displayed a significant decrease in sleep onset latency compared to the SM group. In conclusion, this study found that a brief sleep intervention benefitted the SE group, in comparison to those who were simply monitored. This research suggested the importance of interventions aimed at teaching sleep hygiene and quality (Kloss, 2016).

Consequences of Cognitive Performance Following Sleep Deprivation

Chen studied 7,419 college students by collecting data from the participants' freshman year until their senior year, to examine the relationship between sleep deprivation and GPA and college graduation. Only data from the participants' spring freshman year and the spring of their senior year was used in this study. Chen's study used a sample of 3,549 students with GPA information from schools and a sample of 3,870 students with graduation records from schools. To better estimate how sleep deprivation impacted college students, Chen used the information obtained from school records that showed the student's end-of-semester GPA from the school. The results of this study showed the prevalence of sleep deprivation was high and was negatively associated with GPA. Students who reported chronic sleep deprivation during their senior year only, and during both freshman and senior years had a lower chance of graduating than students who reported no chronic sleep deprivation. Students who suffered sleeplessness during their senior year were 40% less likely to graduate, and those sleep deprived their freshman and senior year were 25% less likely to graduate. The findings of this study revealed that chronic sleep deprivation negatively influenced academic achievement among the studied participants (Chen, 2019).

Chen studied 3,690 college student's data from freshman until senior year, to examine the impact that sleep deprivation had on leadership and the need for cognition. Chen used data only from the spring of the participants' freshman year until the spring of their senior year. A correlation analysis used began with a random-effects model (age, gender, race/ethnicity, parent education, grant/scholarship, etc.) and a fixed-effect model (non-random quantities) to evaluate the relationship between chronic sleep deprivation and developmental outcomes. Statistics showed that over 25% of students reported chronic sleep deprivation during both freshman and senior year. About 15% of students reported being deprived of sleep solely during their freshman year, with another 15% reporting chronic sleep deprivation in their senior year only. Results based on the random-effects model showed that chronic sleep deprivation was associated with decreased leadership skills ($\beta = -.09$, $p < .001$) and need for cognition ($\beta = .08$, $p < .001$). The random effects model showed similar results for leadership skills ($\beta = -.09$, $p < .01$) and need for cognition ($\beta = -.06$, $p < .01$). These results supported the authors' hypothesis stating that chronic sleep deprivation was a predictor of the participants' developmental outcomes (Chen, 2019).

Jei Chen studied 94 healthy college students to evaluate the effects of sleep deprivation in goal-directed learning and habitual actions in participants. Jei Chen used two similar experiments and divided participants into an SC (sleep control) group or SD (sleep deprivation) group. To monitor sleep patterns, each participant was given a sleep diary to complete as well as a wrist actigraphy that was worn until they completed the study. In Experiment 1, the SC group was given a 9-hour sleep opportunity, monitored by wrist actigraphy and woken up the next morning to perform a 10-minute psychomotor vigilance task (PVT (timed reaction test that measures mental alertness and reaction time)). The SD group of Experiment 1 stayed awake the entire night. They were assessed for subjective sleepiness and completed the PVT to measure their alertness during the first 10 minutes of every hour from 10 pm to 6 am. The results of this study showed that subjective sleepiness significantly increased in the SD group. The SD group also presented a reduction of psychomotor vigilance, shown with a decrease in average response speed ($p < 0.001$ for both experiments) and an increase in attention lapses (failure to maintain focus (reaction time ≥ 500 ms)) ($p < 0.001$ for both experiments) in the PVT. These results showed that the experiments were successfully able to manipulate the SD group. As for goal-directed learning, the ventromedial prefrontal cortex (vmPFC) is where goal-directed learning is activated in the brain. The vmPFC showed below-baseline activation in the SD group and showed a significant difference in comparison to the SC group. Learning was concluded to be most efficient under well-rested conditions.

In conclusion, sleep-deprived participants over-relied on habitual control when sleeplessness seemed to impair the participants’ ability to learn (Jei Chen, 2017).

Patrick studied 64 college students to determine whether a night without sleep would have a negative impact on their cognitive performance. Divided into a sleep deprivation or normal night’s sleep group, those who had a normal night's sleep were asked to report how much sleep they had gotten, whereas the sleep deprived group was required to fill out a form every 45 minutes to confirm that they were still awake. The cognitive tests performed consisted of a test for working memory span, involving repeating colors and sounds randomly sequenced. Another cognitive test that was used were standard stroop charts. The stroop charts involved reading blank texts, reading words with a mismatched color, articulating the color of colored blocks, and articulating the color of mismatched words. Following the one night of sleep deprivation, or normal night's rest, no significant differences were found in either of the cognitive tests. This suggested that one night of sleep deprivation had minimal effect on a student’s cognitive capacity. The results of this study indicated that acute sleep deprivation was not detrimental to the participants cognitive abilities (Patrick, 2017).

Heijden studied 1,378 college students to investigate the relationship between chronic sleep reduction, sleep quality, and sleep hygiene knowledge with academic achievement. The academic performance was based on self-reported information regarding participants average grade as well as their last exam grade during that academic year. Students were assessed with a short test that addressed their ability to concentrate and maintain focus during academic tasks. The students also took the Chronic Sleep Reduction Questionnaire (measures sleep debt and sleep need), the Pittsburgh Sleep Quality Index (measures quality and patterns of sleep), and the Sleep Beliefs Scale (measures individual’s beliefs and attitudes about sleep), exploring the participants’ knowledge on the importance of sleep, as well as the activities done leading up to sleep. The results showed that 54% of the participants had a global PSQI score greater than 5, which was indicative of poor sleep quality. Greater chronic sleep loss and worse sleep quality were significant in the association with worse academic achievement (correlation coefficients from -.09 to -.18) and study concentration (r = -0.30 to -0.45). Unfortunately, those with better sleep hygiene knowledge only had a small positive association (r = 0.09) with the average grade from the studies current and past academic year. In conclusion, the hypothesis of this study was proven based on the results that showed chronic sleep reduction was associated with lower academic achievement and subjective study concentration within the participants studied (Heijden, 2017).

Saeed studied 347 undergraduate medical students to determine the connection between sleep patterns and academic performance through a questionnaire-based survey. The questionnaire included questions on the students sleeping patterns, how long they slept, problems with recalling, and ability to focus on studies. The academic performance was evaluated based on their performance during midterms, which were within one month of the survey. The study found that 50% of those with monophasic sleeping patterns (slept once throughout the night 6+ hours), 58.2% of those with biphasic sleeping patterns (slept twice every 24 hours) and 32% of those with polyphasic sleeping patterns (took multiple naps per day) had sufficient sleep. Of the participants, 20.4% who had monophasic sleeping patterns, 32% of biphasic sleeping patterns, and 58% of polyphasic sleeping patterns overslept.

Figure 6. Relationship of sleep patterns with academic performance (Saeed, 2015)

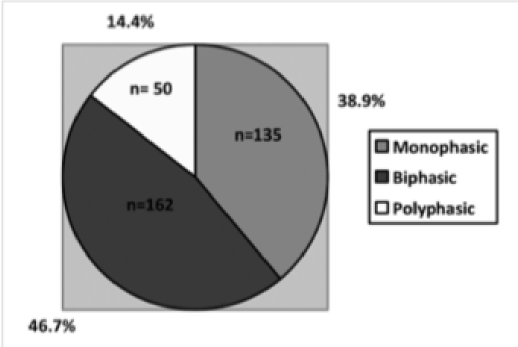


Fig-I. Frequency of sleeping patterns

Sleep Pattern	Academic Performance	
	Pass	Fail
Monophasic	67.4%	32.6%
Biphasic	87.0%	13.0%
Polyphasic	66%	34%

Table-I. Relationship of sleep patterns with academic performance.

Figure 6 shows the results of each sleeping pattern on academic performance. These results indicated most students that had a biphasic sleeping pattern had the best academic performance. Biphasic patterns showed an increased pass percentage (87%), confirming the association between sleep and academic performance. The second most common pattern and least likely to oversleep were monophasic sleepers, who were shown to also have quality sleep. The least common pattern where students overslept the most and had an increased fail percentage (34%) were polyphasic sleepers. In conclusion, this study found that biphasic participants were able to continue most effectively throughout their day with sufficient sleep, and showed the most success during midterm academic achievement, rather than the participants who followed monophasic and polyphasic sleeping patterns (Saeed, 2015).

Sarbazvatan studied 471 medical university students to examine sleep quality and its relationship to academic achievement. Students completed the Pittsburgh Sleep Quality Index (PSQI (measures individuals sleep quality and patterns)) during the first eight weeks of their first semester, and academic achievement was assessed through the student's GPA two following semesters. Based on the students score after taking the PSQI, students were categorized into a poor-sleep group (PSQI > 5) and good-sleeper group (PSQI ≤ 5). In Iran, where this study was conducted, the maximum GPA was 20, and less than 10 was in danger of failing the course (24% had GPAs ranging from 17-20, 63% ranging from 14-16.99, 13% had GPAs under 14; no GPA available for 10 students). When GPA was categorized into <12, 12-15.99 and 16 and above, the eight students who had GPAs less than 12 showed a higher score after taking the PSQI compared to other GPA categories, and showed significantly higher scores in sleep latency, sleep duration, sleep efficiency and sleep disturbance. A correlation between sleep quality and academic achievement was seen (r = -0.102, p = 0.028) as the total PSQI score increased and GPA decreased. This study found that 70% of participants suffered from poor sleep quality, with the mean global score of the PSQI 6.87 ± 2.25. In conclusion, this study reported that the participants who had poor sleep quality had worse academic achievement (Sarbazvatan, 2017).

