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Introduction to Data Analytics

24th April 2024

Investigating the Influence of Sleep on Academic Performance in Universities

Abstract

In the fast-paced university environment, students contend with numerous obligations, from part-time work to demanding coursework, which frequently leaves them with little time for adequate sleep. This study examines the connection between undergraduate students' academic performance and sleep duration in Pakistani universities. We investigate the effect of sleep duration on students' Cumulative Grade Point Average (CGPA) using both primary research—a questionnaire survey designed on Google Forms —and secondary research—a comprehensive literature analysis. Our results highlight the crucial role that getting adequate sleep plays in academic performance by showing a statistically significant link between sleep duration and CGPA backed by secondary research and the analysis of form responses.A closer look shows that while class attendance positively correlates with CGPA, there is no meaningful relationship between academic performance and other factors like social media use, exercise, and study hours. Our findings not only highlight the significance of encouraging students to adopt better sleeping practices, but they also provide important direction for evidence-based interventions that may improve students' overall academic performance in university settings.

Introduction

In today's fast-paced university environment, students find themselves navigating through a variety of challenges that can significantly affect their academic performance. From the rigorous demands of coursework to managing part-time work, maintaining a healthy lifestyle, and nurturing an active social life, students often feel overwhelmed by the multitude of responsibilities they face during the semester.

Among these various factors that can affect academic performance, one that stands out prominently is the quality and duration of sleep. According to Hossain and Rahman, the time of going to bed and

sleep quality and quantity are intricately linked with students' learning abilities and academic performance. This highlights the importance of investigating how sleep patterns affect undergraduate student's academic performance in university settings as often times it is not prioritized by a university student. Moreover, the link between sleep and cognitive function, as well as physical health is also established to some extent in the research literature [3].

Even within the context of Pakistan, where systematic research on sleep-related issues among university students remains limited, the importance of investigating this topic becomes even more essential. Existing research such as those focusing on medical students in Karachi and students at Bahria University, have revealed alarming trends of poor sleep quality among students and its detrimental effects on academic performance. Additionally, studies conducted in Punjab have highlighted a high prevalence of sleep disorders, including insomnia and sleep apnea, among university students.

Since existing research has focused on the impact of the quality of sleep on academic performance; for the scope of this project, we are particularly interested in investigating the relationship between the duration of sleep and students' academic performance. We are also taking into account other variables affecting student performance, and finally, measuring student performance by their Cumulative Grade Point Average (CGPA). By delving into this relationship, we aim to provide valuable insights to help in evidence-backed interventions that not only lead to healthier sleeping habits but also help enhance student performance during the semester.

Methodology:

The methodology employed in this study aimed to investigate the relationship between sleep and academic performance by integrating both primary and secondary research methods. We were able to reach a comprehensive understanding of the topic through combining these approaches.

PRIMARY RESEARCH METHOD:

Sampling Strategy and Sample Collection:

In order to collect data for our primary research from the university students, we designed a questionnaire using Google Forms. The questionnaire comprised 13 questions covering key aspects related to the influence of sleep on Academic Performance in universities. The questions were mainly concerned with academic background, academic performance (such as the CGPA), and lifestyle habits including sleeping patterns, study hours, social media usage, and physical activities. The questionnaire was relatively short taking only 2 to 3 minutes to complete it. Moreover, the questions were designed in such a way that helped us understand students’ perspective and their lifestyles in a better way.

Moreover, in order to get responses for this survey, convenience sampling was used. The survey link was distributed through various online platforms and WhatsApp groups targeting specifically university students. A total of 116 responses were collected for the survey which represented a diverse range of perspectives. Furthermore, quantitative data collected through Google Forms were analyzed using the chi-square test to analyze the relationship between variables. We used a statistical software known as STATA for data processing and analysis which allowed us to have a systematic analysis of the survey responses.

The values generated using chi-square tests helped us to reach coherent conclusions and understand the relationships between the variables in a better way. By comparing the p-values with the significance level, we were able to deduce which variables had a relationship that was statistically significant, and what kind of variables were not dependent on each other.

Moreover, with the help of our data, we were also able to extract some valuable graphs that visually represent some important findings from our data. The graphs are helpful in the visual analysis of the data and in comparing two or more variables with each other.

