The Effects of Sleep Deprivation on the Academic Performance of College Students

Hanah Kim

Abstract— Sleep deprivation is an extremely common problem among college students as approximately 70.6% of the were found to have less than eight hours of sleep per night. Sleep deprivation can have a multitude of adverse effects on college students such as decreased attention spans, fluctuation in emotions, and memory consolidation. This study investigates the effect of sleep deprivation on the academic performance of college students in North Texas. Surveys including questions concerning one's GPA, average sleep time, sleep quality, and daytime sleepiness were distributed to college students in North Texas. Daytime sleepiness was measured using the Epworth Sleepiness Scale (ESS) and sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). It was found that students with a higher GPA generally tended to have a higher average sleep time, lower levels of daytime sleepiness, and better sleep quality. This brings attention to the lack of healthy sleeping habits among college students and unhealthy practices that impede good sleep.

Index Terms— academic performance, college students, daytime sleepiness, sleep deprivation, sleep quality

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1 INTRODUCTION

SLEEP deprivation is defined as when an individual fails to receive enough sleep in order to feel refreshed when they wake up the next day. The recommended amount of sleep for adults is typically estimated to be seven to eight hours, although this number may differ for each person. For example, one may receive six hours of sleep and feel that they have received enough sleep while another may find that they feel sleep deprived after sleeping the same amount of time. Approximately one in five adults is subject to sleeplessness [2].

College students experience various sleep problems that can be caused by a wide range of factor. However, it is important that these students stay focused as colleges and universities provide a unique environment that stimulates more in-depth, critical thinking and allows students to gain experiences that could potentially guide them in the future. Sleeplessness and other sleep disorders can interfere with students achieving academic excellence in higher education institutions as these students take on more responsibilities, such as moving out of their parents' home, internships, and a greater workload. This confirms the significance of research relating sleep and academic performance, particularly among college students.

2 Literature Review

2.1 The Prevalence of Sleepiness

Sleep insufficiency is a very frequently occurring problem and can be caused by several different biological and social conditions. Irregular sleeping patterns can occur more frequently in competitive and stressful environments as seen in Korean and other East Asian high [19], [20]. This pressure can also be seen among many college students who must balance their academic and non-academic commitments. As these young adults pursue their future, they are faced with new responsibilities that they have not encountered previously, including work, internships, and paying for their own living expenses. Moreover, college students are often preoccupied with maintaining their social lives and established new relationships with peers and potentially with romantic partners. These factors can cut into the time spent solely on academics, forcing them to stay up late to finish their school work, which can ultimately hinder them from reaching academic success. In one study, 70.6% of college students were found to have less than eight hours of sleep per night and over 60% were reported to have poor sleep quality [21]. Furthermore, students who were classified as having poor sleep quality had a greater chance of having physical and psychological health problems relative to their peers [21]. The extent of sleep deprivation among college students can also be seen through the 22018 National College Health Assessment for undergraduates from the American College Health Association where "sleep difficulties" was ranked third in factors that students believed to affect their academic performance only behind stress and anxiety [3].

One major cause of sleep deprivation is poor sleep hygiene, which includes the use of substances that may adversely affect one's circadian rhythm or biological clock. Poor sleep hygiene can include alcohol consumption, caffeine and energy drink consumption, intake of stimulants, and technology use. Sleep disorders (e.g. obstructive sleep apnea, insomnia, restless legs syndrome, and narcolepsy) can also make significant contributions to insufficient amounts of sleep [15]. Gaultney claims that 27% of college students are at risk of developing at least one sleep disorder [12]. Additionally, sleep deprivation may be correlated with a student's major, but this has not been thoroughly studied

yet beyond extensive research concerning medical and nursing students primarily. College students who have internships, part-time jobs, or full-time jobs may also see a delay in their bedtimes leading to sleep deprivation, especially for those working later shifts. Older adolescents and young adults are biologically inclined towards a later bedtime due to changes in the circadian rhythm that often results in night-owl tendencies [7].

2.2 Effects of Sleepiness

In literature, sleep deprivation is often grouped into two categories: acute sleep deprivation and chronic partial sleep deprivation. Acute sleep deprivation is when a person stays awake for 24 hours or more [15]. On the other hand, chronic partial sleep deprivation is when a person receives some sleep, but not a sufficient or ideal amount [15]. Both can have an adverse effect on a wide range of cognitive functions, including reactions speed, emotional regulation (especially with depression), executive functions, attention span, and memory consolidation, as well as physical performance.