Dickinson recruited 99 college students to take part in a study that aimed to examine whether sleep restriction impacted decision making in a choice task. The participants completed sleep diaries and wore an actigraphy device for one week and were administered a set of decision tasks at the end of that week. Broken up into “easy” and “hard” trials, the task presented the subjects with an unknown environment, where balls would be drawn with replacement from either the LEFT or RIGHT box. The subject’s job was to indicate which box the balls were drawn from. Base rates (initial information) were used to select a box without shown results, and the selected box then drew five balls with replacement. The resultant sample drawn (the new information), was shown at the bottom of the stimulus. The study found that when total available information strongly favored one decision (seen during the easy trials), subjects tended to weigh the initial information more than the new information, with a significance of p < .01. Similarly seen with the hard trials, the estimated tendency was to place relatively more decision weight on new information after a normal 6 hours of sleep. Specifically, of the voluntary SD group, there was a shift in the estimated decision weight away from the evidence and toward the base rate information. However, participants who were normally rested positively responded to the new information with a significance of $p < .01$. In conclusion, sleep restriction of <6 hours per night over a week suggested a reduced ability to fully incorporate multiple pieces of information into a decision (Dickinson, 2016).

The Effects of Sleep Deprivation on Athletic and Physical Performance

Slutsky studied 24 undergraduate and graduate college students to examine the effects of 24 hours of sleep deprivation and the effects of acute exercise on cognitive performance. The participants' activity and sleep were tracked from the night before the study until completion. Participants were tested following a normal night's rest and after 24 hours of being awake. After 24 hours of sleep deprivation, participants in the exercise condition performed low-intensity cycling, whereas those in the control condition sat quietly on the bike for 15 minutes. Following low-intensity cycling, results found performance during the Psychomotor Vigilance Task (timed reaction test measuring mental alertness and reaction time) to be negatively affected by sleep deprivation. Effects on reaction time (from $p = 0.074$ to $p = 0.000$), false alarms (reaction time < 100 ms (from $p = 0.885$ to $p = 0.016$)), and lapses (reaction time > 500 ms) significantly increased and were detrimental following sleep deprivation. As for the hypothesis expecting acute exercise to affect cognitive performance positively, there were no significant differences in any of the cognitive performance measures. In conclusion, Slutsky found that sleep deprivation negatively affected simple tasks, and decreased brain activity, which caused negative effects in the mental alertness test in the participants studied (Slutsky, 2017).

Mah studied 628 Stanford University student-athletes sleep quality, sleep duration, and daytime sleepiness across a wide range of sports. The student-athletes completed the Pittsburgh Sleep Quality Index (measures quality and patterns of an individual's sleep) questionnaire and the Epworth Sleepiness

Scale (ESS (measures an individual's daytime sleepiness)). A total of 39.1% of athletes and 58.6% of Stanford's sports teams reported an average total sleep time of <7 hours on weekdays, with 7.54 ± 1.18 hours in bed and 6.98 ± 1.02 hours of total sleep. On the weekends, athletes reported 8.4 ± 1.2 hours of total time in bed. In each age category (17-26), average sleep was reported on a weekday to be ≤7, except for 22+-year-old athletes, who indicated an average sleep of 7.4 hours each night.

Table 1. PSQI, Sleep rating on campus and while traveling, and Epworth Sleepiness Scale (Mah, 2018)

	Total	PSQI	Sleep rating	Sleep rating	Epworth
	n (%)	Mean (SD)	On campus	Traveling	Mean (SD)
			Mean (SD)	Mean (SD)	
All participants	628	5.4 (2.4)	7.1 (1.6)	7.6 (1.7)	9.5 (3.9)
Range		0-18.0	2.0-10.0	1.0-10.0	0-23.0
Sex					
Men	343 (54.6)	5.4 (2.4)	7.1 (1.6)	7.6 (1.7)	9.3 (3.9)
Women	285 (45.4)	5.3 (2.5)	7.2 (1.5)	7.5 (1.7)	9.7 (3.8)
Varsity team					
Men's baseball	36 (5.7)	5.5 (2.5)	7.0 (1.8)	8.1 (1.5)	9.1 (4.2)
Men's basketball	16 (2.5)	4.8 (1.9)	7.3 (0.7)	7.0 (1.7)	9.7 (4.3)
Women's basketball	15 (2.4)	5.9 (4.1)	7.4 (1.7)	7.3 (1.8)	8.5 (3.3)
Women's field hockey	19 (3.0)	5.6 (3.4)	7.2 (1.4)	6.6 (1.7)	9.3 (3.7)
Men's soccer	24 (3.8)	5.3 (2.1)	6.5 (1.6)	8.1 (1.6)	8.8 (3.1)
Women's soccer	26 (4.1)	4.7 (3.3)	7.8 (1.5)	8.6 (1.5)	8.3 (3.5)
Women's softball	24 (3.8)	4.9 (2.0)	7.3 (1.4)	7.1 (1.9)	9.2 (4.4)
Men's swimming & diving	13 (2.1)	6.2 (2.6)	7.5 (1.8)	7.4 (1.6)	10.7 (3.9)
Women's swimming & diving	31 (4.9)	4.5 (2.2)	7.8 (1.2)	7.3 (1.2)	10.6 (3.8)
Women's synchronized swimming	9 (1.4)	5.4 (2.0)	6.9 (1.3)	6.9 (1.1)	9.2 (3.6)
Men's tennis	8 (1.3)	3.9 (2.5)	7.9 (1.6)	8.6 (1.3)	10.4 (3.9)
Women's tennis	8 (1.3)	4.5 (2.6)	7.4 (1.3)	8.1 (0.9)	9.8 (2.5)
Men's track & field	20 (3.2)	5.4 (2.5)	7.1 (1.6)	6.9 (1.6)	9.4 (3.7)
Women's track & field	28 (4.5)	5.1 (1.9)	7.5 (1.4)	8.0 (1.8)	9.8 (3.7)
Men's volleyball	18 (2.9)	4.7 (1.7)	7.5 (1.3)	6.6 (1.5)	8.2 (4.1)
Women's volleyball	14 (2.2)	6.2 (2.4)	7.1 (1.8)	7.3 (1.2)	9.3 (2.5)
Men's water polo	20 (3.2)	4.6 (2.2)	7.3 (1.7)	8.6 (1.2)	10.2 (4.4)
Women's water polo	17 (2.7)	6.0 (1.8)	6.9 (1.1)	7.1 (1.6)	9.4 (3.9)
Men's wrestling	26 (4.1)	7.0 (3.1)	6.8 (1.8)	6.6 (2.0)	9.5 (3.0)

Table 1 shows the teams average PSQI score, the sleep ratings reported while on campus and during travels, and the average scores after taking the ESS questionnaire (scores ≥ 10 indicated high levels of daytime sleepiness). The total amount of sleep was predictive of daytime functioning, as a greater amount of sleep was associated with a lower frequency in how often athletes felt tired, had a hard time waking up for class or practice, or had trouble staying awake during daily activities. The study found that 80% of athletes napped at least once per week, and at least 11% of athletes on all teams napped before competition.

Figure 7. Stanford University athletes reported Hours of Sleep on Weekdays (Mah, 2018)

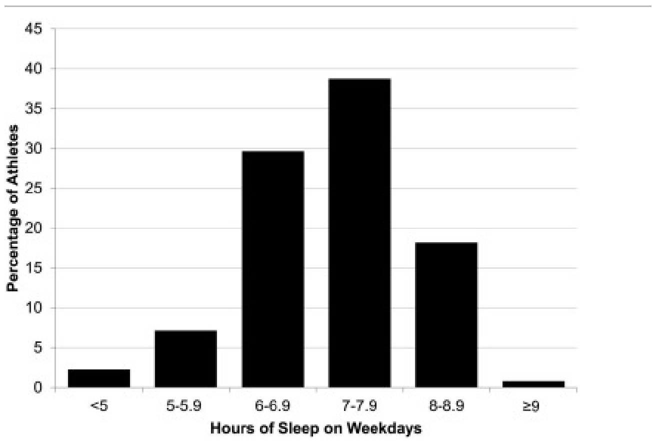


Figure 8. Hours of Weekday Sleep varying across Stanford's athletic programs (Mah, 2018)

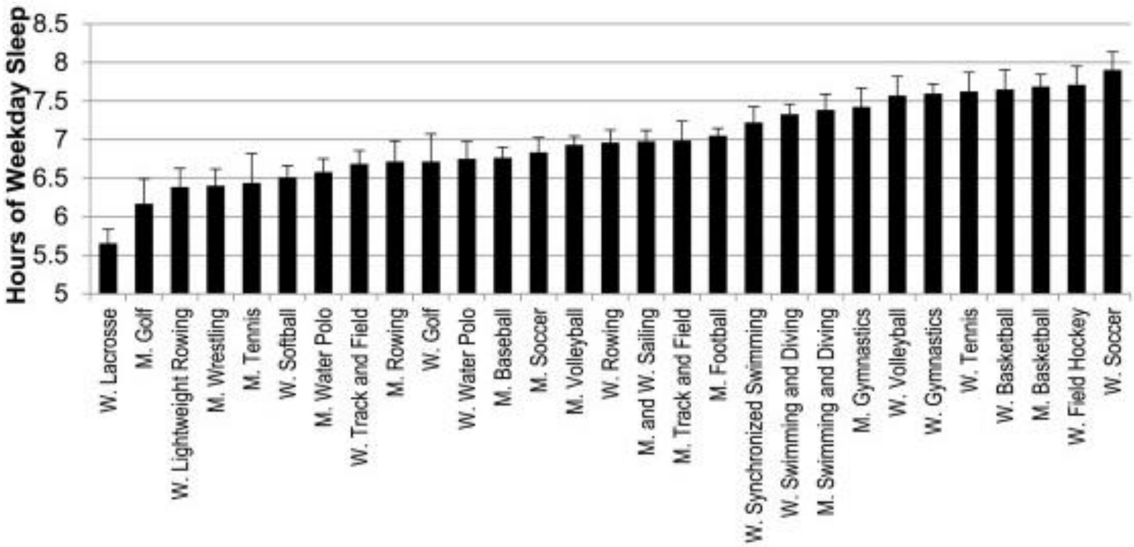


Figure 7 represents an average of the hours Stanford's athletes slept during weekdays, starting at less than five hours during the weekdays, and ending the representation at hours that exceeded 9. Figure 8 shows an average of hours Stanford's athletic programs slept during the weekdays. The ESS scores that indicated high levels of daytime sleepiness were found across 51% of the athletes. Athletes reported frequently feeling tired, including 62.1% of athletes who indicated "often" or "always" feeling tired, and 0% responded "never" be tired. In conclusion, this study found the average of 628 athletes to be poor sleepers with mean PSQI scores of 5.38 ± 2.45, suggesting that poor sleep quality was common and affected participants' daily routines and activities (Mah, 2018).