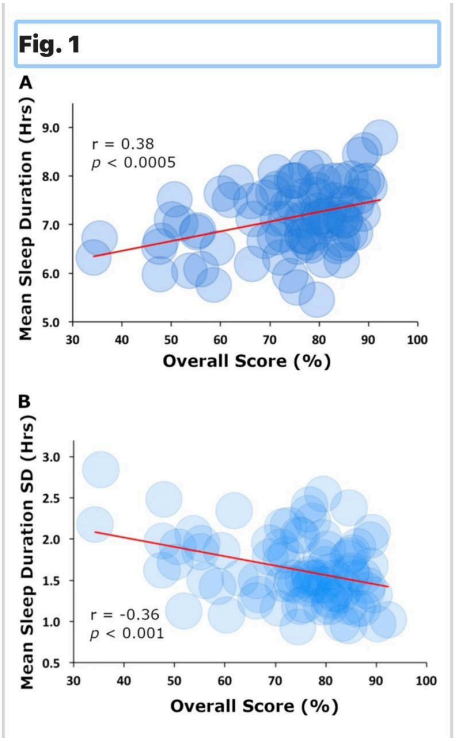
SECONDARY RESEARCH METHOD:

Reading Relevant Literature Review:

In our secondary research analysis, we will analyze the existing literature that exists while deducing the relationship of sleep and academic performance. This investigation will create a link between our primary research analysis while helping us identify similar trends and giving us a broader context of what we are trying to establish.

The study by Hossain and Rahman did a detailed evaluation of the fact that students are often having sleep problems and this affects their academic results as this quote indicates “The time of going to bed and sleep quality and quantity are linked with students’ learning abilities and academic accomplishment.” [1]

Moreover, The administration went on to correlate the use of the Pittsburgh Sleep Quality Index (PSQI) with the fact that only 25% of students indicated having good sleep quality. Although this study applied multiple regressions to specify this relationship between the quality of sleep and student's academic achievement, it remains an area of potential continued research. The study showed that, while good sleep factors like proper sleep duration improve grades, sleep issues such as waiting too long to fall asleep, being frequently woken up, and the need to medicate your sleep have negative effects on marks.



[2]

The research [2] looks very impressive with detailed sleep data, which was recorded by employing wearable technology. The study in Fig. 1a demonstrates the presence of a strong positive correlation between this variable and the others by ($r = 0.38$, $p < 0.0005$). This correlation shows that students who managed to spend more sleep hours did well in the school assessments as compared to those peers who slept for fewer hours.

The second direction where research should be conducted is sleep consistency, as represented in Figure 1b. This is proved to be inversely correlated with the r value of ($r = -0.36$, $p < 0.001$) between the difference in sleep duration and academic score obtained. It means that students usually get poorer grades if they do not have consistent sleep patterns, with a higher standard deviation of sleep duration, and their academic performance is less good. The application of multidimensional analysis (Pearson correlations and stepwise regression) confirms that regular sleep duration and patterns are highly correlated with academic performance thus indicating a strong relationship between sleep quantity and consistency with academic performance.

The sleep of teenagers is addressed from a wide range of aspects through a review that shows the far-reaching consequences that sleep disturbances have not only on academic success but also on psychological health and risk-prone behaviors. The study indicates, “ In a study of 1,629 adolescents, those with excellent academic performance had earlier bedtimes and longer sleep on weekdays with less severe daytime sleepiness than those with poor grades” [3]. Thus, showing what our analysis discussed. This compilation not only reflects the widely extended influence of sleep quality across the various areas of young people's lives, but it also points out the importance of sleep to lead a balanced life.

Gender-based analysis in studies such as Okano's [2]. has shown major differences in how sleep relates to academic success across genders. With a finer lens provided by statistical tools like ANOVA, these studies have carved out a narrative that sleep quality could be a key factor in the observed academic outperformance of women over men in collegiate settings.

The synthesis of scholarly articles and various statistical analyses—ranging from regressions to ANOVA—has expanded our understanding of the observed patterns from our primary research. The collective data from these global studies points to a vital conclusion: student academic performance is significantly influenced by multiple dimensions of sleep, emphasizing the urgent need for tailored sleep improvement initiatives within educational strategies.

Results:

Primary Research:

1- Relationship between Sleep Duration and CGPA range:

In order to analyze the results of the survey, we decided to do a chi-square test to check the dependency of sleep on academic performance.

Table 1:

Relationship between Sleep Duration and CGPA range

TABLE 1

Relationship between Sleep Duration and CGPA range

Sleep Duration	*CGPA range*				
	Below 2.0	**2.1-2.5**	**2.6-3.0**	**3.1-3.5**	**Above 3.5**
Less than 5 hours	0	0	0	1	11
5-6 hours	0	3	6	20	23
7-8 hours	0	1	10	20	18
More than 8 hours	1	0	2	0	0

Null Hypothesis (H0)= There is no relationship between sleeping hours and CGPA.

Alternative Hypothesis (H1) = There is a relationship between sleeping hours and CGPA.

To proceed further with the test, we decided to keep the significance level at 0.05, as there is no risk involved and it is also the standard significance level. In this scenario, our dependent variable is the CGPA of students and the independent variable is the average number of hours they sleep per night.

To proceed with the test, we uploaded the data on STATA, a software used for statistical analysis, to run the chi-square test. After running the statistical test, the value of the chi-square obtained is 59.5170. The p-value for the following test is 0.000. As the p-value is less than the significance level, hence we reject the null hypothesis. This indicates that there is a statistically significant relationship between sleeping hours and CGPA.

