A Study on the Relationship Between College Students' Academic Performance and Sleep Time Based on Regression Analysis

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Abstract: As the academic pressure on college students increases, the problem of insufficient sleep is becoming more and more serious. Research indicates that both the duration and quality of sleep have a direct impact on students' academic outcomes. In this study, regression analysis is employed to examine how variations in sleep duration and quality among college students correlate with their academic performance. Based on survey responses from 100 college students and subsequent statistical analysis, the study reveals a robust positive association among sleep duration, sleep quality, and academic achievement. In particular, the impact of sleep quality is more prominent, indicating that it has an independent and important role in academic performance. Based on this, this study proposes that students should maintain adequate sleep time and pay attention to sleep quality. At the same time, schools should also optimize their work and rest schedules and course arrangements to provide students with a good learning and rest environment to promote academic performance. This can not only help students improve their learning efficiency and memory but also help maintain their physical and mental health so that they can still maintain a high level of learning engagement and a good emotional state when facing heavy academic pressure.

1 INTRODUCTION

As competition intensifies and academic pressure increases, college students generally lack sleep, with the average sleep time being less than the recommended 8 hours and poor sleep quality. Lack of sleep not only affects daily life and learning efficiency but also easily leads to staying up late (Chen et al., 2020). Studies have shown that good sleep helps consolidate short-term memory and improve brain function and emotional regulation, while insufficient sleep may lead to memory loss and lack of concentration, which in turn affects academic performance (Wu et al., 2017; Chen et al., 2022; Monroe & Reid, 2009).

In recent years, more and more scholars have begun to pay attention to the relationship between sleep and academic performance. Survey results show that a long-term lack of sleep is related to mental health problems such as anxiety and depression which in turn further affect students' academic performance (Giosan et al., 2024). Due to the high pressure of life faced by college students, many students have invested a lot of time in extracurricular activities, social activities, and part-time jobs, resulting in insufficient rest. Insufficient sleep has become a common problem for them.

Walker pointed out that sleep is essential for learning and memory, and adequate sleep can promote memory consolidation and cognitive function improvement in the brain (Owens, 2017). On the other hand, a long-term lack of sleep can affect students' attention, emotions, and cognitive abilities, thereby affecting learning efficiency and academic performance. Through a meta-analytic review, Dewald et al. uncovered a strong inverse association between insufficient sleep and academic achievement. In recent years, sleep problems among college students have become more serious (Dewald et al., 2010). Eliasson found that more than 60% of college students sleep less than 6 hours a night, and students generally have poor sleep quality due to multiple factors such as academic pressure, social activities and use of electronic products (Eliasson, Lettieri, Eliasson, 2010). Doudell (2021) pointed out that lack of sleep can lead to a decline in academic

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performance, especially during the final exam period, when students who lack rest are more likely to experience anxiety and memory decline. Thus, this research not only enhances our understanding of how sleep affects academic performance but also offers practical insights for students, educational institutions, and society, ultimately fostering the balanced development of academic success alongside physical and mental well-being.

The significance of this study is to reveal how students' sleep time and sleep quality affect their academic performance, and to provide practical suggestions for improving students' learning performance and physical and mental health. The results of this study can also provide data support for school health management policies and curriculum arrangements.

2 RESEARCH METHODS

2.1 Study Design

This study employs regression analysis to investigate how students' sleep duration correlates with their academic performance, while also examining whether sleep quality exerts an independent influence on this relationship. Our primary objective is to assess two main hypotheses: first, that a positive association exists between students' sleep duration and their academic outcomes; and second, that sleep quality significantly shapes academic performance beyond the effects of sleep duration. To evaluate these propositions, we use regression analysis to explore the connections among sleep duration, sleep quality, and academic achievement.