Schwartz conducted a study on 12 college tennis players to investigate the effects of sleep extension on tennis serving accuracy. To conduct this study, the tennis team continued their normal sleep-wake schedule for one week, followed by a week sleep extension period. During the sleep extension period, participants slept at least 9 hours, including naps. After one week of sleep deprivation, the players extended their sleep by obtaining at least 9 hours each night/day during the second week.

Figure 9. Tennis serving accuracy at week 1 (post-habitual sleep period) and week 2 (post-sleep extension period) (Schwartz, 2015)

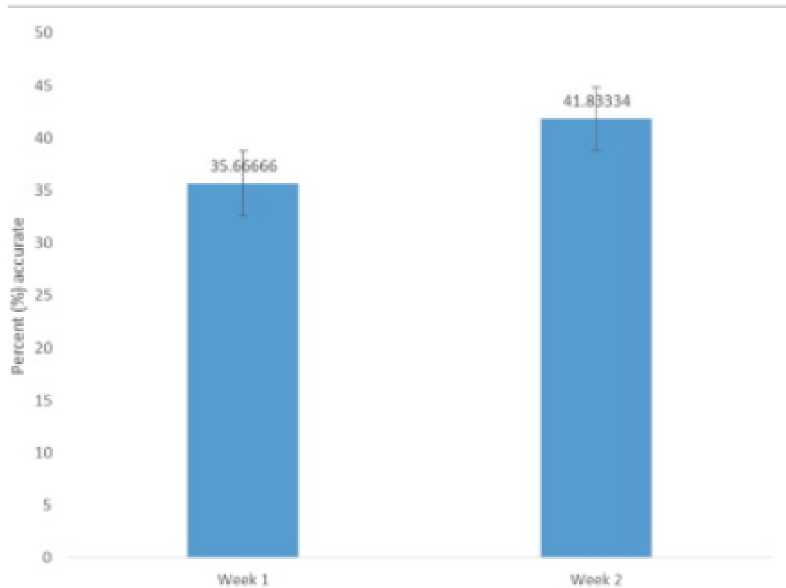


Figure 9 shows a 35.7% tennis serving accuracy one week after sleep deprivation, and 41.8% serving accuracy following sleep extension. This study showed that an increase in sleep duration significantly benefited the accuracy and performance of the athlete's tennis serves. In conclusion, sleep extension of approximately 7-9 hours per night significantly improved the accuracy of tennis serves in the majority of the participants. The results of this study indicated that sleep enhanced athletic performance and was essential for the formation of motor and skill memories (Schwartz, 2015).

Famodu studied 21 female collegiate track athletes to determine the effects of adding one hour of sleep for seven consecutive days on physical performance. The participants maintained their normal sleep habits for one week, measured by an actigraphy and sleep diary. Athletic performance was assessed through the Psychomotor Vigilance Task (timed reaction test measuring mental alertness and reaction time), as well as the standard Wingate Anaerobic Test (measures anaerobic capacity and power output) following the first week of maintenance, and the week of daily sleep extension. After treatment with one hour of additional sleep for seven consecutive days, the results showed that only peak power improved (693 ± 213 versus 714 ± 215 watts; $p = 0.07$). In conclusion, sleep extension for one week did not significantly impact the participants' psychomotor vigilance. This study found that a single week of increased sleep was not sufficient to see improvements in more areas of athletic performance (Famodu, 2017).

Watson reviewed studies dealing with how sleep affects athletic performance in various age groups of athletes; however, for the purpose of this study, only research studies utilizing collegiate athletes were used. One study on male collegiate basketball players found significant improvements with sprint test results and recorded 15.5 ± 0.54 sec after a 5-7 week period of 2 hours sleep extension, vs. 16.2 ± 0.61 sec shown at baseline. The same study found an increased shooting accuracy of 9% while shooting free-throws, and a 9.2% increase while shooting 3-point field goals. In the same study, the Profile of Moods States questionnaire (scale describing feelings people have) showed rates of increased vigor and a decrease in feelings of fatigue, with a significance of 0.001. The review found in a group of male collegiate weightlifters, that one night of total sleep deprivation did not significantly affect lifting performance. Snatch 1RM showed a mean score of 97.78 kg in the sleep loss participants and 97.78 kg in those who slept. Clean and jerk 1RM showed a mean score of 115.56 kg in the sleep loss participants and 116.67 kg in those who slept. Front squat 1RM showed a mean score of 137.50 in the sleep loss participants and 134.44 in those who slept. In conclusion, the presented evidence suggested that optimal sleep significantly improved the athletes performance, vigor, and fatigue states across a range of sports activities, but the effects sleep had on anaerobic activities showed to be less clear (Watson, 2017).

Mental Health Effects of Sleep Deprivation

Pickett studied 497 college students who reported exposure to trauma. He evaluated the trauma and its relationship with sleep disturbances, poor sleep quality, and emotional regulation difficulties.

Once enrolled in the study, participants were assessed using the Traumatic Life Events Questionnaire (list of traumatic events based on the potential occurrence of events). Participants were also asked to identify the traumatic event that caused them the most distress and were assessed based on the Distressing Events Questionnaire (assesses posttraumatic stress disorder), Difficulties in Emotion Regulation Scale (assesses aspects of emotional dysregulation), and the Pittsburgh Sleep Quality Index (measures sleep quality). Bivariate correlations were conducted to examine the relationship between the covariates (age, sex, race, etc.) and the study variables (PTSS, sleep disturbance variables, etc.). All covariates were included in analyses because each had a significant relationship with either a sleep disturbance or an emotion regulation difficulty variable. The analyses demonstrated that PTSD-related sleep disturbance (51% significance) and daily disturbances (49% significance) were strong predictors of total emotion regulation difficulties. In conclusion, the findings of the study demonstrated that both the PTSD-related sleep disturbance and daily disturbances were related to emotion regulation difficulties in the participants studied (Pickett, 2016).

Becker studied 1,700 college students to explore whether sleep problems were associated with suicidal behaviors. The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality, the Depression Anxiety Stress Scale was used to assess depressive symptoms, and Suicidal Behaviors Questionnaire (SBQ-R) was used to measure aspects of suicidal behavior. The participants were classified as meeting the standards for sleep problems (total PSQI score >5) or suicide risk (total SBQ-R score ≥ 7). Regression analyses examined the effects of total sleep problems and their relationship to suicide behaviors. The results of the study showed that about 33% of the subjects had sleep problems, and 25% had suicide risks.

Figure 10. Percentage of College Students with Sleep Problems and/or Suicide Risk (Becker 2018)

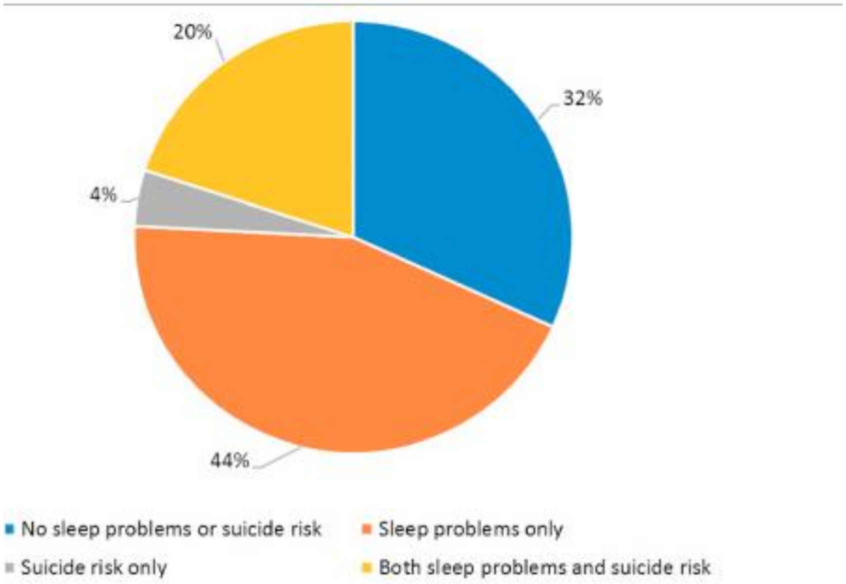


Figure 10 shows the percentages of participants classified with sleep problems and/or suicide risk. The study found that of the 411 participants classified with suicide risk, 82.7% also had sleep problems. Conversely, of 1088 participants with sleep problems, 31.3% also had suicide risks. Females, depression status, and sleep problems were also each uniquely associated with a higher likelihood of suicide risk status. Specifically, participants with depression had a 6.54 times greater suicide risk, and participants with sleep problems had a 2.70 times greater risk for suicide. These findings suggested that though depressive symptoms showed to have a relationship with suicide risk, depression, and sleep did not interact together to indicate suicide behavior or risks. In conclusion, poor sleep was significant, with an increased suicide risk above and beyond depressive symptoms in the participants studied (Becker, 2018).