2- Relationship between time spent on studying and CGPA:

To check whether there is a statistically significant relationship between time spent on studying and CGPA, we decided to do a chi-square test

TABLE 2

Relationship between Time spent on Studying and CGPA

Hours spent on studying	*CGPA range*				
	Below 2.0	**2.1-2.5**	**2.6-3.0**	**3.1-3.5**	**Above 3.5**
Less than 2 hours	1	2	8	6	11
2-4 hours	0	1	4	20	22
5-7 hours	0	1	6	13	11
More than 7 hours	0	0	0	2	8

Null Hypothesis (H0)= There is no relationship between time spent on studying and CGPA.

Alternative Hypothesis (H1)= There is a relationship between time spent on studying and CGPA.

We kept the significance level at 0.05. Our dependent variable is the CGPA of students and our independent variable is the number of hours they spend on coursework and studying.

After running the test, the obtained chi-square value is 18.1148 and the p-value is 0.112. As our p-value is greater than 0.05, hence we fail to reject the null hypothesis as there is not enough evidence to go against it. This indicates that there is no statistically significant relationship between the number of hours spent on studying and the CGPA range.

3- Relationship between Class Attendance and CGPA:

We conducted another chi-square test to check the relationship between class attendance and the CGPA range.

TABLE 3

Relationship between Class Attendance and CGPA range

Class Attendance rate	*CGPA range*				
	Below 2.0	**2.1-2.5**	**2.6-3.0**	**3.1-3.5**	**Above 3.5**
55-69%	1	0	1	0	0
70-84%	0	2	6	8	5
85-100%	0	2	11	33	47

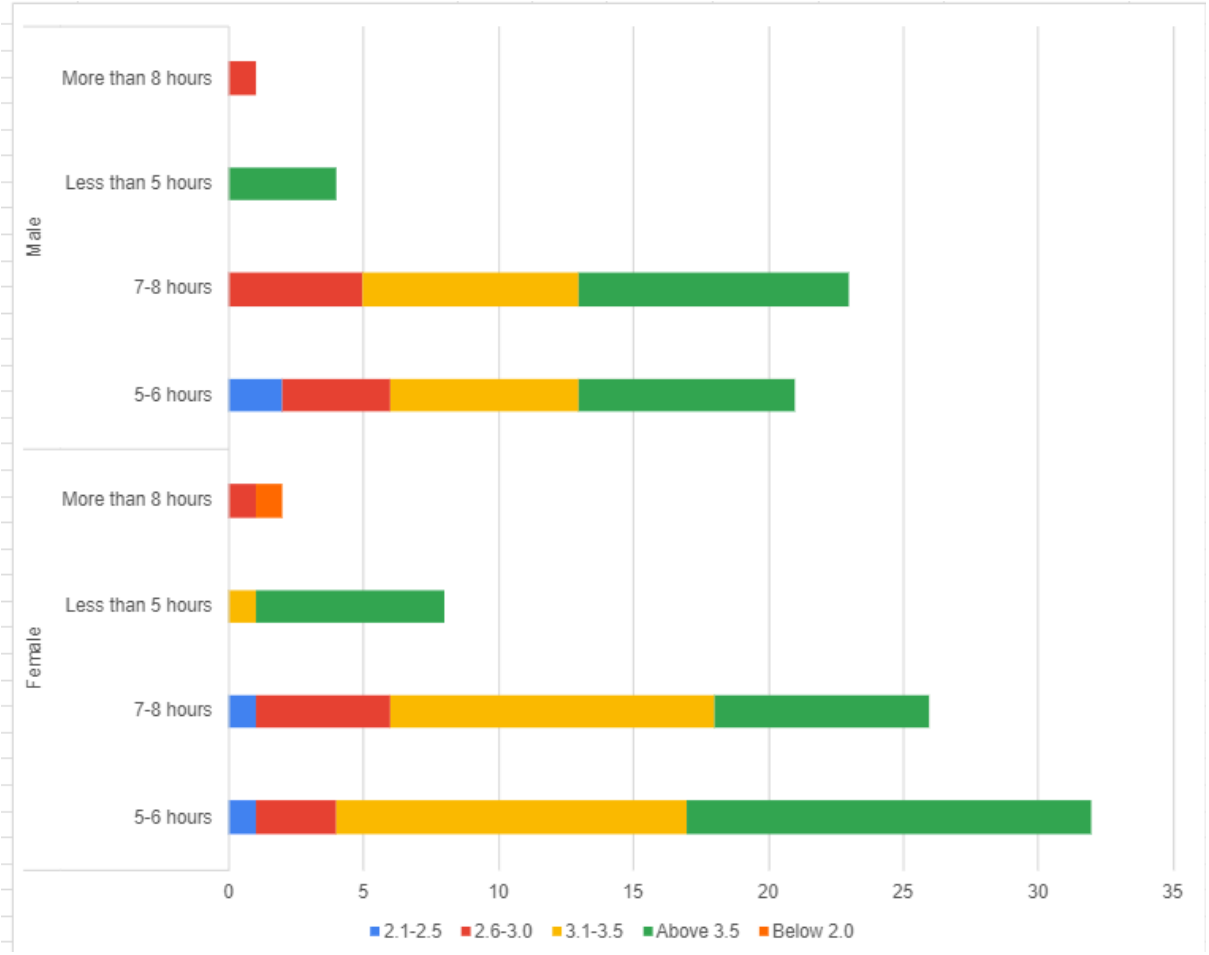
Null Hypothesis (H0)= There is no relationship between class attendance and CGPA.

