

The relationship between sleep and academic performance in high school students: The statistics and the perspectives

word count: 4,131

Abstract

This paper discusses my study which aimed to identify the correlation between sleep quantity and academic performance and to identify adolescent perceptions on this correlation. Sleep data was collected using the Sleep Cycle mobile phone app and adolescent perceptions were collected by administering the Pittsburgh Sleep Quality Index (PSQI) and a survey of my own that I created. Results showed a slight positive correlation between sleep quantity and academic performance. Additionally, a majority of adolescents believed that sleep had a great influence on their academics and that school had a great influence on their quantity of sleep. However, there were mixed results when students were asked if school had a great influence on their quality of sleep. Further research must seek to uncover the mysteries of sleep by improving current research methods.

Keywords: sleep, academic performance, adolescent perceptions, correlation

Introduction and Literature Review

Adolescents frequently suffer from sleep problems that lead to negative effects on their daily functioning (Dewal-Kaufmann, Oort, Bögels, & Meijer, 2013; Gibson et al., 2006; Wolfson & Carskadon, 1998). The consequences of sleep deprivation are highly prevalent among the American youth. Parents, teachers, and adolescents themselves struggle to find solutions to ameliorate the issue. Sleep problems, typically brought on by short sleep duration and low sleep quality, are a common occurrence during adolescence. These issues are a product of both social and biological factors that occur during puberty (Dewal-Kaufmann et al., 2013; de Souza, de Sousa, Maia, & de Azevedo, 2012). Researchers continue to study adolescent physiology to increase their understanding of the complexities of adolescent sleep. Currently, it is known that due to changes in their circadian rhythm (biological clock) adolescents experience a biologically delayed sleep phase that releases melatonin, a sleep-inducing hormone, around eleven p.m. and stops being released around eight a.m. (Hansen, Janssen, Schiff, Zee, & Dubocovich, 2005). Therefore, adolescents are unable to fall asleep earlier in the evening and are not getting enough sleep if they have to wake up early, leaving them tired and sluggish throughout the day.

A general coping technique for managing sleep deprivation is attempting to “catch up” for lost sleep by increasing one’s sleep duration on the weekends. While many believe that this will improve sleep quality, it worsens sleep problems by producing a “jet-lag” feeling (Manzar, Zannat, Kaur, & Hussain, 2015). Although various studies highlighted differences in individual sleep need, researchers suggest that to feel rested and alert, adolescents should obtain approximately eight to ten hours of sleep each night (de Souza et al., 2012; Dewal-Kaufmann et al., 2013; Teufel, Brown, & Birch, 2007). Additionally, many sleep disorders go undiagnosed because the public is oblivious to the significance of sleep or the consequences of low sleep

quality and/or quantity. Thus, adolescents exacerbate their condition by not being able to take preventative measures and treat their sleeping disorder. Specifically, a study conducted in a public university located in the Midwest found that 50% of the sample population of 172 undergraduate students had symptoms of sleep disorders that were not diagnosed (Chiang, Arendt, Zheng, & Hanisch, 2014). Such sleep problems are ubiquitous in this age group (Dahl, 1999). Adolescents can experience these for several reasons--both voluntarily by sacrificing sleep to achieve academic excellence or to fulfill their social life, and/or involuntarily due to the noisy environment they live in (Gaultney, 2010; Mirghani, Mohammed, Almutadha, & Ahmed, 2015).

The repercussions of insufficient sleep or an untreated sleep disorder are profound. Many studies have revealed that sleep not only influences one's mood and behavior, but also leads to poor academic performance (BaHamam, Alaseem, Alzakri, Almeneessier, & Sharif, 2012; de Souza et al., 2012; Ming, Koransky, Kang, Buchman, Sarris, & Wagner, 2011; O'Brien, & Mindell, 2005; Williams, & Aderanti, 2014; Dewald, Short, Gradisar, Oort, & Meijer, 2012). Sleep problems have been associated with, "deficits in attention and academic performance, drowsy driving, risk-taking behavior and depression, impaired social relationships, and poorer health," (Gaultney, 2010) as well as impaired daytime functioning (Onyper, Thacher, Gilbert, & Gradess 2012) and memory (Gradisar, Terrill, Johnston, & Douglas, 2008). For instance, a study conducted at Minnesota State University revealed that in a population sample of 415, 70% of university students had clinically poor sleep quality (Gilbert, & Weaver, 2010). Nevertheless, another study conducted at the University of Toledo revealed that while students perceived that school had a significant impact on sleep patterns, their self-reported grades showed that there was no significant relationship found between sleep quantity and academic performance

(Noland, Price, Dace, & Tell Johann, 2009). Similar results were found in a study from the College of Dentistry in Riyadh, Saudi Arabia, where student self-reported GPA had a strong negative correlation with their Pittsburgh Sleep Quality Index (PSQI) scores (Elagra, Rayyan, Alnemer, Alshehri, Alsaffar, Al-Habib, & Almosajen, 2016). Furthermore, when asked to identify potential factors that influenced their insufficient sleep, 46.5% of students reported that it was because they had too much homework, 42% reported too much stress, 39.4% watching TV, and 30% too much hanging out with friends (AlFakhri, Sarraj, Kherallah, Kuhail, Obeidat, & Abu-Zaid, 2015). In this way, it can be deduced that school has a significant impact on adolescent perceptions of sleep.

In my study, sleep deprivation was defined as students who on average received less than six hours of sleep per night. Sleep quality was defined on the basis of one's level of sleepiness throughout the day, their feelings of restfulness upon waking, and the number of awakenings they experienced in the night. Similarly, sleep quantity was defined as the amount of sleep one obtained. Academic performance was stratified according to one's GPA at the end of the second grading period (nine-week time frame). The grading scale was as follows: a 4.0 indicated an A-average, a 3.0 a B-average, a 2.0 a C-average, a 1.0 a D-average, and anything below that an F-average. Students who were performing better academically had an A- and B-average while those with a C-, D-, and F-average were considered to be struggling academically.

There were various gaps in the literature that needed to be addressed. First, most studies recorded and collected their sleep data through use of a sleep diary. As such, for my own study I decided to use the Sleep Cycle app as a new, more efficient form of data collection. In addition, a majority of studies in the United States focused on college students; those who had high school students were located in Europe and thus, not generalizable to the United States due to

differences in cultural and educational systems. All the studies, to my knowledge, were either quantitative or qualitative; my research is different for it employs a mixed-method design.

The objective of this mixed-methods correlational study was to a) identify the possibility of a correlation between sleep quantity and academic performance and b) analyze adolescent perceptions of their sleep habits. Data was collected through the PSQI, a mobile phone app called Sleep Cycle that analyzed sleep data, and grades. This study sought to answer: What is the correlation between sleep quantity and academic performance? In what ways do high school students perceive the effects of sleep on academic performance?