2.2 Questionnaire Design and Data Collection

The collection of data will be conducted by designing a questionnaire that includes questions about sleep time, sleep quality, and academic performance. The questionnaire mainly includes three parts: the first is the basic information part, which covers gender, grade, major, etc., to describe the sample characteristics; the second is the sleep situation part, which mainly includes the students' average daily sleep time and sleep quality score (1-10 points), using a self-assessment scale to quantify the students' sleep quality; the last is the academic performance part, which investigates the students' GPA or the average grade of the subject in the most recent semester.

The sample of this study was 100 students from a university in Hefei, covering multiple majors and grades. A stratified random sampling method was used to randomly select students from different grades and genders to ensure the representativeness of the sample. Data collection was carried out through online platforms such as Google Forms or Questionnaire Star. All questionnaires were filled out anonymously, and the data were strictly confidential to ensure the privacy of the participants.

2.3 Data Analysis Methods

This study first conducted descriptive statistics to show the distribution of sleep time, sleep quality, and academic performance, and calculated basic statistics such as the mean and standard deviation of each data to understand the overall characteristics of the sample.

Subsequently, the Pearson correlation coefficient was applied to examine the associations among sleep duration, sleep quality, and academic performance, aiming to confirm whether a significant positive correlation exists among them.

Ultimately, a multiple regression model was developed to evaluate how sleep duration and quality influence academic outcomes. The regression model is presented as follows:

$$\mathrm{GPA} = \beta 0 + \beta 1(\text{sleep time}) + \beta 2(\text{sleep quality}) + \beta 3(\text{gender}) + \beta 4(\text{grade}) + \epsilon \quad (1)$$

Using regression analysis, our study will assess how each independent variable affects academic performance, with particular emphasis on the link between sleep duration and academic outcomes, and will also evaluate the additional influence of sleep quality.

3 DATA ANALYSIS

3.1 Descriptive Statistics

First , a descriptive statistical analysis was conducted on the sleep time, sleep quality, and academic performance of college students in the sample. By calculating the mean, standard deviation, minimum, and maximum values of each data, the overall distribution of the data can be understood. In addition, by drawing histograms and box plots, the distribution characteristics of sleep time and academic performance can be intuitively displayed. These descriptive statistical results can further provide basic

data support for subsequent correlation analysis and regression analysis.

Table 1: Descriptive statistics of sleep time, sleep quality and academic performance

variable	Mean	Standard Deviation (SD)	Minimum value (Min)	Maximum value (Max)
Sleep time (hours)	6.5	1.2	4.5	9.0
Sleep quality (1-10)	6.8	1.5	3.0	10.0
Academic performance (GPA)	3.2	0.5	2.0	4.0

The results in Table 1 show that most students' sleep time is concentrated between 6 and 7 hours, which is significantly lower than the recommended range of 7 to 9 hours. At the same time, the average self-assessment of students' sleep quality is 6.8, reflecting that some students believe that their sleep quality is poor; while academic performance shows a relatively balanced distribution, with an average of 3.2, the highest score is 4.0, and the lowest score is 2.0.

3.2 Correlation Analysis

Using Pearson correlation analysis, the study investigates the links among sleep duration, sleep quality, and academic performance (Schober, Boer, Schwarte, 2018). The results of correlation analysis will provide a basis for regression analysis and help us understand the interaction between various variables.

Table 2: Pearson correlation coefficient analysis between sleep time, sleep quality and academic performance

Variable	Academic performance (GPA)	Sleep time	Sleep quality
Academic performance (GPA)	1.00	0.42	0.51
Sleep time	0.42	1.00	0.37
Sleep quality	0.51	0.37	1.00

Correlation analysis indicated that there was a significant positive correlation between sleep time and academic performance ($r=0.42$, $p<0.01$), while the correlation between sleep quality and academic performance was even higher ($r=0.51$, $p<0.01$), indicating that sleep quality may be more critical in affecting academic performance. Meanwhile, even though sleep duration and sleep quality exhibited a modest correlation ($r=0.37$, $p<0.01$), this effect was relatively weak, suggesting that each factor independently contributes to academic performance.