Alternative Hypothesis (H1)= There is a relationship between class attendance and CGPA.

We kept the significance level at 0.05. After running the test, the obtained chi-square value is 68.8205 and the p-value associated with it is 0.000. As the p-value is less than the significance level, hence we reject the null hypothesis. This indicates that there is a statistically significant relationship between class attendance and the CGPA range. It also highlights that class attendance is one of the factors that influence the CGPA of the students.

In addition to the tests conducted above, we performed 2 more chi-square tests to analyze the relationships between the CGPA of students and two other variables incorporated in our research: time spent engaging in physical activities and the duration of social media usage. The significance level for these tests was set as 0.05. The results of the first test revealed that there is no statistically significant relationship between time spent engaging in physical activities and the CGPA of students, as the obtained p-value of 0.102 is greater than the significance level. Moreover, the second test indicated that there is no statistically significant relationship between the duration of social media usage and students' CGPA, as the p-value was 0.791 which again is greater than the significance level. Our findings of these two tests suggest that neither physical activity nor social media usage significantly influence students' academic performance.

4- Relationship between sleep, CGPA, and gender



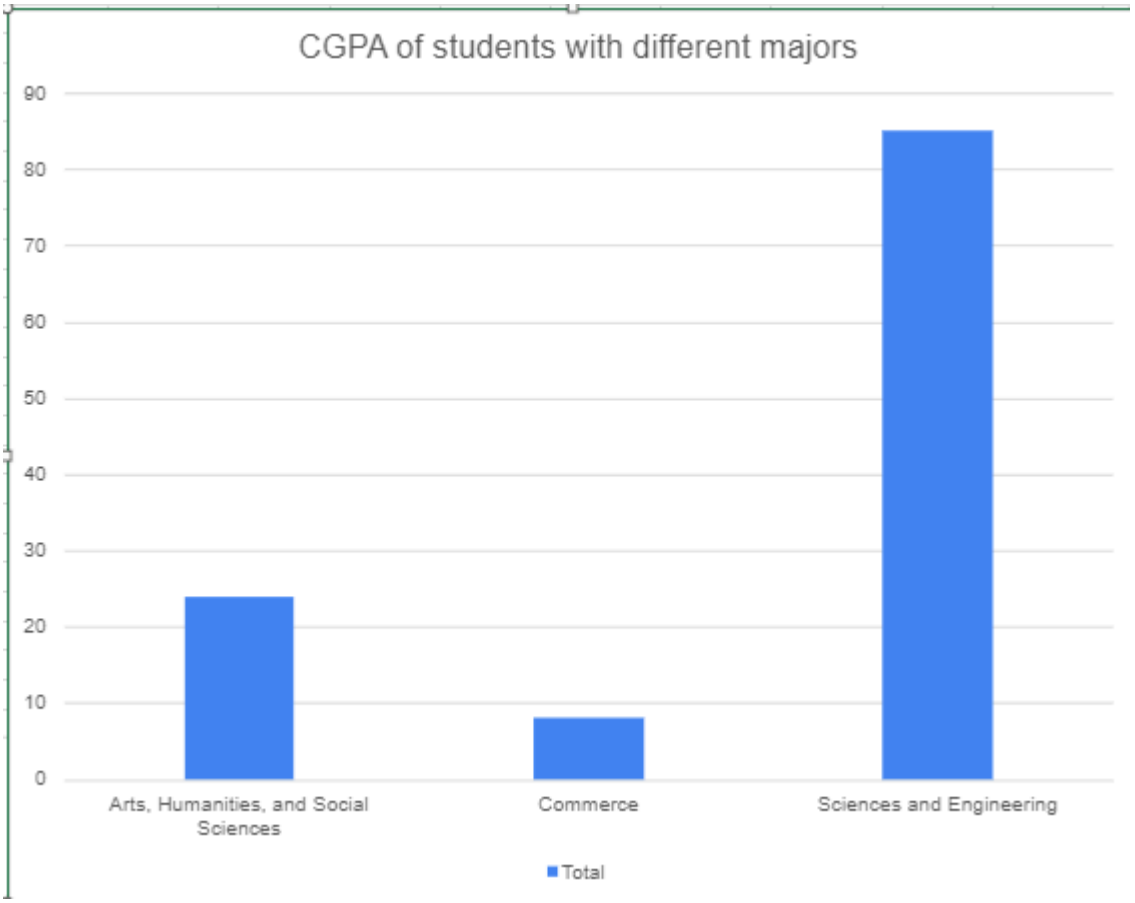
The graph presented depicts a compelling relationship between sleep duration, gender, and academic performance, as measured by CGPA (cumulative grade point average).