Wallace conducted a study among 440 college students to explore the association of stress and depression with sleep problems. The participants were randomized to a control or intervention condition.

All participants were asked to complete four survey assessments; this was to happen at baseline, at four months, at 12 months, and 24 months. Depressive symptoms were assessed using the Center for Epidemiological Studies Depression Scale (CESD-10), stress was measured using Cohen's Perceived Stress Scale, and the Pittsburgh Sleep Quality Index measured sleep problems. Episodic and chronic depressive symptoms were associated with sleep deprivation ($b = 0.47$, $p < .0001$; $b = 0.81$, $p < .0001$). Episodic and chronic depressive symptoms were also seen in participants who had a hard time falling asleep (Odds Ratio for episodic depression = 3.30 $p <.0001$; Odds Ratio for chronic depression = 5.59 $p <.0001$). Similarly seen with participants who had trouble staying awake, were episodic depressive symptoms (Odds Ratio = 2.94, $p < .001$), chronic depressive symptoms (Odds Ratio = 2.77, $p <.01$), stress (Odds Ratio = 1.88, $p < .05$), and sleep quantity. While stress nor depressive symptoms significantly predicted sleep quantity, both significantly predicted sleep quality with depressive symptoms the most significant. In conclusion, this study found sleep quality to be a more meaningful measure of sleep problems as compared to sleep quantity (Wallace, 2017).

Milojevich studied 69 college students to examine whether self-reported sleep quality and mental health were associated with healthy sleeping habits. To participate in the study, university students had to go to bed before 2 am at least four nights a week, get 6 or more hours of sleep each night, and score 10 or less on the Epworth Sleepiness Scale (ESS (measures daytime sleepiness)). Correlations following the completed ESS, Pittsburgh Sleep Quality Index (measures sleep quality), and the Adult Self Report Form (ASR (asks for a report on general behaviors and substance use)), examined whether global sleep quality, nighttime sleep duration, and the frequency of disruptions during a night's sleep were related to symptoms of psychological distress.

Table 2. Correlations among Continuous Sleep Measures and Self-Reported Mental Health (Milojevich, 2016)

Table 2. Correlations among Continuous Sleep Measures and Self-Reported Mental Health.

ASR Factors and Scales	Global Sleep Quality	Nighttime Sleep Duration	Nighttime Sleep Disruptions
Syndrome Scales			
Externalizing Problems	.39*	-.20	.15
Aggressive Problems	.38*	-.22	.02
Intrusive Problems	.03	-.02	.14
Rule-Breaking Problems	.42*	-.16	.18
Internalizing Problems	.35*	-.18	.17
Anxious Problems	.31*	-.21	.06
Somatic Problems	.44*	-.11	.50*
Withdrawn Problems	-.03	-.06	-.20
Total Problems	.46*	-.24	.24
DSM-Oriented Scales			
Antisocial Personality Problems	.37*	-.12*	.07
Anxiety Problems	.41*	-.21	.27*
Attention Deficit/Hyperactivity Problems	.37*	-.18	.20
Avoidant Personality Problems	.12	-.07	-.02
Depressive Problems	.46*	-.23	.20
Somatic Problems	.27*	.00	.55*

Note: Significant findings are indicated (*) when $p \leq .05$.

Table 3. Correlations among PSQI Components and Self-Reported Mental Health (Milojevich, 2016)

Table 3. Correlations among PSQI Components (Range 0–3) and Self-Reported Mental Health.

ASR Factors and Scales	Disruptions	Duration	Dysfunction	Efficiency	Latency	Medication	Quality
Syndrome Scales							
Externalizing Problems	.13	.21	.25*	.11	.32*	.10	.33*
Aggressive Problems	-.07	.28*	.25	.08	.34*	.02	.39*
Intrusive Problems	.09	-.02	-.06	-.03	.10	.09	-.04
Rule-Breaking Problems	.27*	.15	.32*	.20	.24	.12	.34*
Internalizing Problems	.07	.19	.15	.39*	.19	-.01	.31*
Anxious Problems	-.05	.22	.18	.35*	.17	-.12	.31*
Somatic Problems	.45*	.19	.02	.36*	.24	.21	.33*
Withdrawn Problems	-.27*	-.02	.00	.13	-.04	.00	.03
Total Problems	.16	.25	.25*	.30*	.29*	.04	.41*
DSM-Oriented Scales							
Antisocial Personality Problems	.06	.22	.20	.11	.32*	.11	.35*
Anxiety Problems	.14	.21	.08	.21	.37*	.01	.44*
Attention-Deficit/Hyperactivity Problems	.21	.17	.32*	.14	.28*	.00	.26*
Avoidant Personality Problems	-.12	.08	.07	.23	.07	-.04	.12
Depressive Problems	.10	.29*	.21	.39*	.30*	-.08	.40*
Somatic Problems	.51*	.02	-.02	.25*	.07	.26*	.18

Note: The continuous sleep efficiency data were truncated to 100% and scored accordingly for 3 participants who reported more time asleep than time spent in bed. Correlations were conducted controlling for participant race (0 = Asian American or 1 = all other races) and ethnicity (0 = non-Hispanic or 1 = Hispanic). Significant findings are indicated (*) when $p \leq .05$.

Table 2 shows the relationship between global sleep quality and mental health with a significance of 39% in externalizing problems, 38% in aggressive problems, 35% in internalizing problems, and 31% in anxious problems. Table 3 shows the relationship between sleep disruptions and mental health with a significance of 45% in somatic problems, and 27% in rule-breaking problems. Sleep latency also has a relationship with mental health, with a significance of 32% in externalizing problems, 34% in aggressive problems, 32% in antisocial personality problems, 37% in anxiety problems, and 27% in attention-deficit/Hyperactivity problems. The results of this study provide insight into the relationship between sleep and mental health in a population at risk for sleep problems and psychiatric distress. In conclusion, participants who had poor sleep quality also had an increase in total problems, as well as symptoms of psychological distress (Milojevich, 2016).

Amaral studied 549 college students to investigate the relationship between stress and sleep difficulties. To do this, the researchers evaluated the role of repetitive negative thinking and negative emotions and poor self-concept. The Cognitive Emotion Regulation Questionnaire (CERQ (measures individual's coping strategies)), Perseverative Thinking Questionnaire (PTQ-15 (assesses individual's negative thinking, such as worry or rumination)), Profile of Mood States (PoMS (assesses temporary, fluctuating feelings, and negative emotions), and sleep difficulties were used and assessed in each participant. Results showed that 52.3% of the participants were affected by a sleep difficulty. Females reported higher levels of sleep problems and were almost two times more likely to describe having difficulty in maintaining sleep (males showed a significance of 17.8%, and females showed a significance of 30.3%) and early morning awakenings (females showed a significance of 33.2%, and males showed a significance of 21.5%). Females also reported a score of 39% in globally perceived stress, whereas males reported a lower score of 20%. In contrast, correlation analysis showed that males engaged more in cognitive emotion regulation strategies such as self-blaming and blaming-others when compared to female participants in self-blame and blaming others. The link between perceived stress and sleep difficulties was statistically significant ($p < 0.001$) with a confidence interval between 0.0588 and 0.0882. In conclusion, sleep difficulties were positively associated with perceived stress, and negative emotions within the students studied (Amaral, 2018).

Norbury studied 546 university students to evaluate sleep quality, daytime dozing, and anxiety proneness. Subjective sleep quality was assessed through the Pittsburgh Sleep Quality Index, and sleep duration was assessed using the Munich Chronotype Questionnaire. Anxiety was measured using the Spielberger Trait Anxiety Index (STAI), and daytime dozing was assessed using the Epworth Sleepiness Scale. The study found that 46% of participants rated their sleep as fairly bad or very bad, with 33% who reported 7 hours or less of sleep. Six hours and fifty-five minutes were recorded as the average sleep duration during days students studied, and 8.8 hours on their free days. During the comparison of good to poor sleepers, it was found that poor sleepers had significantly greater anxiety levels (t (544) = -.6.97, p < .001, *d* = .6) as well as greater levels of daytime dozing (t (544) = -.3.13, p = .002, *d* = .3). In conclusion, the study's data suggested that over a third of the participants were chronically sleep deprived and found that poor sleep quality was associated with increased anxiety and daytime dozing (Norbury, 2019).

Becker conducted a study of 7,626 college students to evaluate rates of total sleep problems using the Pittsburgh Sleep Quality Index (PSQI (measures sleep quality)) and examine the associations of anxiety, depression, and ADHD symptoms. The students were asked to take the PSQI, the Barkley Adult ADHD Rating Scale-IV (assesses current ADHD symptoms), and the Depression Anxiety Stress Scales-21 (DASS-21 (assesses depressive symptoms)). The questionnaires exposed significant correlations between all mental health symptoms (ADHD, anxiety, depression) and each of the sleep variables (sleep latency, sleep duration, sleep disturbances, etc.). Both anxiety (significance of 46%) and depressive symptoms (significance of 64%) were uniquely associated with disruptions in most PSQI sleep scores. More sleep disturbance (significance of 18%) and sleep medication (significance of 23%) use associations were found with anxiety. Whereas, depressive symptoms instead were uniquely associated with poorer sleep quality (significance of 31%) and increased daytime dysfunction (significance of 16%). Lastly, ADHD symptoms were associated with more sleep disturbances and less daytime dysfunction. Therefore, in conclusion, ADHD, anxiety, and depressive symptoms were associated with poor sleep status in the studied group (Becker, 2018).