Methods

This research was a mixed methods study. Being mixed methods, it included both qualitative (survey) and quantitative (survey; data from Sleep Cycle) aspects.

Participants

A total of 10 adolescents from a southeastern United States public high school in grades 10-12 participated in the study. Students in ninth grade were purposefully left out due to their inexperience and hard transition in high school. Participants were not chosen directly; the study was advertised and whoever wanted to participate was able to. Of this sample, three were male and seven were female. The mean age of the sample was 16.7.

Data Collection

Sleep data and Grades. Ten participants recorded their sleep data through a free mobile sleep app called Sleep Cycle for a two-week period during the second grading period of the school year. Once participants downloaded the app, they were instructed on how to use it and were told to record their sleep each night throughout the fortnight. Sleep Cycle was turned on with the phone placed face down, alerting the app to begin recording sleep. The app recorded

their sleep with consideration to the rapid eye movement (REM) cycle. During REM, one's body is in a state of paradoxical sleep where they are essentially paralyzed. Thus, if the phone does not detect movement, it records the participant as sleeping. However, if the phone detects movement, Sleep Cycle records the participant as awake. Through this, the app was able to analyze the data collected, determining sleep time and quality (See: *Figure 13*). Grades were digitally sent to the researcher from a county gradebook database and collected at the end of the second grading period. Then, this information was correlated with the sleep data collected (See: *Figure 4*).

Surveys. Participants completed a self-report questionnaire, the PSQI, a renowned sleep survey used among prominent researchers that assesses sleep quality over a one-month-time interval. This sleep survey included quantitative and qualitative questions related to usual sleep habits. I also created a supplemental survey that inquired about student perceptions of the accuracy of the Sleep Cycle app utilized and the effect of sleep on their academic performance. This survey used a 5-point Likert scale, a psychometric response scale used in questionnaires to identify a participant's degree of agreement with a set of statements. It asked them to indicate to what extent they agreed with the following remarks: "Sleep has a great influence on my school/academic performance," "School has a great influence on my quantity of sleep," and "School has a great influence on my quality of sleep," (See: *Figure 11*). Students ranged their answers on a one to five scale, one being "strongly disagree" and five being "strongly agree."

Consent forms were signed by participating adolescents and their parents. To ensure confidentiality, no identifying information was released. This data was used to identify student perceptions of their sleep habits and if there was a correlation between sleep quantity and academic performance. This data was compiled into an Excel spreadsheet and the results were analyzed by correlating average sleep time and grade point average (GPA).

Results

In this study, I sought to ascertain the correlation between sleep quantity and academic performance, and high school student's perceptions of that correlation. First, students recorded their sleep data through Sleep Cycle, then completed the PSQI (See: *Figure 12*) to indicate their sleep quality. Lastly, the participants filled out a survey of my own creation that inquired about the accuracy of the app, as well as their perceptions of their sleep and academic performance.

I found that sleep quality was directly correlated to sleep time according to the Sleep Cycle app (See: *Figure 3*). Therefore, when analyzing the correlation with academic performance, I decided to use only one variable—the sleep time variable. This correlation showed that the more you sleep, the better your sleep quality would be; on the same note, the less you sleep, the poorer your sleep quality. There was never a point that indicated high sleep quality and low sleep time.

I identified weekday days as Sunday through Thursday, which are all school nights, and weekend days as Friday and Saturday. The weekday average for these students is 5.8 hours while the weekend average is 7.5 hours (See: *Figure 10*). Over the course of the week, students received less sleep (See: *Figure 2*). Although the data presented a weekday average of 5.8 hours of sleep, when looking at individual data students sometimes slept one or two hours a night (See: *Figure 1, Figure 10*). Specifically, 80% students averaged less than seven hours of sleep. Students slept an average of 1.7 hours more on the weekend and 80% of students slept more on the weekends than the weekdays (See: *Figure 1*).

The PSQI, a renowned sleep survey used among researchers to determine sleep quality, was used in this study. These participants responded to self-administered questions from the

PSQI to determine their global sleep quality score. The PSQI consists of a series of questions of the environment in which the participants sleep and their impression of their quality of sleep. The questions were then scaled, and if an individual obtained a global sleep quality score greater than five in the questionnaire, their sleep quality was deemed poor. In this study, 90% of the students had poor sleep quality. If a score of five equates to poor quality, it can be deduced that those who attained a PSQI score of ten to twelve had significantly poor sleep quality. According to that logic, 40% of students had scores that indicated significantly poor sleep quality (See: *Figure 6*). Additionally, I correlated the PSQI scores with the quantity data gathered from Sleep Cycle, which showed that the scores are consistent with the data gathered from the app (See: *Figure 5*). If the app recorded high sleep quantity, the students' PSQI scores mirrored that. For example, student three (S3) had a high average for sleep time, which translated to good quality of sleep according to the PSQI. In this survey, the students were asked what they perceived as being the most detrimental activities or situations to their sleep habits. The students attributed their lack of sleep to a number of factors. Eighty percent cited that they had to stay up doing homework, 30% listed their jobs, 20% ascribed their insufficient sleep to technology, and 10% said they had no trouble sleeping.

The final relationship between sleep time and academic performance was analyzed, indicating a positive but weak correlation (See: *Figure 4*). Although not statistically significant, the positive correlation suggests that kids with low sleep time are performing worse academically. The correlation showed that for every three hours of additional sleep, the student's GPA would be raised by half of a letter grade. Those with more sleep received better grades; those not getting enough sleep struggled. It is important to note here, however, that correlation does not equal causation; therefore, it cannot be fully concluded that sleep directly influences

academic performance as there may be other variables that played a role.

When students were asked if they thought Sleep Cycle was accurate in the representation of their sleep, 70% said yes, 20% said no, while 10% were not sure (See: *Figure 8*). Students took the survey I had created that utilized a 5-point Likert scale. It asked them to indicate to what extent they agreed with the following statements: “Sleep has a great influence on my school/academic performance”; “School has a great influence on my quantity of sleep”; and “School has a great influence on my quality of sleep” (See: *Figure 11*). Prior to surveying them, I assigned numerical values to the scale. Identifying the statement as one or two would indicate a low influence, three a medium influence, and four or five a high influence. Statement one had an average of 3.7, statement two had an average of 4.3, and statement three had an average of 3.2. More specifically, 70% of students believed that sleep had a great influence on their school/academic performance while 20% believed it only had a moderate influence, and 10% believed it had a weak influence. Eighty percent of the students indicated that school had a great influence on their quantity of sleep, while the remaining 20% said it did not have much of an influence. Lastly, 40% of the students believed that school had a great influence on their quality of sleep, in contrast to the 30% who believed it had only a moderate influence. The final 30% believed school did not have a great influence on their quality of sleep (See: *Figure 8*).