We can observe that students from both genders whose sleep duration is 5-6 hours or 7-8 hours have a majority of students with a CGPA that falls within the higher CGPA categories ("3.1-3.5" or "Above 3.5"). It is, however, also interesting to see how both male and female students who are sleeping less than 5 hours are also at a good academic standing with all the males having a CGPA higher than 3.5 and the majority of the females having a CGPA higher than 3.5 for this sleep range as well.

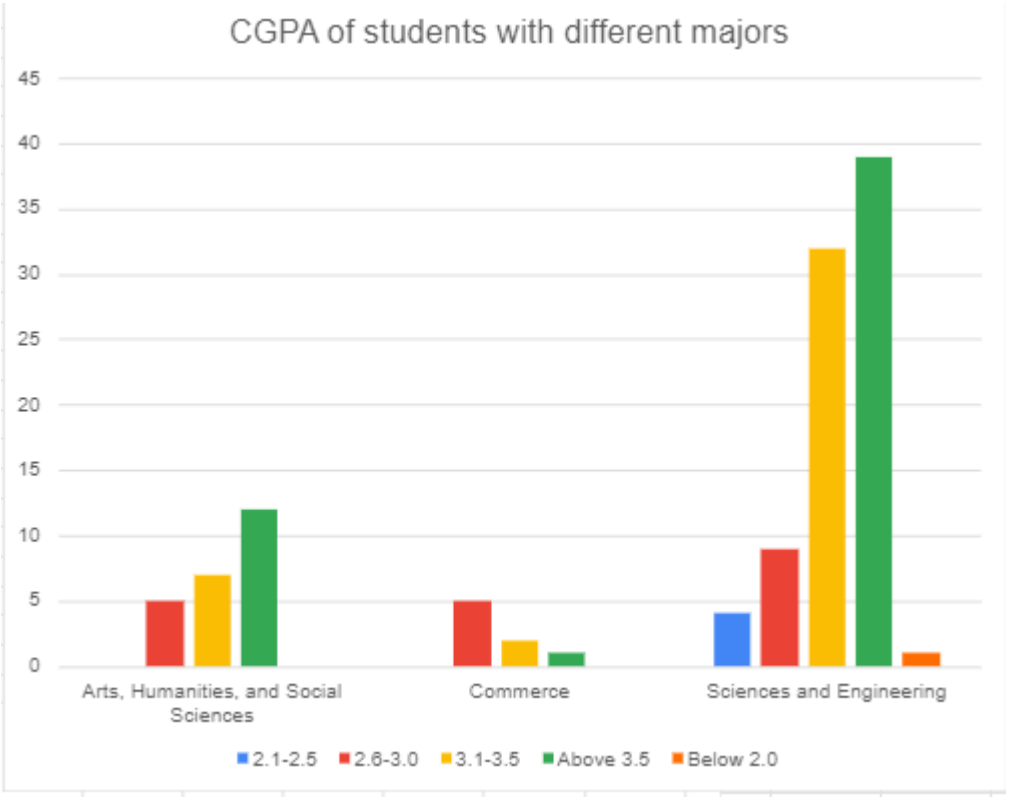
It is also noticeable how across all sleep ranges displayed, females appear to have a higher likelihood of falling into a "better" CGPA category compared to males but both display a CGPA lower than 3.0 for the “more than 8 hours sleep range” while someone in females also has a CGPA lower than 2.0.