First, there are several physical effects of sleep deprivation that must be considered. "Obtaining too little sleep upsets the balance" of certain hormones; this can be seen with the release of the stress hormone cortisol after one receives poor sleep and a spike in ghrelin, the hunger hormone, leading to more cravings, which can consequently lead to a greater risk for obesity [24]. Additionally, sleeplessness can lead to increased vulnerability for hypertension, or increased blood pressure, and cardiovascular diseases [24]. People experiencing sleep problems may also find that their immune system has gotten weaker, increasing their susceptibility to diseases. Therefore, sleep can lead to adversely affect one's wellbeing and result in the deterioration of one's health.

Sleep deprivation also impairs cognitive performance by affecting certain parts of the brain that control higher functions like language and creativity [1]. A lack of sleep can also greatly impact certain parts of the brain, particularly the prefrontal cortex, which is associated with executive functions and one's personality [1]. This can lead to greater fluctuations between emotional states and even increase depressive symptoms [9].

Attention and memory are two of the most commonly researched cognitive functions that can be adversely impacted by sleep deprivation; however, it is also important to consider speed and accuracy when measuring attention or memory [25]. It was found that sleep deprivation had an effect on both speed and accuracy while others have found that sleep loss only affects one or the other, most likely due to differing methodologies [25]. In addition to the previously mentioned functions, one study argues that total sleep deprivation results in students becoming less sensitive to risks and often change their risk preferences, which "may

reflect a change in decision-making strategies that varies for gain versus loss" [22]. The specific cognitive task that is associated with this is still unknown. Furthermore, weekend recovery sleep is a frequent coping method that implies sleep deprivation throughout the week and has an ultimately negative impact on one's attention span. This decline in attention and lengthening in reaction speeds can lead to safety hazards, such as drowsy driving, heightening the risk of getting into an accident for those experienci7ng sleep problems.

2.3 Methods

This study is a convergent parallel mixed-method study concerning college students in North Texas and how sleep deprivation affects their academic performance. A survey was conducted asking for each student's school, educational major, average hours slept daily, GPA as a measure of academic performance, daytime sleepiness, sleep quality and confounding variables that interfere with one's academic performance (i.e. sports, work, social media, etc). Daytime sleepiness was measured using the Epworth Sleepiness Scale (ESS) and sleep quality with the Pittsburgh Sleep Quality Index (PSQI). The data were analyzed using statistical analysis.

This study investigates the impact of sleep deprivation on academic performance in undergraduate students in North Texas because there were no previous studies that researched this particular region separately. Furthermore, it is necessary to research the sleep levels of Texas college students because Texas has the "second-highest population of full-time [college] students in the nation" at 1.5 million with "69 private nonprofit schools, 45 public colleges or universities" and "254 for-profit private colleges" [26]. Since Texas has such a large population of college students, it is necessary and important to determine the relationship between sleep deprivation and academic performance in order to implement more effective countermeasures that address the existing and spreading problem. The study area was limited to North Texas for feasibility reasons in order to reduce the population size because 1.5 million students is a substantial number. This did not hinder the data collection because there was found to be 50 colleges and universities in the North Texas region or 14% of all the colleges in Texas.

3 Methodology

This study is a convergent parallel mixed-methods observational study. For this method, the qualitative and quantitative data are collected concurrently before being merged for the interpretation of the data to come to one cohesive conclusion. This study focuses on the effects of sleep on academic performance of students attending a college or university in North Texas. Previous studies have not yet addressed sleep concerns in North Texas specifically. This study was largely inspired by a 2009 study investigating

irregular bedtimes in Taiwanese university students and its impact on sleep quality, daytime sleepiness, and fatigue. This study used the ESS and the PSQI to measure daytime sleepiness and sleep quality respectively, both of which have been included in the survey.

The data were collected through an electronic survey that was developed after reviewing the literature. Surveys were the most practical method for data collection for this study because the researcher did not have access to actigraphy monitors, tools that can monitor a person's rest and activity cycles. The method of distributing surveys for data collection was employed in several studies. Furthermore, multiple studies have used the Epworth Sleepiness Scale [13], [18], [15] and the Pittsburgh Sleep Quality Index [18], [16], and both tests were proven to be credible.

3.2 Study Population

This study investigates the relationship between sleep deprivation and academic performance among 117 undergraduate students in North Texas. A total of 118 college students responded to the survey; however, one did not consent to the use of their information, and thus, was excluded. The study sample was created by first compiling a list of all of the colleges in North Texas; schools with less than a thousand students were excluded from the list in an attempt to reach a more diverse sample. Schools with a higher number of students enrolled will have a greater range of academic abilities and sleep times than those with fewer than one thousand students. The researcher emailed randomly chosen professors from various colleges in order to ask them to distribute the survey to their students. This method attempts to gather a more representative sample because it was not feasible to visit all the colleges in North Texas for the systematic sampling method. A total of 24 professors were contacted, 3 agreed, 18 did not respond, and 3 declined. All participants were over the age of eighteen and electronically provided informed consent to the use of the data collected in this research. The survey was completely anonymous; no identification was required other than each participant's school and major. All surveys were completed online through Google Forms.