Discussion

The purpose of this study was to identify the correlation between sleep time and academic performance as well as to evaluate adolescent perceptions of those two variables. Through careful research and analysis, I found a positive correlation between sleep quantity and academics. These results have been emulated in various studies (BaHammam, Alaseem, Alzakri, Almeneessier, & Sharif, 2012; de Souza et al., 2012; Ming, Koransky, Kang, Buchman, Sarris, &

Wagner, 2011; O'Brien, & Mindell, 2005; Williams, & Aderanti, 2014; Dewald, Short, Gradisar, Oort, & Meijer, 2012). For instance, Lowry found a significant positive correlation between sleep time and GPA. In his study, students who slept more each night received slightly higher grades (2010). This was also true in a study conducted by Williams whose research demonstrated a strong relationship between sleep patterns and academic performance (2014). My regression analysis showed that those students who slept less and had poor sleep quality were more likely to have lower academic performance. These same results were found in a study conducted by Gilbert where lower sleep quality was directly correlated to academic performance (2010).

Students averaged 5.8 hours of sleep during the week and 7.5 hours of sleep on weekends. One hundred percent of students obtained less than eight hours of sleep which is the minimum recommended sleep time for adolescents (de Souza et al., 2012; Dewal-Kaufmann et al., 2013; Teufel, Brown, & Birch, 2007). According to the definition of sleep deprivation delineated earlier, students who receive less than six hours of sleep on average, 70% of my participants are sleep deprived (See: *Figure 10*). Gibson also found that 70% of his participants obtained less than 8.5 hours of sleep which contributed to Excessive Daytime Sleepiness (EDS) and symptoms of sleep deprivation (2006). Similarly, Teufel's results showed that most early adolescents receive an insufficient amount of sleep—specifically, only 14.1% of the research subjects met the recommended amount of sleep time (2007).

Sleep researchers have revealed that adolescents experience a biological change during puberty that affects their circadian rhythm, resulting in vast changes in their sleep cycle. Sleep researchers have declared that to have a healthy sleep schedule, adolescents must receive an average of eight to ten hours each night (Dahl, 1999). The participants of my study only received a weekday average sleep time of 5.8 hours, and are not reaching the suggested eight hours, even

on the weekend (7.5 hours). This had an impact on their academics, and suggests significant consequences. Although there are many external factors that may contribute to this sleep deprivation, many students have declared it is mainly because of too many demands from school and work. In a similar sleep study, Noland reported that when asked to identify the factors that prevented them from getting enough sleep, 46.5% of students reported that it was because they had too much homework, 42% reported too much stress, 39.4% watching TV, and 30% too much hanging out with friends (Noland, 2009). Per these adolescent perceptions, school has a significant impact on quantity of sleep. Additionally, 70% of the participants in my study declared that sleep had a great influence on their academics, 80% believed that school had a great influence on their quantity of sleep, and 40% believed that school had a great influence on their quality of sleep. Alfakhri found similar results that stated that 78% of students believed sleep had a negative impact on their academic performance (2015).

There have been studies that have found conflicting results to mine--for example, Elagra declared that PSQI was not associated with academic performance (2016). Likewise, Noland discovered that while students perceived that school had a significant impact on sleep patterns, their self-reported grades showed that there was no significant relationship found between sleep quantity and academic performance (2009). Further, Mak found mixed results in the relationship between sleep duration and academic performance—while some students experienced adverse effects of insufficient sleep, others showed that daily functioning and academic performance was not associated with total sleep duration in adolescents (2012). Nonetheless, most studies established that sleep had a significant impact on academic performance.

Implications of these results are far reaching, affecting school boards, educators, parents, and the students themselves. Sleep has been shown to play a significant role in learning and

cognitive function; the community must be informed of the possible consequences. Without healthy sleep, students will suffer physical, mental, emotional, social, and academic repercussions (Gaultney, 2010). Such findings may influence school board decision making to change school times to better accommodate an adolescent's biologically-altered sleeping schedule. Boyland found numerous benefits to changing school times to combat adolescent sleep deprivation. He conducted a longitudinal study that examined the parent and teacher perceptions of school time changes. Parents were satisfied with the outcome of increased student sleep duration and increased learning times. The time change that was implemented benefitted students for it closely matched their natural sleep schedules (2015). Although there are complications involved in changing school times, such as the difficulty of adjusting teacher, parent, and school activity schedules and the cost of additional bus services, changing school hours would result in an increase in academic scores and sleep. Also, there may be a decrease in tardiness, behavioral problems, car accidents, and dropout rates as it did in a 2002 study in various states including Kentucky, Virginia, Connecticut, and Minnesota (Kalish, 2008). The benefits far outweigh any inconveniences that may come with changing school times that better accommodate the natural adolescent sleep pattern.

Furthermore, if parents are aware of the importance of sleep and the impact of sleep deprivation, they may be able to help their children develop healthy sleep habits. Parents often play a vital role in a child's sleep schedule and can help with their children's sleep by setting a bedtime, limiting electronic use during night-hours, teaching time management, and most importantly, educating their kids on the topic of sleep. If students aren't aware of the importance of sleep and unhealthy sleep habits, it may result in an endless cycle of sleep deprivation that leads to severe social, mental, emotional, and physical consequences. Many sleep deprived

students are already at risk for sleep disorders, and a lack of knowledge may lead to an increase in sleep disorders (Gaultney, 2010). If this is approached correctly through educational services and an increased awareness of the topic, communities can unite to confront this problem that is affecting so many individuals in every age group. Communities can begin to recognize signs of sleep deprivation, take control of their sleep hygiene, raise awareness of healthy and unhealthy sleep habits, and execute preventative measures and treatments when necessary.

Limitations

There were various limitations I encountered in my study. Firstly, I handed out over 30 consent forms and only got 18 back. In the end, I had an even smaller sample size because only 10 participants followed the study's instructions correctly. The response rate was less than expected which may have impacted the validity of the study. Furthermore, because of the difficulties that come with working with high school students, such as a lack of reliability, there was missing information for sleep times for some of the students (See: *Figure 10*). This may reduce the credibility of the results. Additionally, the credibility of the Sleep Cycle app is unknown because no other researcher, to my knowledge, has used it in their studies. A more credible device would have been actigraphy or FitBits—both being devices that monitor the human rest/activity cycle. However, that would require monetary contributions that I did not have access to. Also, additional variables that may have impacted sleep and/or academic performance were not collected, and as such not analyzed, thus preventing me from being able to make causal conclusions. If I did so, it could have led to different discoveries. The use of a sleep diary to collect data, as used in numerous other sleep studies, in conjunction with the Sleep Cycle app, could possibly give clues as to why students slept more or less on certain days as compared to others. Nevertheless, the Sleep Cycle app was chosen as the preferred method of acquiring

data due to its ability to be more effective and efficient in collecting the said data. Moreover, I had noticed that none of the other researchers approached this type of method, thus suggesting a gap in the research that could be filled. Furthermore, the PSQI relies on subjective data which may reduce the validity of the study. Lastly, the application of a cross-sectional research design limited this study; due to time constraints, I was not able to conduct a longitudinal study which could offer more credibility to the data collected. If all of these elements were to be changed or adjusted for this study, then I believe the future implications and directions would be significant.