Zhang studied 242 undergraduate nursing students to explore the association between sleep quality and depressive symptoms and examine the role coping styles would have between this association. There were four coping styles involved in this research. Engaged-coping was when an individual directly tried to influence the stressor. Disengaged-coping was when an individual tried to distance oneself physically and emotionally from the stressor. Emotional-coping was when an individual found a way to reduce the negative emotional response that came with the stress. Lastly, problem-coping was when an individual reduced the stress by problem-solving. Both problem and emotion disengagement had a positive correlation with sleep quality and depressive symptoms. A significance of 29% for sleep quality and 44% in depressive symptoms was shown in problem disengagement, and a significance of 35% in sleep quality and 63% in depressive symptoms was shown in emotion disengagement. Whereas, problem engagement showed a negative correlation with poor sleep quality (significance of -24%) and depressive symptoms (-29%). Results found a 41% reduction in the association between depressive symptoms and sleep quality when the four coping styles were together. In conclusion, this study found that poor sleep quality among the studied nursing students was closely associated with depressive symptoms, and that coping styles were able to reduce the strength of this association (Zhang, 2018).

Nadorff studied 747 undergraduate students and examined the relationship between insomnia symptoms and nightmares, and suicide risk. To examine the association between insomnia and nightmares with suicide risk, the authors conducted a correlation analysis based on a series of questionnaires the participants took, that examined multiple sleep variables and their association with suicide risk. Results found that insomnia symptoms had a negative correlation and were not associated with suicide risk; however, nightmares were. A significance of 83% in the capability variable, an 80% significance with belongingness and capability variables, and a 98% significance with the combination of burdensome, belongingness, and capability variables were shown. However, after adding depressive symptoms to the model, nightmares no longer showed to be statistically significant, and insomnia symptoms showed a significance of .01 with suicide attempts.

Table 4. Insomnia symptoms, nightmares, and constructs in relation to suicide attempts (Nardoff, 2014)

Predictors	Insomnia symptoms				Nightmares			
	R^2	β	*t*	*p*	R^2	β	*t*	*p*
Step 1:	.04			<.01	.05			<.01
Age		.04	0.82	.42		.03	0.56	.58
Sex		.02	0.35	.73		.02	0.46	.65
Race		–.04	–0.71	.48		–.04	–0.80	.42
SES		–.00	–0.02	.99		–.00	–.09	.93
Burdensomeness		.10	1.50	.14		.09	1.48	.14
Belongingness		.15	2.30	.02		.15	2.42	.02
Capability		.02	0.51	.61		.02	0.44	.66
Step 2:	.04				.06			
Burdensomeness×belongingness		.10	1.40	.16		.14	1.87	.06
Burdensomeness×capability		–.14	–2.14	.03		–.09	–1.37	.17
Belongingness×capability		.06	1.01	.31		.05	.84	.40
Step 3:	.04				.07			
Burdensomeness×belongingness×capability		.05	0.58	.56		.14	1.82	.07
Step 4:	.05				.16			
Insomnia symptoms/nightmares		.13	2.69	<.01		.31	7.01	<.01
Step 4 Alt:	.05				.16			
Depressive symptoms		.02	0.32	.75		–.01	–0.20	.84
Insomnia symptoms/nightmares		.12	2.50	.01		.32	6.91	<.01

Table 4 shows insomnia symptoms and nightmares in relation to suicide risk before and after depressive symptoms were included. In conclusion, this study found insomnia symptoms and nightmares to have an association with perceptions of burdensomeness and increased feelings of isolation. Furthermore, nightmares and insomnia were associated with suicide risk and behaviors of the participants (Nardoff, 2014).

Peach studied 218 college students to find whether or not poor sleep quality was associated with greater depressive symptoms and worse subjective well-being. Participants completed a series of questionnaires that measured their positive and negative mental health, sleep patterns, behaviors, and demographic information. The study used a statistical analysis to see if sleep hygiene indirectly or directly predicted mental health. Sleep hygiene showed significant indirect effects on subjective well-being (beta = -.30, $p < .001$) and depressive symptoms (beta = .28, $p < .001$). When sleep hygiene was allowed to predict subjective well-being and depression directly, a significance of -10% in well-being and 7% in depression was shown. Sleep quality was also significant, with a score of 70% in a direct relationship to depression and a score of -69% in an indirect relationship to subjective well-being. The study found that quality sleep among the participants predicted both positive and negative dimensions of mental health. Worse sleep quality was associated with greater depressive symptoms and lower subjective well-being. Specifically, sleep hygiene showed to indirectly affect mental health by influencing sleep quality and directly affected depression and subjective well-being. In conclusion, the study found that participants with better sleep quality reported better mental health. (Peach, 2016).

Peltz studied 335 college students by exploring sleep hygiene and environmental disturbances to sleep as predictors to both depressive symptoms and sleep disturbances. Participants completed a handful of questionnaires that assessed depressive symptoms, sleep disturbance and sleep hygiene.

Figure 11. Path model testing the indirect effects of sleep hygiene and environmental factors on depressive symptoms for college students who live alone (Peltz, 2016)

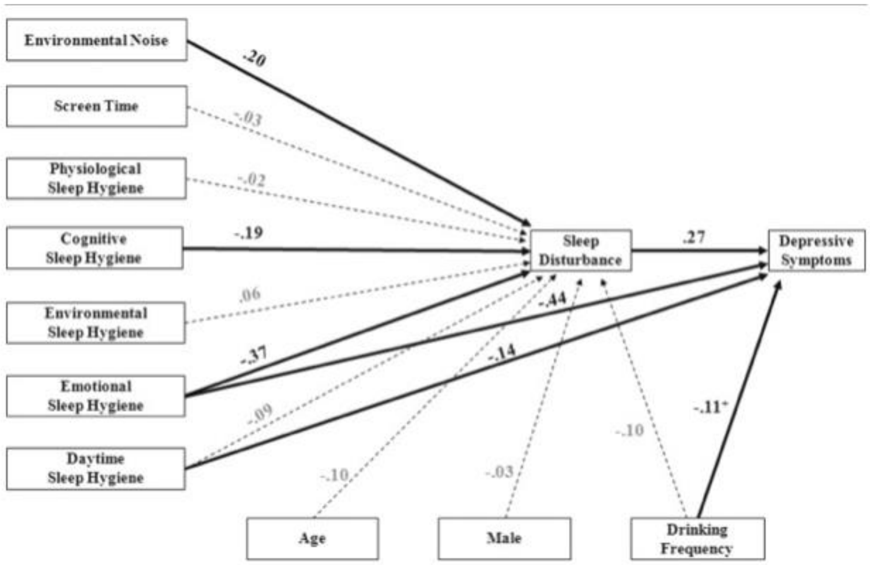
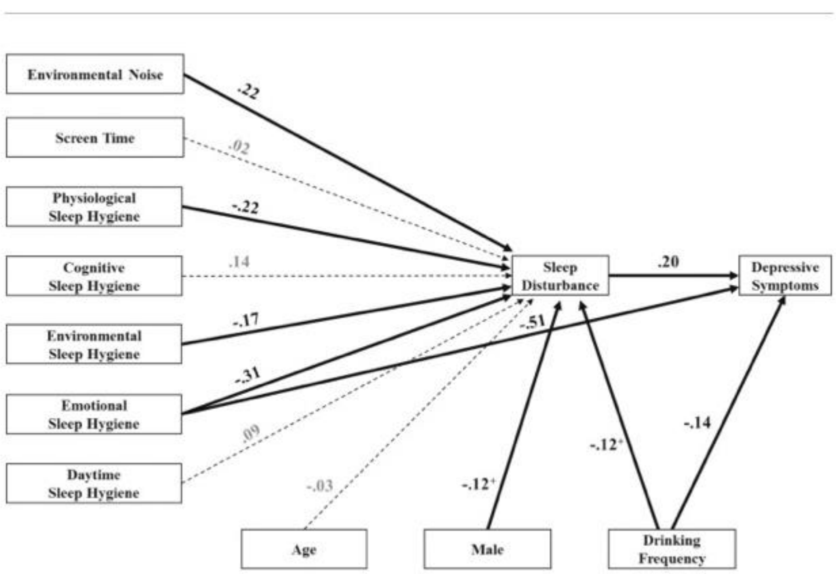


Figure 12. Path model testing the indirect effects of sleep hygiene and environmental factors on depressive symptoms for college students who live with roommates (Peltz, 2016)



Note: $^{+}P < .08$. Unless otherwise noted, bolded lines represent significant ($P < .05$) pathways, dashed lines represent nonsignificant pathways, and nonsignificant direct pathways between all predictors and depressive symptoms have been removed.

