The Relationship Between Sleep Quality, Sleep Duration and Students' Academic Performance

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Keywords: Sleep Quality, Sleep Duration, Students' Academic Performance.

Abstract: With growing concerns about student health and academic achievement, this study explores the critical role of sleep quality in educational outcomes. The implications lie in the effects of sleep on cognitive function and emotional regulation necessary for learning. This article objectively measures, through questionnaires and a huge amount of data, the relationship between sleep patterns and academic indicators. The result of the research shows that there is a nonlinear relationship between sleep duration and academic achievement, which is especially prominent among younger primary school students with insufficient sleep. The authors found that alertness mediated the relationship between children's sleep quality and their academic performance when they were 10 to 12 years old, hence the need for sleep regularity to ensure academic success. Poor sleep patterns disrupt the biological clock, which negatively impacts cognitive functions responsible for learning. The conclusion outlines that good quality sleep, appropriate duration, and regularity are the factors that will help in achieving academic success. The study insinuates that for students to achieve full academic potential, sleep is of the essence and hence it should always be considered at an educational policy level. Mediating factors like stress, motivation, and learning strategies do need further analysis in later studies for the realization of focused educational interventions. Lastly, what the study insists on, is an overall approach: students' well-being and performance, taking sleep as the core of it, and invites further research into complex relationships between sleep and academic outcomes.

1 INTRODUCTION

It is the quality of sleep that has received considerable attention from scholars in educational research in regard to academic performance-a key determinant of students' wellbeing and achievements. Much literature, including the seminal work of Okano et al., supports the fact that sleep quality and duration are important in academic success because it affects cognitive functions and emotional regulation responsible for learning and memory consolidation. However, while there is consensus on all these factors, there still remains a poor understanding of how such sleep factors interact with students' academic performance across the continuum of age and stages of education. This lacuna in research is particularly disturbing because growing academic pressures lead to sleep deprivation in students, which apart from the disturbance in learning processes, might also threaten their health over the long term (Okano et al., 2019). It is further emphasized by the work of Itani et al. in their systematic review study in; this shows the linkage of short sleep duration and different various it can have. Among them are mortality, diabetes, cardiovascular diseases, coronary heart disease, and obesity. These findings reveal the importance of addressing sleep deprivation with urgency, both academically and from the standpoint of the overall health and well-being of students. The significance of this study lies in its comprehensive approach to filling these research gaps (Oi and Miyake, 2016). We will further examine the complex interplays among sleep quality, duration, and regularity that affect academic performance to a great extent and will try to provide a theoretical framework and some actionable insights for educational policymakers. This study becomes particularly relevant in view of the growing attention being given to the importance of sleep for educational outcomes, and the need for evidence-based strategies to support students' health and performance.

Zhu, H.
The Relationship Between Sleep Quality, Sleep Duration and Students' Academic Performance.
DOI: 10.5220/0014109600004942

In *Proceedings of the 2nd International Conference on Applied Psychology and Marketing Management (APMM 2025)*, pages 153-158
ISBN: 978-989-758-791-7

2 IMPACT OF SLEEP QUALITY ON ACADEMIC PERFORMANCE AND MENTAL HEALTH

According to the data from China Family Panel Studies in 2018, Liu's study used data from 3993 primary and secondary school students aged 6 to 16 and both of their parents for this research. The results pointed out that the average hours for sleeping among primary and secondary school students were around 9. 02 ± 0. 96 while those for studying were at an average of 2. 78 ± 0. 92 hours. The measure of academic performance is primarily test scores: academic achievement is measured by grades or GPAs). The results of the study showed that increased sleep duration did improve academic performance, but mainly for primary school students who did not meet the sleep duration requirement. For primary and middle school students who meet the sleep standards, their academic performance decreases with the increase of sleep time (Liu, 2024). This finding suggested that the relationship between sleep and academic achievement may not be linear, and the effect of sleep duration on academic achievement may vary for students under different sleep conditions. Okano et al found that sleep quality, duration, and consistency were positively related to college students' academic performance. This paper tested the relationship between these measures of sleep and academic performance with a sleep dataset collected with wearable Fitbit devices from 100 MIT students. Devices by Fitbit are worn to track a user's daily activities: sleep, exercises, and general health. These results indicated that the combined three sleep measures accounted for 24. 44% of the variance in overall achievement, hence a significant association of sleep and academic achievement. The finding underpins the use of sleep as a key factor in educational outcomes (Okano et al., 2019).

Hou et al. investigated the relationship between sleep quality and classroom attention and academic performance. In this research, undergraduates from 10 full-time universities in Guangdong Province were selected as research objects by adopting stratified random sampling. In the paper, a total of 838 valid questionnaires were recovered, and the investigation showed that sleep quality was in significant correlation with students' attention and academic performance, which again proved the importance of good sleep for cognitive function (Hou et al., 2020). This would therefore suggest that strategies to improve sleep quality will also enhance classroom concentration and thereby improve academic performance.