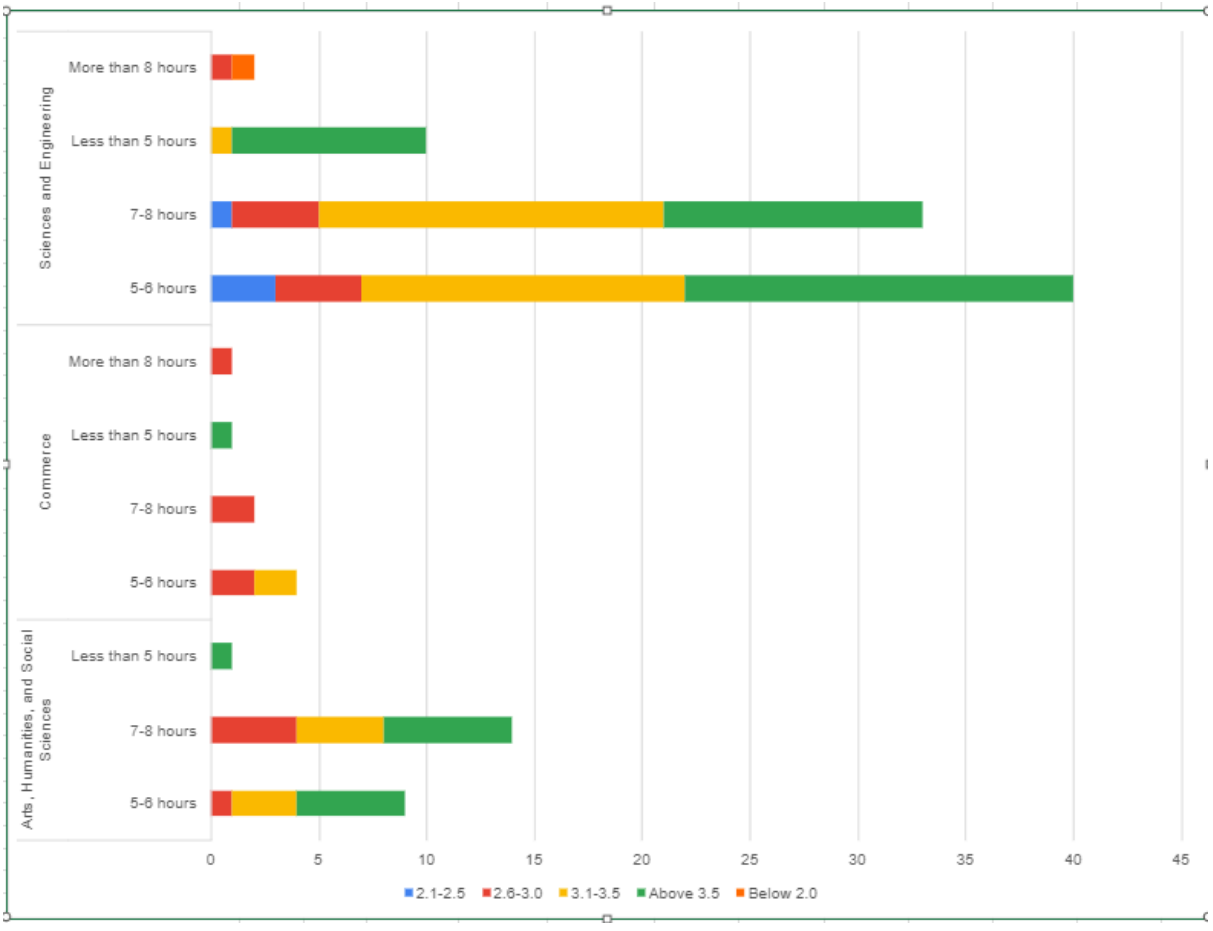
5- Relationship between sleep, CGPA, and major

The graph below shows us the total count of the different majors among our responses with the highest count at about 85 responses received by students from the “Sciences and Engineering” major and the least responses with a count of about 8-9 received by students from the “Commerce” major.



It is also compelling to observe from the graph below that in addition to the “Sciences and Engineering” major having the greatest responses, the majority of them also fall into the higher CGPA category (above 3.1) approximately about 71 out of the 85 students. Moreover, we can also identify the highest count of students within the “Art, Humanities and Social Sciences” major and the “Sciences and Engineering” major is that of students with a CGPA greater than 3.5. However, in the “Commerce major”, these results are contradicting since the highest count is that of students with a CGPA in the range of 2.6 to 3.0.