Figure 11 shows the results of the indirect effects of sleep hygiene and environmental factors on depressive symptoms for college students that lived alone. The pathway from sleep disturbance to depressive symptoms shows a significance of 27%. Emotional sleep hygiene's pathway to depressive symptoms shows a significance of -44% and its pathway to sleep disturbance shows a significance of -37%. Environmental noise also shows a significance of 20% on the path to sleep disturbance. Figure 12 represents those who lived with roommates, and the pathway from environmental noise toward sleep disturbance shows a 22% significance. Emotional sleep hygiene's pathway to sleep disturbance shows a significance of -31% and its pathway to depressive symptoms shows a significance of -51%. Lastly, sleep disturbances pathway to depressive symptoms showed a significance of 20%. The models show that participants who lived with or without a roommate had similar results. In both models, higher levels of depressive symptoms were associated with higher levels of sleep disturbance and environmental noise. Also, negative associations with all of the sleep hygiene subscales were found. In conclusion, several environmental and sleep hygiene factors were associated with the participants' poor sleep, which was related to levels of depressive symptoms (Peltz, 2016).

A systematic review was conducted using 19 PubMed, EMBASE, and PsychINFO original peer-reviewed databases to research and evaluate suicide and self-harm behaviors and their relationship with sleep in university students. All of the investigations present in the conducted review assessed sleep-related variables, such as insomnia, sleep disruption, and nightmare distress, by using questionnaires. Results showed that insomnia symptoms within the past month were positively associated with suicidal ideas within the past two weeks. Poor sleep was found to predict increased suicidal ideas, independent of depression. In the same study, nightmares independent of insomnia and depression were reported to have an increased association with suicidal ideas, in comparison to those who did not experience nightmares. In another study, sleep disruption rather than sleep timing, duration, and onset latency, was associated with suicidal ideas. Overall, these studies suggested that poor sleep was associated with increased self-harm thoughts and behaviors. In conclusion, the literature found consistently demonstrated studies that indicated poor sleep to be associated with elevated suicide risks (Russell, 2019).

Cahuas conducted a study among 1,143 college students to examine the relationship between physical activity, sleep, and depression based on questionnaires. The results of the questionnaires indicated that 29% of the participants participated in minimal physical activity, 47% in moderate physical activity, and 24% in vigorous physical activity. A score of less than 5 indicates quality sleep based on the Pittsburgh Sleep Quality Index. The average sleep score was found to be 4.53. Twenty percent of participants had poor sleep quality. A score of 16 points or more indicates depression based on the Center for Epidemiologic Studies Depression Scale. The participants' average score was 13.59, and 40% percent of the participants scored 16 or higher. Physical activity and sleep accounted for 35.3% of the total variance in depression. Only vigorous physical activity was significant in predicting depression levels at .001. As for sleep, the results revealed that all sleep subscales (subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction) had significant relationships with total depression (significance of .006). In conclusion, this study found that vigorous physical activity and all sleep subscales significantly predicted depression levels in the participating university students (Cahuas, 2019).

Chapter 3

Introduction

The statement of the problem, summary, conclusions, and recommendations for further study are discussed in this chapter. The CDC has reported more than a third of American adults do not get enough sleep regularly (CDC, 2016). Most college students have averaged between 6-6.9 hours of sleep each night (University Health Center, 2019). One of the reasons a healthy sleep regimen is important, is due to the increased risk seen in insufficient sleep and mental health disorders. Every additional night of insufficient sleep showed an increased risk of experiencing mental health symptoms by more than 20% on average (AASM, 2019). Sleep is also important to help a person think clearly, remember information, and make decisions. Without enough sleep, executive function is impaired, and academics, work, and daily life suffer the consequences (National Sleep Foundation, 2019). Lastly, Grandner found that one-third of student-athletes recorded less than 7 hours of sleep each night (Grandner, 2018). This becomes significant because sleep plays a large part in the recovery process before and after competition. Less sleep increased the possibility of fatigue, low energy, and poor focus during athletic performance (National Sleep Foundation, 2019).

Summary and Statement of the Problem

This researcher reviewed literature that pertained to the possible consequences of sleep deprivation among college students. Thirty-two professional medical journals and twelve professional websites were researched. Conclusions were drawn concerning the consequences of insufficient sleep in various areas of college students’ lives. The purpose of this study was to investigate the effects of sleep deprivation on college-age students.

Conclusions

Prevalence, causes, and awareness of sleep deprivation were closely examined. Barone studied 19 working college students to discover how they experienced and thought about sleep. The study did not show consistently poor sleep habits, but due to the small sample size, statistical tests to examine relationships between hours worked and hours slept were not possible. This study also found that sleep loss rises and falls depending on students' course calendar; therefore, this study may have found different results later in the semester (Barone, 2017). Ranasinghe studied 100 college students to highlight the prevalence and contributing factors of sleep deprivation. He found that the major cause of sleep deprivation was internet usage (38%), indicating that participants sacrificed sleep to have more screen time. Another major cause of sleep deprivation was stress (21%) as students attempted to balance studies and social life. Inadequate sleep hygiene was common as students often sacrificed sleep for technology, their social environment, and/or academic purposes (Ranasinghe, 2018). A study of 440 undergraduate students examined the frequency, length, and time naps were taken and its relationship of these variables with nighttime sleep. The results of this study found a higher risk of poor nighttime sleep quality and sleep deprivation after long, frequent, and late naps (Lichuan Ye, 2015). Another study of 734 college students, investigated sleep problems related to technology. A direct relationship between executive functioning problems and sleep problems were found with a significance of 26%. Anxiety/dependence also predicted sleep problems due to daily smartphone use and nighttime phone awakenings. Rosen found participants with executive functioning problems, who were also anxious and dependent on technology, had a compromised state of sleep (Rosen, 2016). Kloss conducted a sleep program to educate 120 undergraduate students about healthy sleep practices, helpful thoughts about sleep, and ways to improve sleep. His research found significant improvements after two 90-minute presentations that highlighted sleep benefits, with an increased score in Dysfunctional Beliefs about Sleep, better sleep knowledge scores, and a decrease in sleep onset latency (Kloss, 2016).

The consequences of cognitive performance following sleep deprivation were closely examined. Chen studied 7,419 college students to examine the relationship between sleep deprivation and GPA and college graduation. Chen found students who suffered sleeplessness during their senior year were 40% less likely to graduate, and those sleep deprived their freshman and senior year were 25% less likely to graduate. This study revealed that chronic sleep deprivation negatively influenced academic achievement (Chen, 2019). Another study of 3,690 college students examined the impact that sleep deprivation had on leadership and the need for cognition. Results based on the random-effects model showed that chronic sleep deprivation was associated with decreased leadership skills ($\beta = -.09$, $p < .001$) and need for cognition ($\beta = .08$, $p < .001$). The random effects model showed similar results for leadership skills ($\beta = -.09$, $p < .01$) and need for cognition ($\beta = -.06$, $p < .01$), confirming chronic sleep deprivation was a predictor of the participants developmental outcomes (Chen, 2019). A study of 94 college students evaluated the effects of sleep deprivation in goal-directed learning and habitual actions. Results presented a reduction of psychomotor vigilance, shown with a decrease in average response speed ($p < 0.001$) and an increase in attention lapses (failure to maintain focus (reaction time ≥ 500 ms)). The results of this study found participants over-relied on habitual control when sleeplessness seemed to impair the participants' ability to learn (Jei Chen, 2017). Patrick studied 64 college students to determine whether a night without sleep would have a negative impact on the cognitive performance of students. Results found no significant differences following one night of sleep deprivation, which indicated that acute sleep deprivation was not detrimental to participants' cognitive abilities (Patrick, 2017). A study of 1,378 college students investigated the relationship between chronic sleep reduction, sleep quality, and sleep hygiene knowledge with academic achievement. Results showed greater chronic sleep reduction and worse sleep quality were significant in the association with worse academic achievement (correlation coefficients from -.09 to -.18) and study concentration ($r = -0.30$ to -0.45) (Heijden, 2017). A study to determine the connection between sleep patterns and academic performance was conducted using 347 undergraduate students. Results indicated most students that had a biphasic sleep pattern (slept twice every 24 hours) showed an increased pass percentage (87%) during midterms compared to the other two sleeping patterns. Monophasic sleeping patterns (slept once for 6+ hours) showed to be the least likely to oversleep, and 58% of participants who had polyphasic patterns (took multiple naps per day) overslept the most and had an increased fail percentage (34%) (Saeed, 2015). A study on 471 university students examined sleep quality and its relationship to academic achievement. A correlation between sleep quality and academic achievement was seen ($r = -0.102$, $p = 0.028$) as the total PSQI score increased and GPA decreased (Sarbazvatan, 2017). Another study examined 99 college students and whether sleep restriction would impact decision making in a choice task. The study found that when total available information strongly favored one decision, participants tended to weigh the initial information more than the new information with a significance of $p < .01$. Sleep restriction of <6 hours per night over a week suggested a reduced ability to fully incorporate multiple pieces of information into a decision (Dickinson, 2016).