3.3 Measures

Both quantitative and qualitative data was collected through a survey concerning the relation between sleep deprivation and academic performance in college students. In the context of this research, the data are primarily quantitative and will be validated by qualitative data. The qualitative and quantitative data will be analyzed separately before being brought together to consolidate a single conclusion.

The survey is consisted of four sections to evaluate each student's major, GPA, total sleep time, daytime sleepiness, sleep quality, and potential confounding variables.

The first section of the survey asks questions concerning one's college and major. These two questions were included because different fields of studies require varying levels of commitment; for example, department A may entail a greater workload than department B, which could potentially cut into sleep time and act as a confounding variable. Additionally, this can also change between colleges. Some colleges may have students with a higher average GPA and a greater work ethic while others do not. Additionally, each professor or school may have varying grading standards, prohibiting uniformity. Students were then asked how many hours they sleep every day on average given the following ranges: less than 2, 2–4, 5–7, 8–10, and more than 10. This is to get an approximate estimate of the students' sleep times. Students were also asked what their ideal sleep time was given the same ranges. This served to find the difference between students' average sleep time and their ideal sleep time. GPA was categorized into four ranges (3.70 or above, 3.69–2.70, 2.69–1.70, 1.69–0.00) and students were also given the choice of "I don't know". The final option was included to prevent skewed data so that when students cannot recall their GPA, they will not choose an answer choice that failed to reflect their true GPA. If students were to select a false option, the data would be inaccurate and consequently leading to faulty conclusions.

The next section of the survey was the Epworth Sleepiness Scale (ESS) to numerically evaluate the daytime sleepiness [17] of each student. The ESS requires students to review a series of eight specific situations and choose how likely they are to doze off or fall asleep, in contrast to feeling tired, with a four-number scale. The scale provided was as follows:

0: would never doze or sleep
1: slight chance of dozing or sleeping
2: moderate chance of dozing or sleeping
3: high chance of dozing or sleeping

A numerical score is calculated by adding the numbers chosen for each situation. A score of 0–10 is normal, 11–14 denotes mild sleepiness, 15–17 is moderate sleepiness, and 18 or higher suggests severe sleepiness. The ESS was determined to be "reliable" with only "one main dimension in its variance" and is a "standardized method for measuring daytime sleepiness in adults" [17]. The ESS was included due to the significant association between daytime sleepiness and sleep deprivation [8]; the correlation between the two allows for the assumption that those who experience daytime sleepiness are most likely sleep deprived. Furthermore, this segment of the survey attempts to address different sleep needs as some people may need more or less sleep than others. Because the ESS is related to sleeplessness,

it can be used in order to assess if one is really sleep deprived.

The third section was the Pittsburgh Sleep Quality Index (PSQI) to determine the sleep quality of each student. The PSQI is specifically based on sleeping habits of the past month and provides a numerical score of the sleep quality of each student. The first four questions of the questionnaire concern the number of hours slept in the past month. The next four questions require the students to record how many times certain situations (i.e. cannot fall asleep within 30 minutes, taken sleep medication, cannot breathe properly while sleeping, etc.) have occurred in the past month. The scale provided is as follows:

0: Not during the past month
1: Less than once a week
2: Once or twice a week
3: Three or more time a week

The last question asks the students to self-evaluate their sleep quality the past month in which:

0: Very good
1: Fairly good
2: Fairly bad
3: Very bad

Receiving a total score of 5 or above is believed to indicate that one has poor sleep quality. The PSQI is known to have a "high test-retest reliability" [4]. One study found that "a global PSQI score greater than 5 yielded a diagnostic sensitivity of 89.6% and specificity of 86.5%" [6] making it a reliable test for research. The PSQI is needed to evaluate the sleep quality and sleep time of college students. This component of the study was also included to contribute and enhance the sleep deprivation variability in the research; it will be used alongside the ESS to address differences of what is perceived to be sleep deprivation among individuals.

The next section of the survey is a series of questions concerning potential confounding variables, which can skew the data collected if not addressed. Some confounding variables may include internships, part-time jobs, family conflict, etc. A student's academic performance will not only be affected by the amount of sleep they get, but by other physical and psychological factors. The inclusion of this question is to identify the external influences other than sleep and to limit the data to the effects of sleep deprivation. The last question in the survey asks whether students think that sleep has an effect on academic performance. This is subjective to their own perspectives. The purpose of this question was to determine whether sleep deprivation is perceived to impact academic performance.