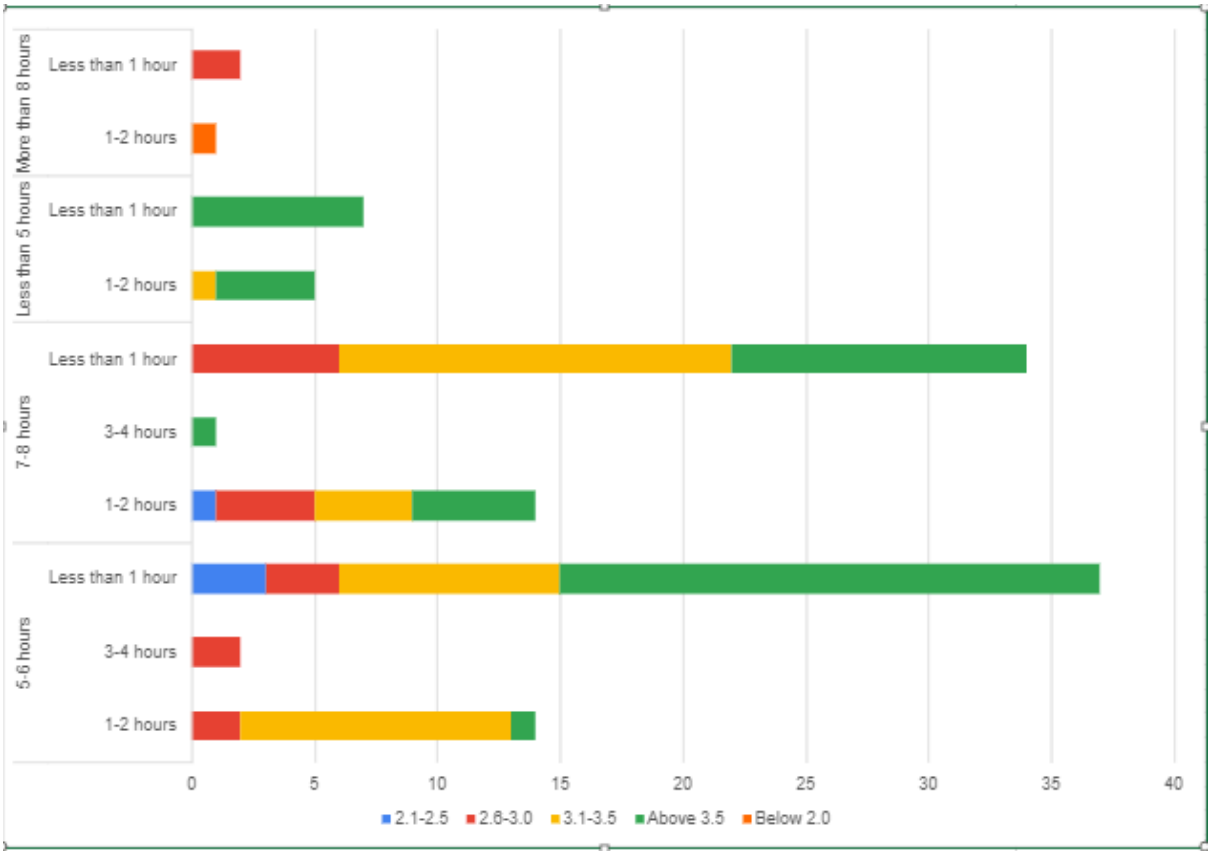

CGPA of students with different majors
45
40
35
30
25
20
15
10
5
0
Arts, Humanities, and Social Sciences
Commerce
Sciences and Engineering
2.1-2.5
2.6-3.0
3.1-3.5
Above 3.5
Below 2.0


Sciences and Engineering
More than 8 hours
Less than 5 hours
7-8 hours
5-6 hours
Commerce
More than 8 hours
Less than 5 hours
7-8 hours
5-6 hours
Arts, Humanities, and Social Sciences
Less than 5 hours
7-8 hours
5-6 hours
0
5
10
15
20
25
30
35
40
45
2.1-2.5
2.6-3.0
3.1-3.5
Above 3.5
Below 2.0

The graph above shows CGPA for students from different majors with different sleep schedules. The majority of the students across the “Science and Engineering” as well as “Art, Humanities, and Social Sciences” categories who achieve 7-8 hours of sleep appear to be in higher CGPA categories ("3.1-3.5" or "Above 3.5"). It is also interesting to see that all students with “Commerce” as their major who are getting 7-8 hours of sleep appear to have a CGPA between “2.6-3.0”. Students across the majors with more than 8 hours of sleep appear to be in lower CGPA categories like “Below 2.0” or “2.6-3.0”.

It is also evident from the graph above that the majority of the students in the “Science and Engineering” major have higher CGPA (greater than 3.1) and the duration of their sleep does not affect their CGPA.

6- Relationship between sleep, CGPA, and physical activity



The graph depicts a complex relationship between sleep duration (categorized as "More than 8 hours", "Less than 5 hours", "7-8 hours", and "5-6 hours"), physical activity levels (categorized as "Less than 1 hour", "1-2 hours", or "3-4 hours"), and CGPA categories.

It is clear from the graph above that students who are sleeping for more than 8 hours regardless of their physical activity levels have a CGPA of lower than 2.0 or between 2.6 to 3.0.

It is also interesting to observe from the graph that all students who are sleeping less than 5 hours have better CGPA (greater than 3.1) with the majority having above 3.5. The best result can be seen in students who are sleeping less than 5 hours and engaging in physical activity for less than an hour since all have a CGPA above 3.5.

The majority of the students who sleep between “5-6 hours” or “7-8 hours ” and engage in physical activity of less than 1 hour or 1-2 hours have higher CGPA (greater than 3.1). However, it is also intriguing to see that all students who are engaged in 3-4 hours of physical activity but different sleep durations have contradicting results. All students in this category but with a sleep duration of 7-8 hours have a CGPA above 3.5 whereas the students sleeping for “5-6 hours” in this category have a CGPA between 2.6 to 3.0.

Conclusions

The findings from this study highlight a clear link between sleep duration and academic performance among university students. The chi-square test conducted to check the relationship between sleep duration and academic performance uncovers a statistically significant relationship between the 2 variables. This could help us deduce that the duration of sleep of students is an essential factor that influences their academic performance. Moreover, the statistically significant relationship between class attendance and the CGPA could be because of the fact that when students attend classes regularly then the content of that class can be retained in their minds and they can recall the important points easily while trying to study which could in return improve their CGPA. However, one shocking result that we obtained from our research was that there was no statistically significant relationship between time spent studying and the CGPA of the students. This could be due to the fact that the attention span of students these days is very low and they get distracted easily. Moreover, this could also be because of the significant relationship between class attendance and CGPA since students retain most knowledge in class and consequently, give less time to coursework outside of class.