Conclusion

In conclusion, my results showed a positive correlation between sleep time and academic performance, highlighting the connection between the two variables. The study revealed adolescent perceptions of this correlation—a majority of students believed that sleep had a great influence on their academic performance and that school had a great influence on their sleep time. Conversely, there were mixed results on whether school had a significant influence on one's quality of sleep.

Future Directions

Further research must seek to uncover the mysteries of adolescent physiology by improving current research methods. Through the conduction of longitudinally designed studies and the application of objective research approaches, such as using actigraphy or a Fitbit to record and collect sleep data, researchers can make immense progress with sleep studies. Additionally, isolating and analyzing other variables that may be a strong influence on academic performance and/or sleep will help lead to causal conclusions. Executing these ideas will help identify and implement potential solutions and precautionary policies that diminish the

prevalence of sleep problems among adolescents during puberty. Lastly, but most importantly, it is essential to educate and raise awareness of healthy and unhealthy sleep habits.

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Appendix A

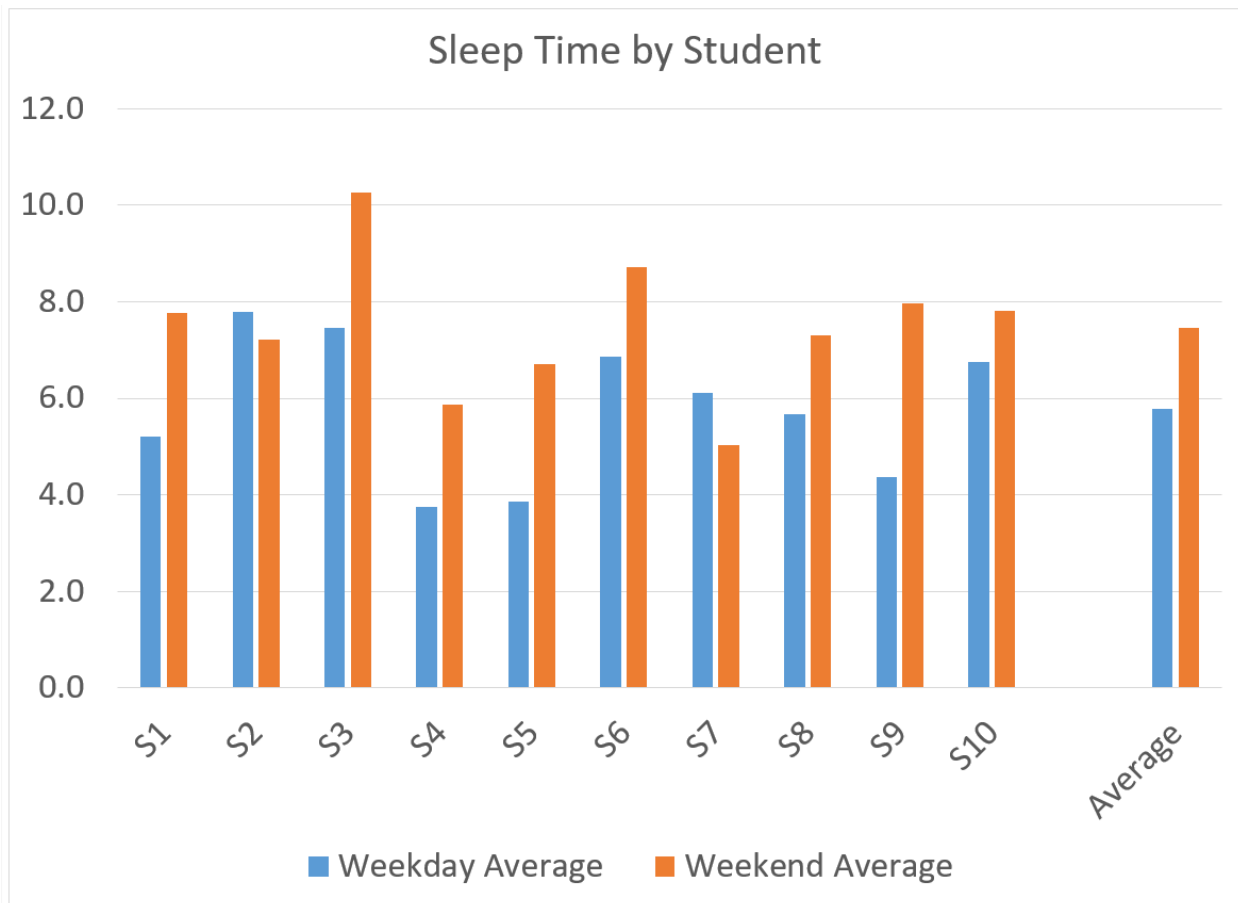


Figure 1: This graph shows average weekday and weekend sleep time by student.