3.4 Data Analysis

Each student's ESS score is calculated by adding up all the values that correspond with the answer choices for each scenario. Scores range from 0 to 24 and a higher score implies greater levels of daytime sleepiness. The PSQI score was calculated using a scoring database [23]. Scores range from 0 to 21, and a number higher than 5 indicates poorer sleep quality. All data were analyzed statistically through SAS University Edition, a free analytical software for academic purposes [11].

4 Results

A total of 118 surveys were returned. Four of the surveys were excluded for failing to provide their GPA and one was excluded for not consenting to the use of their information. Therefore, of the 118 surveys returned, 113 were included in the final analysis. Of the 113 students 69 were nursing students, 19 kinesiology students, 7 health studies students, 7 health and human performance students, 2 students each from general studies, health informatics, and adapted physical education; 1 student each from sociology, engineering, nutrition, and pre-physical therapy. Figure 1 shows the distribution of educational majors within the sample.

fig.1

Major	Frequency
Nursing	69
Kinesiology	19
Health Studies	7
Health and Human Performance	7
General Studies	2
Health Informatics	2
Adapted Physical Education	2
Sociology	1
Engineering	1
Nutrition	1
Pre-Physical Therapy	1

No students reported having a GPA of 1.69 or below. Six students, 5.31%, reported having a GPA of 1.70–2.69. 63 students, 55.75%, reported having a GPA of 2.70–3.69. The remaining 44 students, 38.94%, reported having a GPA of 3.70 or above. The mean sleep time per night was 6.0702 hours, approximately two hours less than the recommended 8 hours. 79.5% of the students claimed to sleep five to seven hours on average, 11.1% eight to ten

hours, 8.5% 2 to 4 hours, and 0.9% more than 10 hours. Additionally, the difference in sleep needs depending on the person is seen through the distribution of ideal sleep time, in which 78.6% selected eight to ten hours as their ideal, 17.9% chose five to seven hours, and 3.4% chose more than 10. The distribution in responses suggests that one person may feel sleep deprived after five to seven hours of sleep while another feels that it was enough.

Figure 2 shows the mean ± standard deviation sleep hours per night, ESS, and PSQI organized by GPA. The highest GPA interval had the greatest average sleep time at 6.5227 hours and the lowest ESS score at 9.2954±3.903. Those who reported their GPA to be between 1.70–2.69 had the shortest average sleep time at 5.750 hours and the highest ESS score at 10.833. Students in the lower two GPA intervals had an average ESS score slightly above the healthy range while students in the highest interval had an average ESS score within the normal range. All three groups had PSQI scores that were above meaning, meaning that all three groups had poor sleep quality. However, those reported to be in the highest GPA interval had a significantly lower PSQI score compared to the other three groups indicating better sleep quality.

fig.2

GPA	n	Sleep (hrs)	ESS	PSQI
1.69 or below	0	—	—	—
1.70–2.69	6	5.750±2.1852	10.833±5.193	12.905±3.0376
2.70–3.69	63	6.1984±1.2654	10.286±4.278	9.7826±2.6961
3.70 or above	44	6.5227±1.2893	9.2954±3.903	8.5333±2.8251

Figure 3 shows the confounding variables reported by the students to the question asking them to list factors that they believed affected their academic performance. Work was the most frequently referenced, followed by sleep, family, health, and stress.

fig.3

Variable	Frequency
Work	64
Sleep	48
Family	38
Health	21
Stress	19
Significant Other	15
Workload	10
Friendship	9
Lack of Motivation	9
Distractions	8
Anxiety	7
Fatigue	6
Children	5
Exercise	5
Social Life	5
Food	4
Money	4
Time Management	4
Commute	3
Volunteering	3
Chores	2
Roommate	2
Pets	2
Social Media	2
Alcohol	1
Confidence	1
Medication	1
Sports	1

Students who have higher GPAs were found to have longer sleep times per night; those who reported a GPA of 3.70 or above had an average sleep time of 6.5227 hours

with a standard deviation of 1.2893 while those who have GPAs within the intervals of 2.70–3.69 and 1.70–2.69 had an average sleep time per night of 5.750±2.1852 and 6.1984±1.2654 respectively. Although the difference may not seem significant, even a slightly shorter sleep time can contribute to higher levels of sleep deprivation. Figure 4 shows the least squares regression line (LSRL) or the line of best fit relating sleep time and GPA. There was a positive slope of 0.3864 meaning that for every increase in GPA, there was a 0.3864 hour increase in sleep time. The coefficient of determination (r^2) was 0.9915 meaning that 99.15% of the variation in hours of sleep can be explained by the linear relationship between sleep time and GPA.