The effects of sleep deprivation on athletic and physical performance were closely examined. Slutsky studied 24 undergraduate and graduate college students to examine the effects of 24 hours of sleep deprivation and the effects of acute exercise on cognitive performance. Effects on reaction time (from $p = 0.074$ to $p = 0.000$), false alarms (reaction time < 100 ms (from $p = 0.885$ to $p = 0.016$)), and lapses (reaction time > 500 ms) significantly increased following sleep deprivation. Slutsky found that sleep deprivation negatively affected simple tasks, and decreased brain activity, which caused negative effects in the mental alertness test (Slutsky, 2017). In another study, 628 Stanford University student-athletes sleep quality, sleep duration, and daytime sleepiness across a wide range of sports were measured. The study found athletes to be poor sleepers with mean PSQI scores of 5.38 ± 2.45, suggesting that poor sleep quality was common and affected participants' daily routines and activities (Mah, 2018). Schwartz conducted a study on 12 collegiate tennis players to investigate the effects of sleep extension on tennis serving accuracy. Results found a 35.7% tennis serving accuracy one week after sleep deprivation vs. a 41.8% serving accuracy following sleep extension. Researchers found that sleep enhanced athletic performance and was essential for the formation of motor and skill memories (Schwartz, 2015). A study of 21 female collegiate track athletes investigated the effects of adding one hour of sleep for seven days on physical performance. Results found only peak power improved (693 ± 213 versus 714 ± 215 watts; $p = 0.07$) and concluded that a single week of increased sleep was not sufficient to see improvements in more areas of athletic performance (Famodu, 2017). Watson conducted a review to examine how sleep affects athletic performance. Collegiate basketball players showed an increase of 9% at shooting successful free-throw shots, a 9.2% increase while shooting successful 3-point field goals, and significant improvements with sprint test time results, during a 5-7 week period of sleep extension. However, one night of sleep deprivation did not significantly affect collegiate weightlifters lifting performance. This study suggested that optimal sleep significantly improved an athlete's performance, but the effects sleep had on anaerobic activities showed to be less clear (Watson, 2017).

The effects sleep deprivation had on mental health were closely examined. Pickett evaluated 497 college students' trauma exposure and its relationship between trauma and sleep disturbances, poor sleep quality, and emotional regulation difficulties. The study found that both PTSD-related sleep disturbances (51% significance) and daily disturbances (49% significant) were strong predictors of emotion regulation difficulties (Pickett, 2016). Becker studied 1700 college students to explore whether sleep problems were associated with suicidal behaviors. Results found that of 411 participants classified with suicide risk, 82.7% had sleep problems, and of 1088 participants with sleep problems, 31.3% also had suicide risks. Poor sleep was significantly associated with increased suicide risks (Becker, 2018). A study among 440 college students was conducted to explore the association of stress and depression with sleep problems. Episodic and chronic depressive symptoms were seen in participants who had a hard time falling asleep (Odds Ratio for episodic depression = 3.30 p <.0001; Odds Ratio for chronic depression = 5.59 p <.0001). Similarly seen with participants who had trouble staying awake, were depressive symptoms, stress, and sleep quantity. This study found sleep quality to be a more meaningful measure of sleep problems as compared to sleep quantity (Wallace, 2017). Milojevich studied 69 college students to examine whether self-reported sleep quality and mental health were associated. Global sleep quality (39% in externalizing problems), nighttime sleep disruptions (45% in somatic problems), and sleep latency (37% in anxiety problems) all had significant effects on mental health greatly related to symptoms of psychological distress (Milojevich, 2016). Amaral studied 549 college students to investigate the relationship between stress and sleep difficulties, by evaluating the role of repetitive negative thinking, and negative emotions and poor self-concept. Results showed a significance between perceived stress and sleep difficulties with a confidence interval between 0.0588 and 0.0882, confirming the association between sleep difficulties, and perceived stress and negative emotions (Amaral, 2018). Norbury studied 546 university students to evaluate sleep quality, daytime dozing, and anxiety proneness. The study found that over a third of the participants who were chronically sleep deprived had significantly greater anxiety levels (t (544) = -.6.97, p < .001, *d* = .6) as well as greater levels of daytime dozing (t (544) = -.3.13, p = .002, *d* = .3) (Norbury, 2019). Another study conducted on 7,626 college students, evaluated rates of total sleep problems and its relationship with anxiety, depression, and ADHD symptoms. Significant correlations between all mental health symptoms (ADHD, anxiety, depression) and each of the sleep variables (sleep latency, sleep duration, sleep disturbances, etc.) were found. Anxiety (significance of 46%), depression (significance of 64%), and ADHD were uniquely associated with poor sleep status (Becker, 2018). Zhang studied 242 undergraduate students to explore the association between sleep quality and depressive symptoms and examine the role coping styles would have between this association. He found that problem and emotion disengagement had a positive correlation with sleep quality and depressive symptoms; however, problem engagement showed a negative correlation with poor sleep quality (significance of -24%) and depressive symptoms (-29%). Results found that poor sleep quality was closely associated with depressive symptoms, and that coping styles were able to reduce the strength of this association (Zhang, 2018). A study of 747 undergraduate students examined the relationship between insomnia symptoms and nightmares, and suicide risk. Results found that insomnia symptoms had a negative correlation and were not associated with suicide risk; however, nightmares were. However, after adding depressive symptoms to the correlation analysis, nightmares no longer showed to be statistically significant, and insomnia symptoms showed a significance of .01 with suicide attempts. Results found nightmares and insomnia both were associated with suicide risk and behaviors (Nardoff, 2014). Peach studied 218 college students to find whether or not poor sleep quality was associated with greater depressive symptoms and worse subjective well-being. Sleep hygiene showed significant indirect effects on subjective well-being (beta = -.30, $p < .001$) and depressive symptoms (beta = .28, $p < .001$). Also, sleep hygiene was directly related to subjective well-being (-10% significance) and depression (7% significance). Sleep quality had a score of 70% in a direct relationship to depression and a score of -69% in an indirect relationship to subjective well-being. The study found participants with better sleep quality reported better mental health (Peach, 2016). Sleep hygiene and environmental disturbances to sleep as predictors to both depressive symptoms and sleep disturbances were studied in 335 college students. The study found that many environmental and sleep hygiene factors were related to participants' depressive symptoms. The pathway from sleep disturbance to depressive symptoms showed a significance between 20-27% (Peltz, 2016). A review conducted evaluated suicide and self-harm behaviors and their relationship with sleep in university students. Results found that insomnia symptoms and poor sleep were positively associated with suicidal ideas. In another study, sleep disruption was associated with suicidal ideas. This review suggested that poor sleep was associated with increased self-harm thoughts and behaviors (Russell, 2019). Cahuas conducted a study to examine the relationship between physical activity, sleep, and depression among 1,143 college students. Of minimal, moderate, and vigorous physical activity, only vigorous physical activity was significant in predicting depression levels at .001. As for sleep, all sleep subscales had significant relationships with total depression (significance of .006) (Cahuas).

Recommendations for Further Study

There are a few recommendations for further research regarding how sleep deprivation affects college students' cognitive capabilities and athletic performance. There needs to be more research on the effects that acute sleep deprivation has on cognitive performance to see if there is a difference in results. Many studies focused on chronic sleep deprivation rather than acute; therefore, there was not enough evidence shown to deem acute sleep deprivation in cognition as insignificant. It is important to understand all aspects of sleep, and without studies regarding acute sleep deprivation, a well-rounded understanding of the consequences shown with lack of sleep in college students is compromised.

There also needs to be more research on the benefits of sleep and athletic performance. There was not enough recent research found to conduct a valid argument on whether sleep was consistent in positively or negatively affecting performance. It would be interesting to see a study conducted that consisted of collegiate athletes' entire season, and how sleep plays a role in a successful or disastrous performance. The study could consist both of good quality sleepers, as well as poor sleepers, and continuously evaluate and compare the athletes’ performance throughout their sports season. More studies should also evaluate potential relationships between one’s entire collegiate athletic career and the positive contribution that sleep may have.

Works Cited

Amaral, Ana Paula, et al. "Sleep Difficulties in College Students: The Role of Stress, Affect and Cognitive Processes." *Psychiatry Research*, vol. 260, Feb. 2018, pp. 331–337. *MEDLINE with Full Text*, doi:10.1016/j.psychres.2017.11.072.

Barone, T.Lynne. "'Sleep Is on the Back Burner': Working Students and Sleep." *The Social Science Journal*, vol. 54, no. 2, June 2017, pp. 159–167. *PsycINFO*, doi:10.1016/j.soscij.2016.12.001.

Becker, Stephen P., et al. "Sleep in a Large, Multi-University Sample of College Students: Sleep Problem Prevalence, Sex Differences, and Mental Health Correlates." *Sleep Health*, vol. 4, no. 2, Apr. 2018, pp. 174–181. *MEDLINE with Full Text*, doi:10.1016/j.sleh.2018.01.001.

Becker, Stephen P., et al. "Sleep Problems and Suicidal Behaviors in College Students." *Journal of Psychiatric Research*, vol. 99, Apr. 2018, pp. 122–128. *Academic Search Complete*, doi:10.1016/j.jpsychires.2018.01.009.

Cahuas, Ana, et al. "Relationship of Physical Activity and Sleep with Depression in College Students." *Journal of American College Health*, Mar. 2019. *PsycINFO*, doi:10.1080/07448481.2019.1583653.

"CDC Newsroom." *Center for Disease Control and Prevention*, 2016, www.cdc.gov/media/releases/2016/p0215-enough-sleep.html.

Chen, Wei-Lin, and Jen-Hao Chen. "Consequences of Inadequate Sleep during the College Years: Sleep Deprivation, Grade Point Average, and College Graduation." *Preventive Medicine*, vol. 124, July 2019, pp. 23–28. *Academic Search Complete*, doi:10.1016/j.ypmed.2019.04.017.

Chen, Wei-Lin, and Jen-Hao Chen. "Sleep Deprivation and the Development of Leadership and Need for Cognition during the College Years." *Journal of Adolescence*, vol. 73, June 2019, pp. 95–99. *Academic Search Complete*, doi:10.1016/j.adolescence.2019.04.003.

"College Students: Getting Enough Sleep Is Vital to Academic Success." *American Academy of Sleep Medicine – Association for Sleep Clinicians and Researchers*, 6 Nov. 2017, aasm.org/college-students-getting-enough-sleep-is-vital-to-academic-success/.