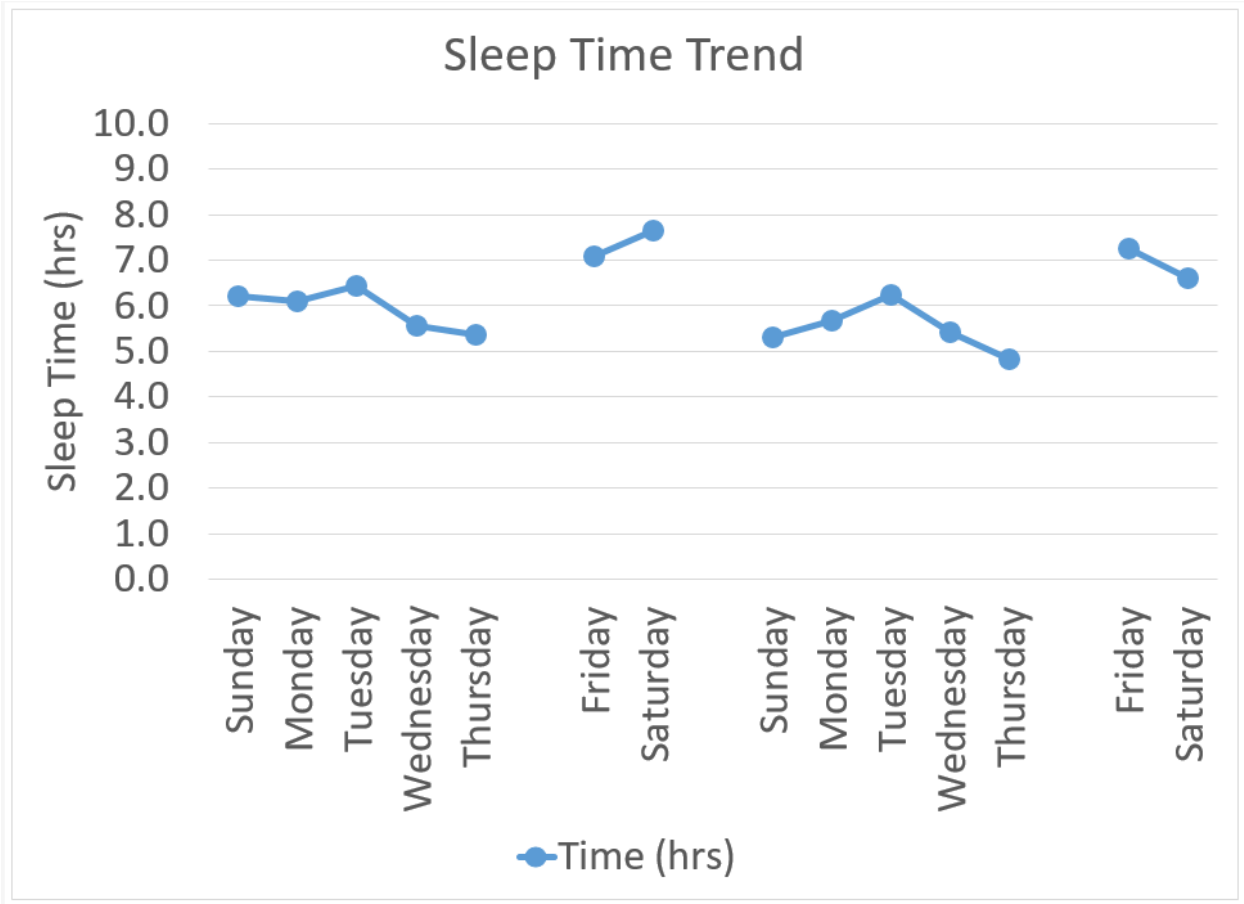


Figure 2: This graph shows the sleep time trend of students throughout two school weeks.

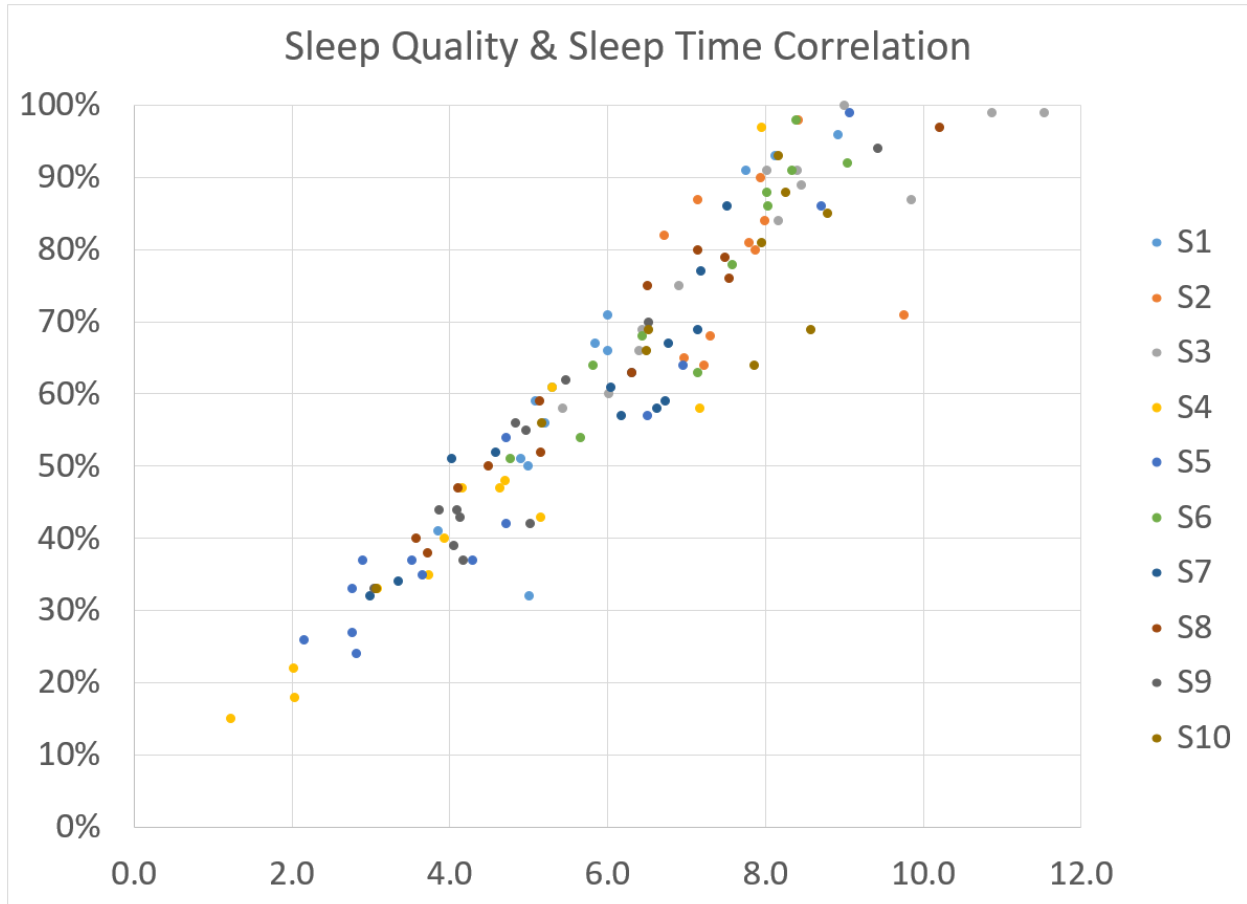


Figure 3: This graph shows the direct correlation between the sleep quality and sleep time variables per the Sleep Cycle app.