fig.4
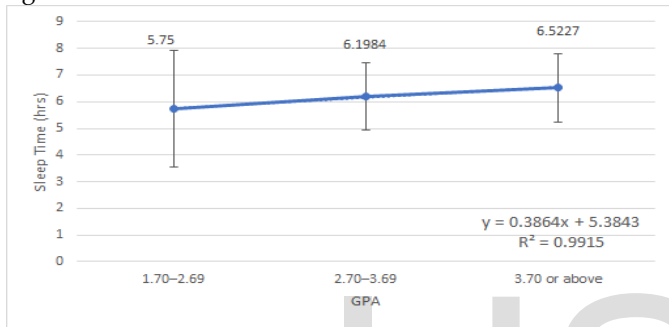
Furthermore, students who have higher GPAs had lower ESS scores. Students with a GPA of 3.70 or above had an average ESS score of 9.2954±3.903, a normal level of daytime sleepiness as it is between 0 and 10. However, students with a GPA within 2.70–3.69 and 1.70–2.69 had average ESS scores that were slightly higher than the normal, healthy amount at 10.286±4.278 and 10.833±5.193 respectively. This shows that there is an association between excessive daytime sleepiness and academic success, as those who portrayed academic excellence had lower levels of sleepiness and lack of energy throughout the day. Figure 5 shows the LSRL relating ESS and GPA. There was a negative slope of -0.7688, which indicates that for every increase in GPA, ESS scores decreased by 0.7688 points. The line has an r^2 value of 0.973 meaning that 97.3% of the variation in ESS scores can be explained by the linear relationship between daytime sleepiness and GPA.

fig.5
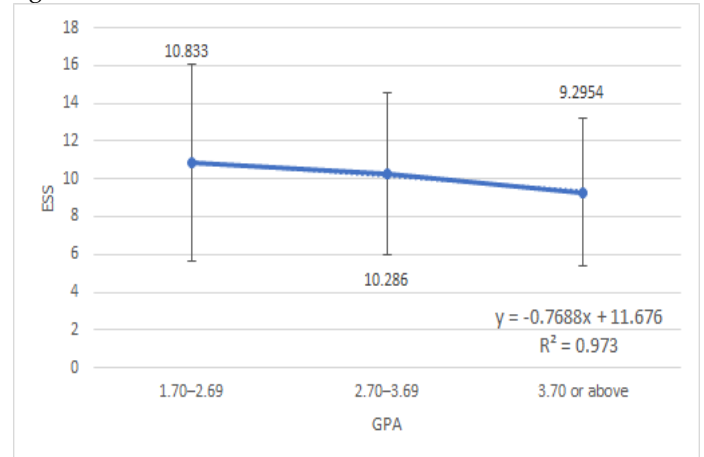
The PSQI scores showed similar results: students with a higher GPA had better sleep quality relative to the others. Those reporting a GPA of 3.70 or above had the lowest average PSQI score at 8.5333±2.8251, implying better sleep quality when compared to those with GPAs within 2.70–3.69 and 1.70–2.69. These results show that poor sleep quality has a negative impact on academic performance as those who reported lower GPAs had PSQI scores reflecting a greater extent of poor sleep quality. Figure 6 shows the LSRL relating PSQI and GPA. There was a negative slope of -2.2993, which indicates that for every increase in GPA, PSQI scores decreased by 2.2993 points. The line has an r^2 value of 0.8912 meaning that 89.12% of the variation in PSQI scores can be explained by the linear relationship between sleep quality and GPA.

fig.6
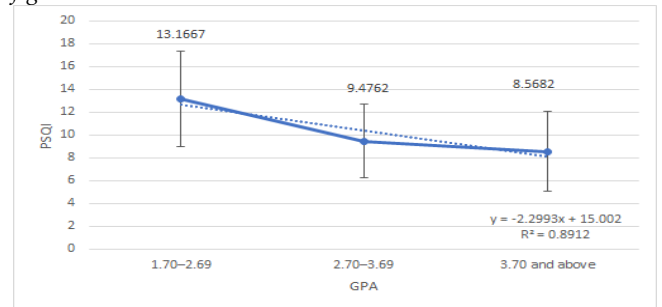
78.63% of students either slept above or under their ideal sleep time, meaning that college students failed to sleep according to the number of hours they believe they need in order to feel refreshed when they wake up. When unable to get enough sleep to feel energized, students can experience a wide array of effects cognitively and physically. Similarly to a lack of sleep, students who sleep more than needed can feel sluggish when they wake up and can be a sign of poor sleep quality. Moreover, 99.1% of students responded "yes" to the question asking whether or not they thought that sleep could affect their academic performance. This shows that the potential effects of sleep deprivation are well-known among college students in North Texas; despite the fact that

sleeplessness is acknowledged as a likely problem in a school environment, there has not been any action to reduce the extent of the problem, raising further concerns about sleep deprivation.