Moreover, findings from our study suggest that neither the time spent engaging in physical activities nor the duration of social media usage has a statistically significant relationship with students’ CGPA. The results suggest that factors such as physical activity and social media usage do not have a

substantial impact on student's overall academic performance. However, it is imperative to understand that these findings are relevant to the specific data analyzed in this research.

Limitations

The findings from our results are relevant to the specific data analyzed and the responses we received. One of the limitations we faced was not getting enough responses according to our target sample size which we calculated with a 90% confidence interval and 6% margin of error with a total aggregate of university-going students being 2 million. The data for students was obtained through the HEC annual report of 2020; we were not able to find a more latest one[4]. The sample size was obtained through the SurveyMonkey sample size calculator and gave a result of 190 [5]. However, we fell short with our responses so we cannot accurately predict if our results would be applicable to the population.

Moreover, when designing the form, student feedback was that despite the anonymity, a lot of them were not comfortable in telling their exact CGPA for which we introduced specific ranges for the CGPA eg above 3.5 or 2.1-2.5 as input in the form. This change influenced our analysis techniques and limited us to some extent since it resulted in categorical variables and we were unable to perform statistical analysis techniques like Regression, T-tests, or ANOVA (Analysis of Variance).

Also one of the results of our research was the significant relationship between class attendance and CGPA but it could have been limited by the fact that a major subsection of the responses we received were from Habib University students and Habib University enforces a strict 85% attendance policy.

Acknowledgment

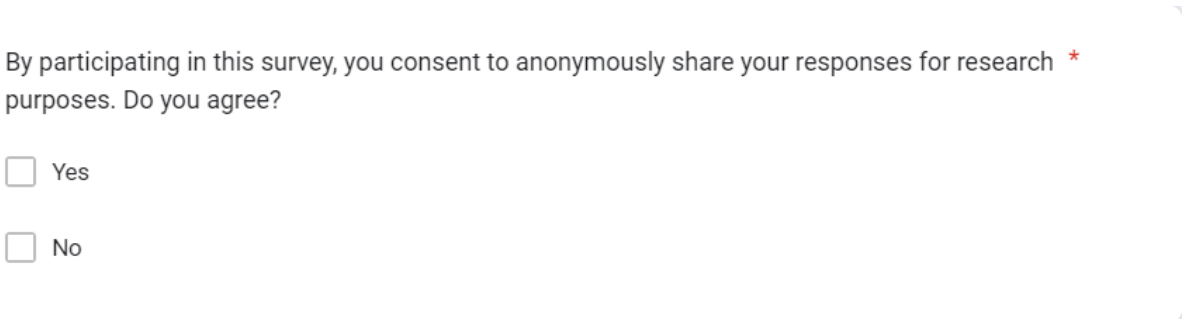
Firstly, we would like to acknowledge all the participants who took the time to complete our survey.

Secondly, we would like to acknowledge Sir Usman Salahuddin for his seminar lecture on the general structure of a questionnaire and for giving us feedback on the initial form we had designed. His insights also helped us modify the questions in our Google form.

Moreover, we also consulted Sir Thusita Kumara in our project. We also administered his advice by changing our research topic from " investigating the impact of sleep on academic success" to " investigating the impact of sleep on academic performance". The earlier topic would have had to cater to a lot of other variables that could have impacted academic success. Also, the definition of academic success is very subjective and depends highly on the individual.

Data Privacy and Consent Statement

Since a lot of people are not comfortable with telling their CGPA and other important details, we made sure our Google form is anonymous. Also for all those participating in the survey, we first asked if they gave us consent to use their responses for our research by the following question:



For those who did not consent, we removed their entries from our responses by using the filter option in Excel before proceeding with analyzing the data.

Supplementary Data

We created additional files such as Excel and Google Docs files to record the results. Other than that, we made a Google form through which we collected responses for our research topic. The link to the Google form:

https://forms.gle/e23o45iCrhckzLs77

The Excel file contains all the pivot charts we have analyzed in this document by extracting the relevant information through pivot tables. The Excel file also contains all the form responses we received. The link to the Excel sheet:

Investigating the Influence of Sleep on Academic Performance in Universities (Responses) 1.xlsx

Furthermore, we had a document where we had separately compiled all the tables of the chi-square tests, the link to which is:

https://docs.google.com/document/d/1BzEXSkRzqsaVdNwsMJ6I6vRiwMLUsCl2go-2K0IBmiE/edit?usp=sharing

Finally , the google drive link contains the data and corresponding codes from STATA:

https://drive.google.com/drive/folders/1jnKAfcNU-V4Hl2ZA_2Tj9AFQucX9f0ZR?usp=drive_link

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