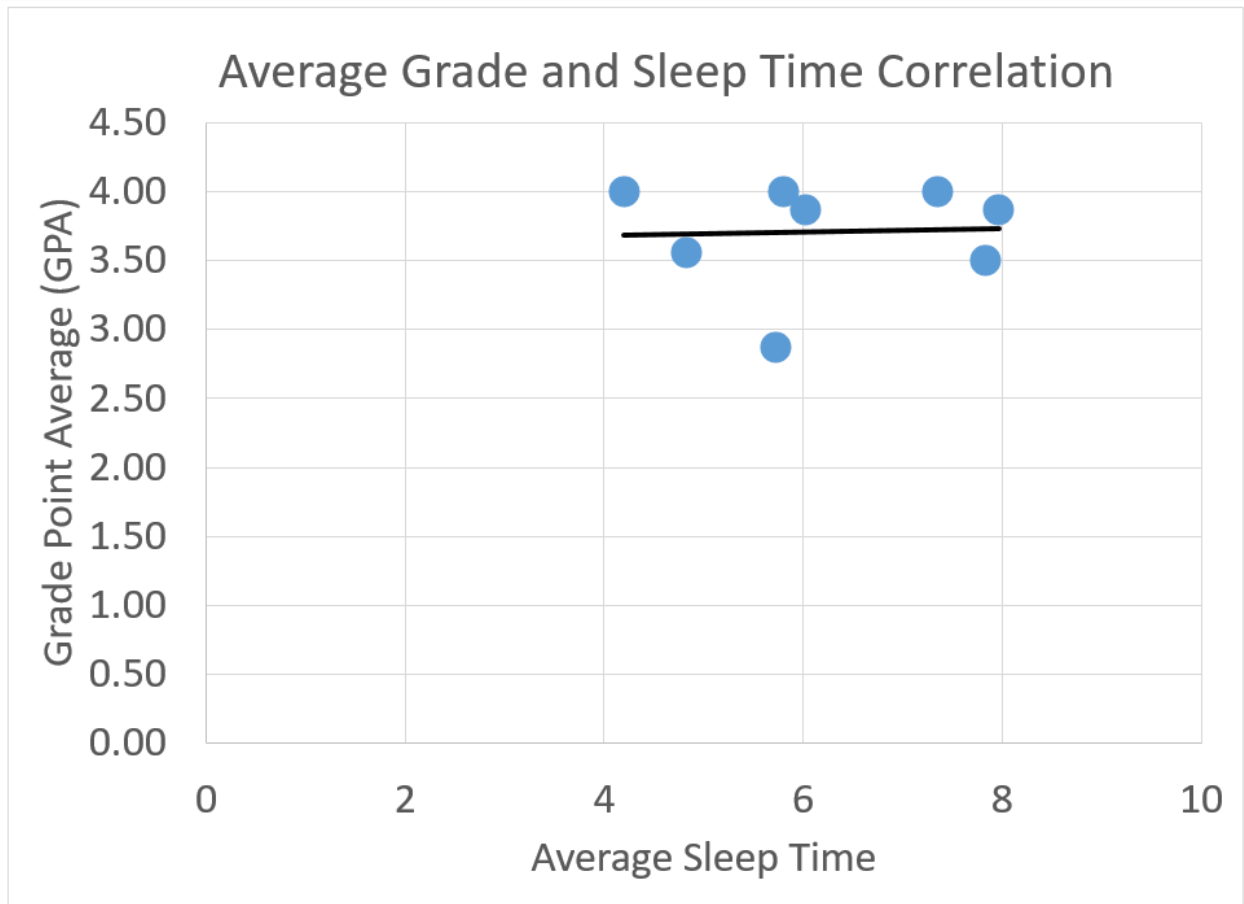


Figure 4: This graph shows the correlation between average student grades and sleep time.

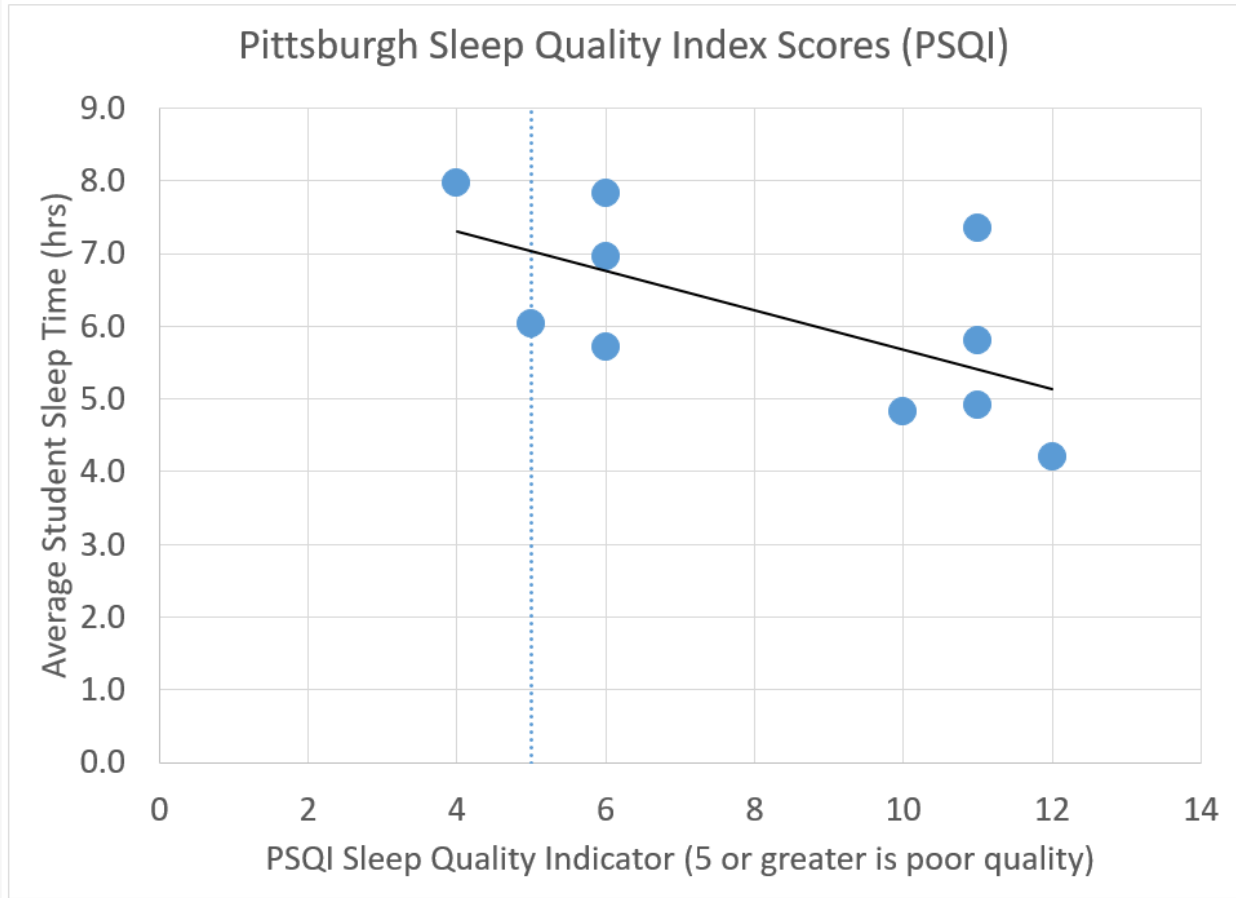


Figure 5: This graph shows the correlation between average sleep time and PSQI scores.