5 Discussion

5.2 Implications

When considering the implications, it is necessary to remember that the data and the implications are based on college students in North Texas only because the study took place solely in the North Texas region.

This study shows that there is a clear association between sleep deprivation and academic performance among North Texas college students. This relationship was further corroborated by the ESS and the PSQI, both of which had an inverse relationship with GPA. As sleep time increased, there was a general decrease in daytime sleepiness and better sleep quality, showing that there is a correlation between total sleep time, drowsiness during the day, and sleep quality.

The data suggests that people who get more sleep per night tended to have a higher GPA, and thus, performed better academically. It was also determined that those who experience daytime sleepiness to a greater extent did not perform as well academically in comparison to those who have lower levels of daytime sleepiness. This trend corroborates that sleep deprivation negatively affects academic performance by accounting for the variation in sleep needs for each student. Students who feel that they are sleep deprived are more likely to experience elevated levels of daytime sleepiness as they are unable to pay attention or focus throughout the day. The data also suggests that students with better sleep quality tend to have a higher GPA. Sleep quality is affected by numerous factors including light, technology use before going to sleep, caffeine intake, anxiety, medications, etc. Poor sleep quality can lead to a student feeling sleep deprived when they wake up despite fulfilling their ideal sleep time, contributing to daytime sleepiness.

One recent study concerning the relationship between sleep habits and academic performance in medical students found similar results in which "a higher proportion of the 'excellent' group felt that they obtained sufficient nocturnal sleep," prompting the conclusion that sufficient amount of sleep was an indicator to academic success [5]. Furthermore, the same study found that the "average" group had higher levels of daytime sleepiness [5]. Drowsiness during the day can impair cognitive tasks, such as attention, problem-solving, and critical reasoning. Sleep deprivation is also associated with depression [27], and can potentially lead to a lack of motivation, loss of interest, and other depressive symptoms. Sleep deprivation has "an association with slowed reaction time, [...] compromised

memory and learning" [14]. Both can potentially have adverse effects because acuteness and memory are crucial to academic success. This is highlighted among college students who are pushed to think outside of the box at higher levels and this must use a wider range of cognitive skills. A common practice among college students is pulling an all-nighter to complete assignments or to study, which, despite its ubiquity, can lead to grave cognitive effects. The consequences of staying up to study for an exam essentially cancels out and defeats the purpose of pulling an all-nighter. The prevalence of this shows that students may not be fully aware of the negative implications of sleep deprivation or that students do not understand the extent of sleep deprivation's impacts.

This study provides a new understanding of the effects of sleep deprivation on the academic performance of college students attending a college or university in North Texas and is significant because of the relatively large population of college students that are located in the state of Texas. A large proportion of the college student population in North Texas is sleep deprived, experience moderate to severe levels of daytime sleepiness, and due to flawed sleeping habits, have poor sleep quality. Sleep deprivation is associated with lower rates of academic performance and is known to cause a greater risk for diseases and detrimentally impact select cognitive tasks. Therefore, the prevalence of sleeplessness, when considering its harmful effects, calls for the need of a solution. Some studies have found that educational programs addressing healthy and unhealthy sleep, such as maintaining good sleep hygiene, benefitted college students who were found to have better sleep quality after the instruction [5], [15]. Colleges and universities in North Texas may find it beneficial to integrate these kinds of programs to promote better sleeping habits and ideally reduce the negative effects of sleep deprivation.

5.3 Strengths and Limitations

There are several strengths to the research. One advantage to the survey used is addressing the confounding variables that may prevent a student from reaching their full academic potentials, such as personal conflict, ailments, work, financial problems, and other factors. It is significant to note that academic performance is not solely affected by the amount of sleep a student gets or the quality of sleep. Additionally, the sample size is restricted to North Texas college students, allowing for more concentrated research that focuses on one specific region.