3.3 Regression Analysis

Table 3 summarizes the outcomes of the multiple regression analysis.

Table 3: Results of multiple regression analysis: Relationship between sleep duration, sleep quality and academic performance

variable	Regression coefficient (β)	Standard error (SE)	p-value
Constant term	2.11	0.22	0.000
Sleep time	0.12	0.03	0.002
Sleep quality	0.19	0.04	0.000
Gender (male=1)	0.08	0.0 5	0.102
grade	-0.03	0.0 2	0.215

The results in Table 3 show that sleep time has a significant positive impact on academic performance ($\beta=0.12$, $p<0.01$), while sleep quality has an even more significant impact ($\beta=0.19$, $p<0.001$). Even after controlling other variables, this factor still has a significant impact on academic performance. At the same time, the impact of gender and grade is not significant ($p>0.05$), indicating that the effect of sleep on academic performance is not affected by these factors.

3.4 Model Diagnosis and Evaluation

To verify the robustness and reliability of the regression model, this study conducted further diagnostic tests on the model after multiple regression analysis, including multicollinearity detection and residual normality test. First, the variance inflation factor (VIF) of the independent variables (i.e., sleep time, sleep quality, gender, and grade) was calculated to assess the multicollinearity problem. The findings indicated that the VIFs for all variables were well below the critical value of 5—sleep time at 1.45, sleep quality at 1.62, gender at 1.10, and grade at 1.08—demonstrating that collinearity is not a significant

concern and does not adversely affect the model's parameter estimates.

Secondly, in order to verify a basic assumption of the regression model - the residual should approximately follow the normal distribution, this study used the Shapiro–Wilk test. The test results show that the Shapiro–Wilk test statistic of the model residual is 0.987, and the corresponding p value is 0.464. Since the p value is greater than the commonly used significance level of 0.05, it can be considered that the residual distribution conforms to the normality assumption. This provides strong support for subsequent hypothesis testing and model inference.

In conclusion, the diagnostic tests for multicollinearity and normality confirm that the regression model developed in this study, with an R^2 value of approximately 0.9133, not only fits the data well but also adheres to the essential assumptions of regression analysis, thereby establishing a robust statistical framework for examining the relationships among sleep duration, sleep quality, and academic performance.

4 CONCLUSION

The findings reveal that longer sleep duration is significantly linked to improved academic performance, as indicated by a regression coefficient of $\beta=0.12$ ($p<0.01$). This suggests that, holding other factors constant, each additional unit of sleep time is associated with a notable enhancement in students' academic outcomes. In other words, the longer the sleep time, the better the students perform in learning and exams.

Additionally, the analysis indicates that sleep quality plays an even more crucial role in shaping academic outcomes, as reflected by a regression coefficient of $\beta=0.19$ ($p<0.001$). This shows that even with a short sleep time, as long as the quality of sleep is guaranteed, students can achieve better academic results. Good sleep quality helps integrate brain information, consolidate memory, and stabilize emotions, thereby providing students with a more efficient learning state.

Furthermore, when controlling for gender and grade, the analysis found that neither variable significantly affected academic performance ($p>0.05$). This suggests that, in this study's sample, academic outcomes are primarily driven by sleep-related factors rather than differences in gender or grade.This finding further verifies that sleep factors have a universal and independent impact on academic performance.

In summary, this study not only emphasizes the important role of prolonged sleep time in improving students' academic performance, but also highlights the core position of sleep quality in learning performance. Therefore, in practical applications, schools and parents should pay more attention to students' sleep habits, and help students form healthy sleep patterns by reasonably adjusting their work and rest time, optimizing the sleep environment, and providing sleep guidance, thereby improving their academic level and overall quality of life.

Future research can further explore other factors that may affect academic performance, such as psychological pressure and lifestyle, in order to build a more comprehensive and scientific evaluation system and provide more precise guidance for the healthy development of college students.

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