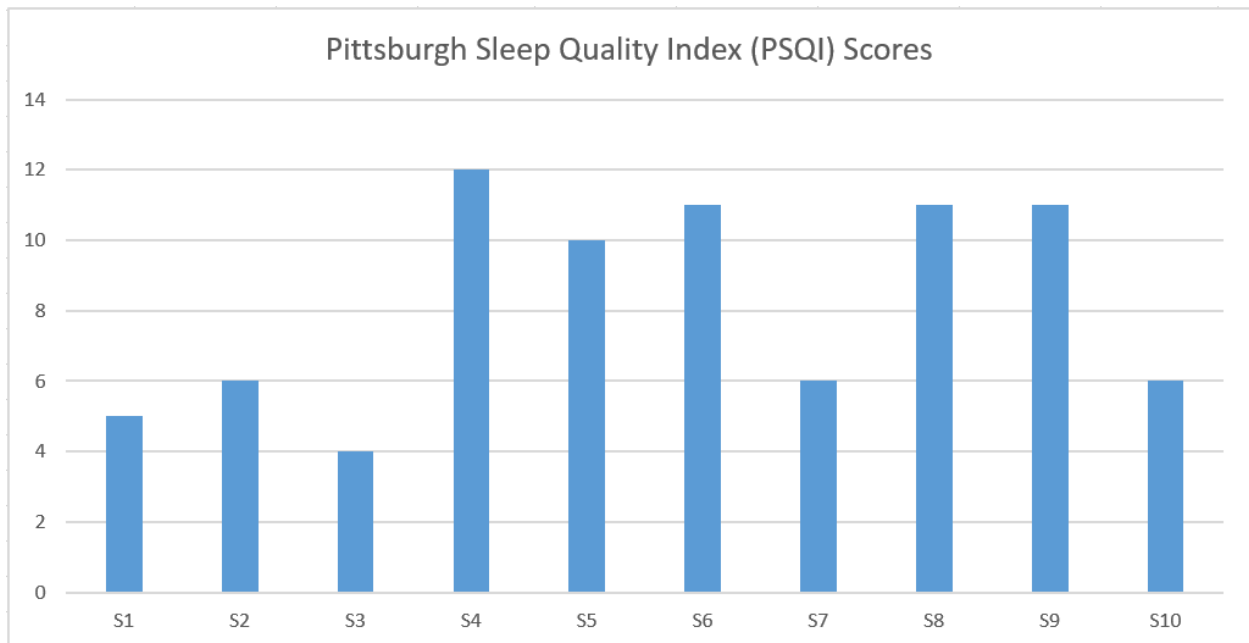


Figure 6: This graph shows PSQI scores by student.

Grades	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
	C	B	A	B	A	A	A	A	A	A
	C	A	A	B	A	A	A	A	B	A
	B	B	A	A	A	A	A	A	D	A
	C	A	A	B	A	A	A	A	A	A
	A	A	A	A	A	A	A	A	A	A
	A	A	B	B	A	A	D	A	A	A
	A	B	A	A	A	A	A	A	B	A
	B	A	A	A	B	A	A	A	F	A
						A	B			
	2	3	4	3	4	4	4	4	4	4
	2	4	4	3	4	4	4	4	3	4
	3	3	4	4	4	4	4	4	1	4
	2	4	4	3	4	4	4	4	4	4
	4	4	4	4	4	4	4	4	4	4
	4	4	3	3	4	4	1	4	4	4
	4	3	4	4	4	4	4	4	3	4
	3	4	4	4	3	4	4	4	0	4
						4	3			
Average Grade	3.00	3.63	3.88	3.50	3.88	4.00	3.56	4.00	2.88	4.00

Figure 7: This graph shows student grades and their corresponding Grade Point Average (GPA) during the second grading period of school when their sleep data was recorded.

Question	Yes	No	Unsure
Do you think the Sleep Cycle app was accurate in the representation of your sleep? Why or why not?	70%	20%	10%
Statement	High	Medium	Low
Sleep has a great influence on my school/academic performance	70%	20%	10%
School has a great influence on my <u>quantity</u> of sleep	80%	0%	20%
School has a great influence on my <u>quality</u> of sleep	40%	30%	30%

Figure 8: Ratios among student answers for each statement on the adolescent perceptions survey.

Weekday	Day	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Total Average
Sunday	14	51%	82%	87%	48%	27%	54%	57%	76%	62%	88%	
Monday	1	61%	80%	84%	47%	37%	63%	77%	59%	56%	64%	
Tuesday	2	56%	98%	60%	47%	24%	91%	58%	97%	44%	69%	
Wednesday	3	32%	71%	91%	22%	42%	78%	52%	50%	33%	66%	
Thursday	4	50%	90%	100%	33%	35%	68%	32%	40%	39%	81%	
Friday	5	91%		99%		26%	98%	34%		94%		
Saturday	6	93%	64%	99%	61%	86%	92%	59%	79%	70%	69%	
Sunday	7	71%	84%	69%	40%	37%	51%	86%	47%	42%	33%	
Monday	8	67%	68%	75%	15%	54%	88%	69%	75%	44%	56%	
Tuesday	9	66%	65%	66%	97%	33%	86%	67%	63%	55%		
Wednesday	10	41%	81%	89%	18%	57%	80%	%	52%	43%		
Thursday	11	59%	87%	58%	35%	37%	64%	%	38%	37%		
Friday	12	96%		91%	43%	99%		51%	80%		93%	
Saturday	13	63%			58%	64%		61%			85%	
Weekday Average		55%	81%	78%	40%	38%	72%	62%	60%	46%		59%
Weekend Average		86%	64%	96%	54%	69%	95%	51%	80%	82%		75%

Figure 9: Sleep Quality Data

Weekday	Day	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Total Average
Sunday	14	4:54	6:43	9:51	4:42	2:46	5:39	6:10	7:32	5:28	8:15	
Monday	1	5:18	7:52	8:10	4:38	2:54	7:08	7:11	5:08	4:50	7:51	
Tuesday	2	5:12	8:25	6:01	4:09	2:49	8:20	6:37	10:12	4:05	8:34	
Wednesday	3	5:00	9:45	8:01	2:01	4:43	7:35	4:35	4:29	3:02	6:29	
Thursday	4	4:59	7:56	9:00	3:05	3:39	6:26	2:59	3:34	4:03	7:57	
Friday	5	7:45		11:32		2:09	8:23	3:21		9:25		
Saturday	6	8:07	7:13	10:52	5:18	8:42	9:02	6:44	7:29	6:31	6:31	
Sunday	7	6:00	7:59	6:26	3:56	4:17	4:46	7:31	4:06	5:01	3:04	
Monday	8	5:50	7:18	6:54	1:13	4:43	8:01	7:08	6:30	3:52	5:10	
Tuesday	9	6:00	6:58	6:24	7:57	2:46	8:02	6:46	6:18	4:58		
Wednesday	10	3:51	7:47	8:27	2:02	6:30			5:09	4:08		
Thursday	11	5:05	7:08	5:26	3:44	3:31	5:49		3:43	4:10		
Friday	12	8:55		8:24	5:09	9:04		4:01	7:08		8:10	
Saturday	13	6:18			7:10	6:57		6:02			8:47	
Weekday Average		5.2	7.8	7.5	3.7	3.9	6.9	6.1	5.7	4.4	6.8	5.8
Weekend Average		7.8	7.2	10.3	5.9	6.7	8.7	5.0	7.3	8.0	7.8	7.5
Weekend-Weekday Average		2.6	-0.6	2.8	2.1	2.9	1.8	-1.1	1.6	3.6	1.1	1.7

Figure 10: Sleep Time Data

Adolescent Perceptions of Their Sleep and Academic Performance

Do you think the Sleep Cycle app was accurate in the representation of your sleep? Why or why not?