There are several limitations that must be considered when reviewing the data. First, the sampling method could have led to biased data. The researcher emailed randomly chosen professors at colleges in North Texas and asked them to distribute the survey to their students. This method can lead to overrepresentation of

certain parts of the population that made up the majority of the sample size and underrepresentation of those who did not make up a prominent proportion of the overall sample. The majority of the data came from students attending Texas Woman's University and Texas A&M University-Commerce. However, there are 50 colleges in North Texas alone, meaning that the sample represents only a very small proportion of the population. The lack of full representation of the population relates to sample bias; this can be seen as the students are not evenly distributed among all of the departments offered at the colleges. However, other methods were not feasible in the context of this research because a sampling frame of the population was unavailable. Moreover, very few professors responded and agreed to distribute the survey, resulting in a sample concentrated within a small collection of colleges in all of North Texas. Thus, one major limitation of the data collected is that the sample was not representative of the entire population because the research conducted was clustered in only one area of North Texas because the sample was not ideal for the given population. Additionally, the uneven distribution of GPAs acted as a limitation in the data analysis because it prohibited effective comparisons of the four GPA intervals. This is prominent with the lowest GPA range of 1.69 or below, which did not have any data, and the second lowest range of 1.70–2.69, which only six students selected.

Another limitation is that the academic performance of the students was limited to their GPA, which is not the only measure of how well one does in school. There are other measures that were not taken into account concerning academic performance; for example, students with test anxiety. One's GPA may not truthfully represent a student's academic achievements because there are multiple factors that play into one's success in the educational system, and this may lead to an ineffective analysis of the data. Furthermore, there were some who did not want to fill out the survey leading to nonresponse bias. A source of response bias is that sleep times and GPAs were self-reported, allowing for potential response bias among students who do cannot recall when they fall asleep or what their GPA is. Because the answers were subjective, there is a higher chance of bias and inaccuracies within the data.

Finally, this study is an observational study, and so it is unable to establish causation. Because it was not an experimental design that assigned different treatments to individuals, it cannot be said that sleep deprivation causes a decline in academic performance. It is only possible to say that students who are sleep deprived generally had a lower GPA. This also limits the implications and the data significantly. For these reasons, the data collected must be interpreted with careful consideration.

6   Conclusion

This study investigates the effects of sleep deprivation on academic performance in college students in North Texas. Sleep time in hours and GPA had a strong, positive, linear relationship, indicating that students who received more sleep per night had a higher average GPA. Daytime sleepiness and GPA had a strong, negative, linear relationship, suggesting that students with greater levels of daytime sleepiness had a lower average GPA. Sleep quality and GPA also had a strong, negative, linear relationship, implying that students with poor sleep quality had a lower average GPA. The implications of the data call for the need of programs promoting better sleep quality and hygiene in colleges and universities in North Texas. There should be further research concerning the differences in sleep aspects among various fields of studies or majors. This is because one major may entail a greater workload or be more difficult academically, which would contribute to variations in sleep.

References

[1] Alhola, P., & Polo-Kantolo, P. (2007). Sleep deprivation: Impact on cognitive performance. *Neuropsychiatric Disease and Treatment, 3*(5), 553–567. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2656292/.

[2] American Academy of Sleep Medicine. (2008). Sleep Deprivation. https://aasm.org/resources/factsheets/sleepdeprivation.pdf.

[3] American College Health Association. (2018). American College Health Association: National College Health Assessment II Undergraduate Student Reference Group Executive Summary Spring 2018. https://www.acha.org/documents/ncha/NCHA-II_Spring_2018_Undergraduate_Reference_Group_Executive_Summary.pdf.

[4] Backhaus J., Junghanns, K., Broocks, A., Riemann, D., & Hohagen, F. (2002). Test-retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. *Journal of Psychosomatic Research, 53*(3), 737–740.

[5] BaHammam, A.S., Alzakri, A.A., Almeneessier, A.S., & Sharif, M.M. (2012). The relationship between sleep and wake habits and academic performance in medical students: a cross-sectional study. *BMC Medical Education, 12*(1). https://doi.org/10.1186/1472-6920-12-61.

[6] Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R., & Kupfer, D.J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193–213.

[7] Carskadon, M.A., Vieira, C., & Acebo, C. (1993). Association between Puberty and Delayed Phase Preference. *Sleep, 16*(3), 258–262. https://doi.org/10.1093/sleep/16.3.258.

[8] Chokroverty, S. (2017). Sleep Deprivation and Excessive Daytime Sleepiness. *Sleep Disorders Medicine*, 22–39. https://doi.org/10.1007/978-1-4939-6578-6_3.

[9] Conklin, A.I., Yao C.A., & Richardson C.G. (2018). Chronic sleep deprivation and gender-specific risk of depression in adolescents: a prospective population-based study. *BMC Public Health, 18*(1). https://doi.org/10.1186/s12889-018-5656-6.