Dickinson, David L., et al. "Voluntary Sleep Choice and Its Effects on Bayesian Decisions." *Behavioral Sleep Medicine*, vol. 14, no. 5, Sept. 2016, pp. 501–513. *Academic Search Complete*, doi:10.1080/15402002.2015.1028064.

Famodu, O., et al. “0083 Impacts of a Single Week of Sleep Extension on Performance, Mood, and Nutrition among Females College Track Athletes.” *Sleep*, vol. 40, Apr. 2017, pp. A32. doi.org/10.1093/sleepj/zsx050.082

Grandner, Michael. “Mind, Body and Sport: Sleeping Disorders.” *NCAA.org - The Official Site of the NCAA*, 20 June 2018, www.ncaa.org/sport-science-institute/mind-body-and-sport-sleeping-disorders.

Hershner, Shelley D., and Ronald D. Chervin. “Causes and Consequences of Sleepiness among College Students.” *Nature and Science of Sleep*, Dove Medical Press, 23 June 2014, www.ncbi.nlm.nih.gov/pmc/articles/PMC4075951/#b2-nss-6-073.

“How Lack of Sleep Impacts Cognitive Performance and Focus.” *National Sleep Foundation*, 2019, www.sleepfoundation.org/articles/how-lack-sleep-impacts-cognitive-performance-and-focus.

“Insufficient Sleep Linked to Mental Health in College Students - AASM.” *American Academy of Sleep Medicine – Association for Sleep Clinicians and Researchers*, 7 June 2019, aasm.org/insufficient-sleep-college-student-athletes/.

Jie Chen, et al. “Sleep Deprivation Promotes Habitual Control over Goal-Directed Control: Behavioral and Neuroimaging Evidence.” *Journal of Neuroscience*, vol. 37, no. 49, Dec. 2017, pp. 11979–11992. *Academic Search Complete*, doi:10.1523/JNEUROSCI.1612-17.2017.

Kloss, Jacqueline D., et al. “A ‘Sleep 101’ Program for College Students Improves Sleep Hygiene Knowledge and Reduces Maladaptive Beliefs about Sleep.” *Behavioral Medicine*, vol. 42, no. 1, Jan. 2016, pp. 48–56. *PsycINFO*, doi:10.1080/08964289.2014.969186.

Kosecki, Danielle. “How Much Sleep Do Fitbit Users Really Get? A New Study Finds Out.” *Fitbit Blog*, 5 Oct. 2017, blog.fitbit.com/sleep-study/.

Mah, Cheri D., et al. “Poor Sleep Quality and Insufficient Sleep of a Collegiate Student-Athlete Population.” *Sleep Health*, vol. 4, no. 3, June 2018, pp. 251–257. *MEDLINE with Full Text*, doi:10.1016/j.sleh.2018.02.005.

Milojevich, Helen M., and Angela F. Lukowski. “Sleep and Mental Health in Undergraduate Students with Generally Healthy Sleep Habits.” *PLoS ONE*, vol. 11, no. 6, June 2016, pp. 1–14. *Academic Search Complete*, doi:10.1371/journal.pone.0156372.

Nadorff, Michael R., et al. "Sleep Disorders and the Interpersonal–Psychological Theory of Suicide: Independent Pathways to Suicidality?" *Journal of Affective Disorders*, vol. 152–154, Jan. 2014, pp. 505–512. *Academic Search Complete*, doi:10.1016/j.jad.2013.10.011.

Norbury, Ray, and Simon Evans. "Time to Think: Subjective Sleep Quality, Trait Anxiety and University Start Time." *Psychiatry Research*, vol. 271, Jan. 2019, pp. 214–219. *MEDLINE with Full Text*, doi:10.1016/j.psychres.2018.11.054.

Patrick, Yusuf, et al. "Effects of Sleep Deprivation on Cognitive and Physical Performance in University Students." *Sleep & Biological Rhythms*, vol. 15, no. 3, July 2017, pp. 217–225. *Academic Search Complete*, doi:10.1007/s41105-017-0099-5.

Peach, Hannah, et al. "Sleep Hygiene and Sleep Quality as Predictors of Positive and Negative Dimensions of Mental Health in College Students." *Cogent Psychology*, vol. 3, no. 1, Dec. 2016. *PsycINFO*, doi:10.1080/23311908.2016.1168768.

Peltz, Jack S., and Ronald D. Rogge. "The Indirect Effects of Sleep Hygiene and Environmental Factors on Depressive Symptoms in College Students." *Sleep Health*, vol. 2, no. 2, June 2016, pp. 159–166. *MEDLINE with Full Text*, doi:10.1016/j.sleh.2016.01.007.

Pickett, Scott M., et al. "The Relationship Between Subjective Sleep Disturbance, Sleep Quality, and Emotion Regulation Difficulties in a Sample of College Students Reporting Trauma Exposure." *Psychological Trauma: Theory, Research, Practice, and Policy*, vol. 8, no. 1, Jan. 2016, pp. 25–33. *PsycINFO*, doi:10.1037/tra0000064.

Ranasinghe, Abigail Nirandhi, et al. "Awareness of Effects of Sleep Deprivation among College Students." *Drug Invention Today*, vol. 10, no. 9, Sept. 2018, pp. 1806–1809. *Academic Search Complete*, oralroberts.idm.oclc.org/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=131123668&site=ehost-live&scope=site.

Rosen, Larry, et al. "Sleeping with Technology: Cognitive, Affective, and Technology Usage Predictors of Sleep Problems among College Students." *Sleep Health*, vol. 2, no. 1, 2016, pp. 49–56., doi:10.1016/j.sleh.2015.11.003.

Russell, Kirsten, et al. "Sleep Problem, Suicide and Self-Harm in University Students: A Systematic Review." *Sleep Medicine Reviews*, vol. 44, Apr. 2019, pp. 58–69. *MEDLINE with Full Text*, doi:10.1016/j.smrv.2018.12.008.

Saeed, Zeba, et al. "Sleep Patterns of Medical Students; Their Relationship with Academic Performance: A Cross Sectional Survey." *Professional Medical Journal*, vol. 22, no. 7, Nov. 2015, pp. 919–923. *Academic Search Complete,* oralroberts.idm.oclc.org/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=a9h&AN=109169312&site=ehost-live&scope=site.

Sarbazvatan, Horyeh, et al. "Sleep Quality and Academic Progression among Students of Tabriz University of Medical Sciences, Northwest of Iran." *Research & Development in Medical Education*, vol. 6, no. 1, Jan. 2017, pp. 29–33. *Academic Search Complete*, doi:10.15171/rdme.2017.006.

Schwartz, Jennifer, and Richard D. Simon Jr. "Sleep Extension Improves Serving Accuracy: A Study with College Varsity Tennis Players." *Physiology & Behavior*, vol. 151, Nov. 2015, pp. 541–544. *MEDLINE with Full Text*, doi:10.1016/j.physbeh.2015.08.035.

"Seven or More Hours of Sleep per Night: A Health Necessity for Adults." *American Academy of Sleep Medicine – Association for Sleep Clinicians and Researchers*, 7 Nov. 2017, aasm.org/seven-or-more-hours-of-sleep-per-night-a-health-necessity-for-adults/.

"Sleep Deprivation and Deficiency." *National Heart Lung and Blood Institute*, U.S. Department of Health and Human Services, 2019, www.nhlbi.nih.gov/health-topics/sleep-deprivation-and-deficiency.

"Sleep Rocks! ...Get More of It!" *University Health Center, Student Affairs, University of Georgia*, 2019, www.uhs.uga.edu/sleep.

Slutsky, Alexis B., et al. "The Effects of Low-Intensity Cycling on Cognitive Performance Following Sleep Deprivation." *Physiology & Behavior*, vol. 180, Oct. 2017, pp. 25–30. *ScienceDirect*, doi:10.1016/j.physbeh.2017.07.033.

"The Effects of Sleep Deprivation." *The Effects of Sleep Deprivation | Johns Hopkins Medicine*, 2019, www.hopkinsmedicine.org/health/wellness-and-prevention/the-effects-of-sleep-deprivation.

van der Heijden, Kristiaan B., et al. "Chronic Sleep Reduction is Associated with Academic Achievement and Study Concentration in Higher Education Students." *Journal of Sleep Research*, vol. 27, no. 2, Apr. 2018, pp. 165–174. *Academic Search Complete*, doi:10.1111/jsr.12596.

Wallace, Deshira D., et al. "Multilevel Analysis Exploring the Links between Stress, Depression, and Sleep Problems among Two-Year College Students." *Journal of American College Health*, vol.

65, no. 3, Apr. 2017, pp. 187–196. *Academic Search Complete*, doi:10.1080/07448481.2016.1269111.

Watson, Andrew M. “Sleep and Athletic Performance.” *American College of Sports Medicine,* Dec. 2017, pp. 413-418. www.revdesportiva.pt/files/para_publicar/Sleep_and_Athletic_Performance.11.pdf.

Ye, Lichuan, et al. “Napping in College Students and Its Relationship With Nighttime Sleep.” *Journal of American College Health*, vol. 63, no. 2, Feb. 2015, pp. 88–97. *SPORTDiscus with Full Text*, oralroberts.idm.oclc.org/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=s3h&AN=101047582&site=ehost-live&scope=site.

Zhang, Yuan, et al. “Relationships among Sleep Quality, Coping Styles, and Depressive Symptoms among College Nursing Students: A Multiple Mediator Model.” *Journal of Professional Nursing: Official Journal of The American Association of Colleges of Nursing*, vol. 34, no. 4, July 2018, pp. 320–325. *MEDLINE with Full Text*, doi:10.1016/j.profnurs.2017.12.004.