Using the scale below, indicate to what extent you agree with each of the following items

Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
1	2	3	4	5

Sleep has a great influence on my school/academic performance.

- 1)
- 2)
- 3)
- 4)
- 5)

School has a great influence on my quantity of sleep.

- 1)
- 2)
- 3)
- 4)
- 5)

School has a great influence on my quality of sleep.

- 1)
- 2)
- 3)
- 4)
- 5)

Figure 11: This document is the survey I created that asked about adolescent perceptions on the accuracy of Sleep Cycle and their perceptions of their sleep and academic performance.

Name _____ Date _____

Sleep Quality Assessment (PSQI)

What is PSQI, and what is it measuring?

The Pittsburgh Sleep Quality Index (PSQI) is an effective instrument used to measure the quality and patterns of sleep in adults. It differentiates "poor" from "good" sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medications, and daytime dysfunction over the last month.

INSTRUCTIONS:

The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

During the past month,

- When have you usually gone to bed? _____
- How long (in minutes) has it taken you to fall asleep each night? _____
- What time have you usually gotten up in the morning? _____
- A. How many hours of actual sleep did you get at night? _____
 B. How many hours were you in bed? _____

5. During the past month, how often have you had trouble sleeping because you	Not during the past month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
A. Cannot get to sleep within 30 minutes				
B. Wake up in the middle of the night or early morning				
C. Have to get up to use the bathroom				
D. Cannot breathe comfortably				
E. Cough or snore loudly				
F. Feel too cold				
G. Feel too hot				
H. Have bad dreams				
I. Have pain				
J. Other reason (s), please describe, including how often you have had trouble sleeping because of this reason (s):				
6. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?				
7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?				
8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?				
9. During the past month, how would you rate your sleep quality overall?	Very good (0)	Fairly good (1)	Fairly bad (2)	Very bad (3)

Scoring

Component 1 #9 Score	C1 _____
Component 2 #2 Score (<15min (0), 16-30min (1), 31-60 min (2), >60min (3)) + #5a Score (if sum is equal 0=0; 1-2=1; 3-4=2; 5-6=3)	C2 _____
Component 3 #4 Score (>7(0), 6-7 (1), 5-6 (2), <5 (3))	C3 _____
Component 4 (total # of hours asleep) / (total # of hours in bed) x 100 >85%=0, 75%-84%=1, 65%-74%=2, <65%=3	C4 _____
Component 5 # sum of scores 5b to 5j (0=0; 1-9=1; 10-18=2; 19-27=3)	C5 _____
Component 6 #6 Score	C6 _____
Component 7 #7 Score + #8 score (0=0; 1-2=1; 3-4=2; 5-6=3)	C7 _____

Add the seven component scores together _____ **Global PSQI** _____

A total score of "5" or greater is indicative of poor sleep quality.
If you scored "5" or more it is suggested that you discuss your sleep habits with a healthcare provider

Figure 12: The Pittsburgh Sleep Quality Index (PSQI) was used to determine an individual's global sleep quality score.

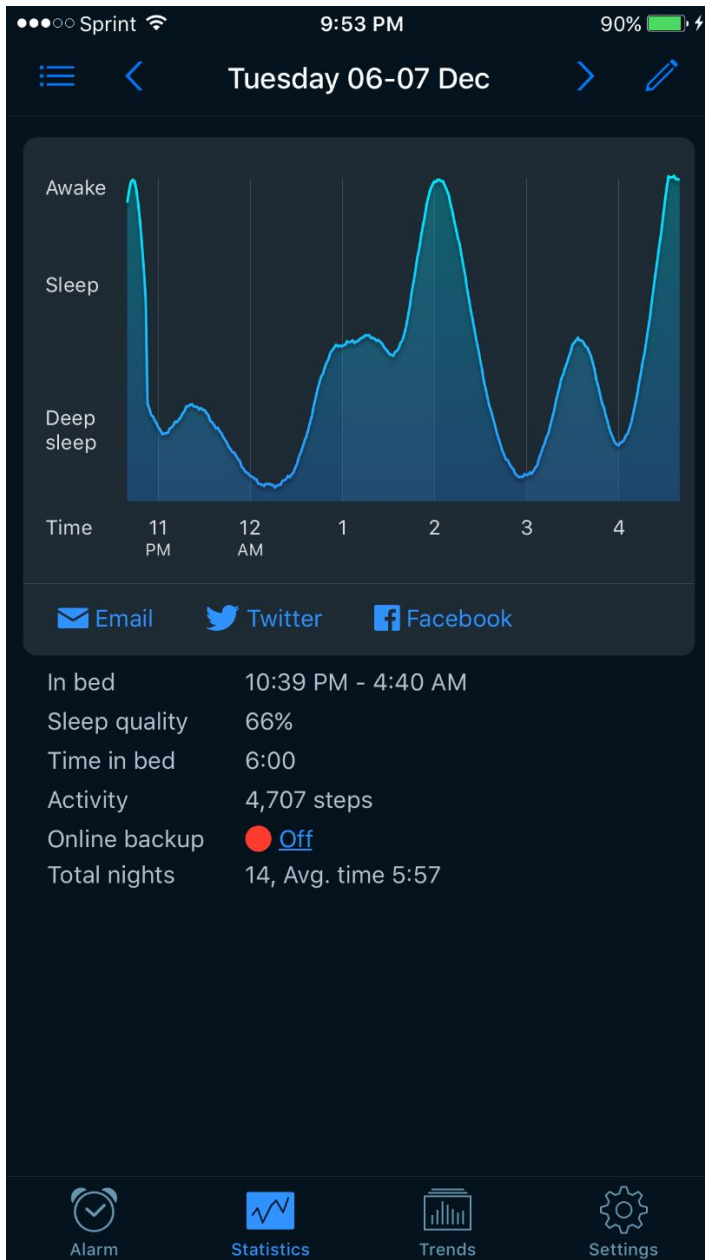


Figure 13: An example of how the Sleep Cycle app records sleep data.