[10] *Epworth Sleepiness Scale.* (2018). Retrieved from http://healthysleep.med.harvard.edu/narcolepsy/diagnosing-narcolepsy/epworth-sleepiness-scale.

[11] *Free Statistical Software, SAS University Edition*. (2019). *Sas.com*. Retrieved from https://www.sas.com/en_us/software/universityedition.html.

[12] Gaultney, J.F. (2010). The Prevalence of Sleep Disorders in College Students: Impact on Academic Performance. *Journal of American College Health, 59(2)* 91–97. https://doi.org/10.1080/07448481.2010.483708.

[13] Gibson, E.S., Powles, A.P., Thabane, L., O'Brien, S., Molnar, D.S., Trajanovic, N., Chilcott-Tanser, L. (2006). "Sleepiness" is serious in adolescence: Two surveys of 3235 Canadian students. *BMC Public Health, 6*(1). https://doi.org/10.1186/1471-2458-6-116.

[14] Hershner, S.D. (2015) Is sleep a luxury that college students cannot afford? *Sleep Health, 1*(1), 13–14. https://doi.org/10.1016/j.sleh.2014.12.006

[15] Hershner, S.D., & Chervin, R.D. (2014). Causes and consequences of sleepiness among college students. *Nature and Science of Sleep, 6*, 73–84. https://doi.org/10.2147/NSS.S62907.

[16] Hysing, M., Harvey, A.G., Linton, S.J., Askeland, K.G., & Sivertsen, B. (2016) Sleep and academic performance in later adolescence: results from a large population-based study. *Journal of Sleep Research, 25(3)*, 318–324. https://doi.org/10.1111/jsr.12373.

[17] Johns, M.W. (1992). Reliability and Factor Analysis of the Epworth Sleepiness Scale. *Sleep, 15*(4), 376–381. Retrieved from https://academic.oup.com/sleep/article-pdf/15/4/376/13659687/sleep-15-4-376.pdf.

[18] Kang, J.H., & Chen, S. (2009). Effects of an irregular bedtime schedule on sleep quality, daytime sleepiness, and fatigue among university students in Taiwan. *BMC Public Health, 9*(1). https://doi.org/10.1186/1471-2458-9-248.

[19] Kim, S.J., Lee Y.J., Cho S., Cho, I., & Lim, W. (2011). Relationship Between Weekend Catch-up Sleep and Poor Performance on Attention Tasks in Korean Adolescents. *Archives of Pediatrics & Adolescent Medicine, 165(9)*, 806–812. doi:10.1001/archpediatrics.2011.128.

[20] Lo, J.C., Ong J.L., Leong R.L.F., Gooley, J.J., & Chee, M.W.L. (2016). Cognitive Performance, Sleepiness, and Mood Partially Sleep Deprived Adolescents: The Need for Sleep Study. *Sleep, 39(3)*, 687–698. https://doi.org/10.5665/sleep.5552.

[21] Lund, H.G., Reider, B.D., Whiting, A.B., & Prichard, R. (2010). Sleep Patterns and Predictors of Disturbed Sleep in a Large Population of College Students. *Journal of Adolescent Health, 46*(2), 124–132. https://doi.org/10.1016/j.jadohealth.2009.06.016.

[22] McKenna, B.S., Dickinson, D.L., Orff, H.J., Drummond, S.P.A. (2007). The effects of one night of sleep deprivation on known-risk and ambiguous-risk decisions. *Journal of Sleep Research, 16*(3), 245–252. https://doi.org/10.1111/j.1365-2869.2007.00591.x.

[23] *Pittsburgh Sleep Quality Index*. (2019). *Sleep.pitt.edu*. Retrieved from https://www.sleep.pitt.edu/research/instruments.html.

[24] *Sleep and Disease Risk*. (2019). *Healthysleep.med.harvard.edu*. Retrieved 1 April 2019, from http://healthysleep.med.harvard.edu/healthy/matters/consequences/sleep-and-disease-risk.

[25] Smith, M.E., McEvoy, L.K., Gevins, A. (2002). The Impact of Moderate Sleep Loss on Neurophysiological Signals during Working-Memory Task Performance. *Sleep, 25*(7), 784–794. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1626388/

[26] Tomar, D. (2018). *A 50-State Look at Colleges & Universities in the U.S. TheBestSchools.org*. Retrieved 1 April 2019, from https://thebestschools.org/magazine/college-by-state/#TX.

[27] Tsuno, N., Besset, A., & Ritchie, K. (2005). Sleep and Depression. *The Journal of Clinical Psychiatry, 66*(10), 1254-1269. http://dx.doi.org/10.4088/JCP.v66n1008.