A systematic review and meta-analysis were performed by Itani et al., that linked short sleep duration to aspects of health outcomes, namely mortality, diabetes, Cardiovascular Disease (CVD), Coronary Heart Disease (CHD), and obesity. In the study, insufficient sleep, which was defined here as less than 6 hours, considerably raised these health aspects (Oi and Miyake, 2016). Thus, sleep seems to be not only important regarding academic performance but also related to health in general.

Cooper et al. briefly reviewed in the relationship of sleep deprivation to obesity. Based on this study, sleep deprivation may modulate the increase in body mass index through increased ghrelin, leptin inhibition, and hedonic signaling during food intake. Moreover, sleep reduction promotes increased fatigue, hence decreasing the capacity to exercise. On the other hand, obesity can also enhance sleep disorder vulnerability, which is associated with poor quality sleep (Cooper et al., 2018). The review presents a bidirectional relationship between sleep and health, with an impact on academic performance.

3 EFFECTS OF SLEEP QUALITY ON ACADEMIC PERFORMANCE IN CHILDREN AGED 10-12 YEARS

Fang examined the effect of sleep quality on the academic performance of children aged 10-12 years old, considering the mediating role of alertness. Alertness is the ability of a child to be awake and focused during the day. It is one of the most important factors affecting academic performance because it involves cognitive control and efficiency of information treatment. The study has shown that sleep quality may influence academic performance through alertness, therefore giving a new insight into the relationship between sleep quality and academic performance (Fang et al., 2023). This might mean that improvement in sleep quality could indirectly result in the improvement of academic performance because of improved alertness.

Yang et al. conducted a survey of 6401 high school students from 28 high schools in Shanghai using a three-stage sampling method. The results showed that 94. 8% of the students slept less than 8 hours, and of those, 62. 8% had less than 7 hours of sleep. Using a rank correlation analysis, sleep time and self-reported academic performance showed that

the spearman rank correlation coefficient is 0. 109; P<0. 01, which implies an association of both factors. In particular, students sleeping 7-8 hours and over 8 hours had higher academic achievements with OR scores of 1. 42 and 2. 04, respectively, compared with students sleeping less than 7 hours (Yang et al., 2018).

The study showed that sleep loss or poor sleep quality can affect the executive function of the prefrontal cortex of the brain, thereby reducing the capability for learning and achieving good academic performance. More critically, sleep loss could weaken the activity in the brain necessary for neurocognitive processing during nighttime, further degrading high-order cognitive capacities, including abstract thinking and creativity. Thus, with a good night's rest, changing school start times can help improve academic performance among high school students. In addition, an intervention such as education in sleep health should also be given to the high schoolers for improvement in their sleeping and hence academic performance.

According to Qian et al., it was suggested that sleep deprivation would have a complex, higher-order impact on various cognitive domains, such as attention, executive function, and long-term memory. This study used a cross-sectional survey of 6401 high school students via a three-stage sampling method and found that 94. 8% of the students slept less than 8 hours and 62. 8% slept less than 7 hours. Through the use of statistical analysis, a significant positive relationship was revealed between sleep duration and the self-perceived academic performance of students, suggesting that longer the sleep duration, better is the self-perceived academic performance by students. (Qian et al., 2020)

Among the most important research issues in education is how sleep influences learning and memory. Sleep deprivation has been shown to have a negative impact on the process of memory consolidation, which makes it difficult to retain new information. This is particularly harmful for academic performance since it hampers students' ability to learn and apply new knowledge. Getting enough sleep is therefore necessary to support effective learning and memory processes.

Indeed, Long et al. show that sleep quality was strongly positively related to emotional eating and expressive suppression but weakly and nonsignificantly with cognitive reappraisal, which is indicative of the fact that sleep quality may affect the use of emotion regulation strategy selection and frequency, hence emotional eating behavior. Furthermore, the negative effects of sleep deprivation on emotion may relate to changes in neural circuit activity in the brain involved in emotion regulation. It has been shown that sleep loss can affect the functioning of the prefrontal cortex and the amygdala, two brain regions strongly implicated in emotional processing and regulation (Long et al., 2020).

The interplay between sleep quality, emotion regulation, and emotional eating is complex. Improved sleep quality may enhance the ability of emotion regulation, reduce emotional eating, and then exert a positive effect on an individual's mental health and quality of life. Further studies are needed to establish the interaction between sleep quality and emotion regulation and then develop effective interventions to enhance sleep quality and improve the emotional well-being of the subjects.

Sheng et al. showed that sleep provides a critical period for memory consolidation. Indeed, research has confirmed different types of learning related to the mechanisms of sleep-based memory consolidation and differential brain effects on various parts of the brain during nocturnal stages of sleep. Sleep promotes the development of the process of long-term enhancement (LTP), the essential mechanism of memory consolidation. Total sleep deprivation, REM sleep deprivation and fragmented sleep may disrupt memory consolidation through different molecular mechanisms (Sheng and Zhang, 2013).

Okano also noted in the research study the importance of a holistic perspective in determining the relationship of sleep to academic performance. Besides the quality and quantity, consistency of sleep patterns plays an important role in maintaining sleep. Irregular sleep patterns have shown to disrupt the body's internal rhythms, leading to difficulty sleeping or staying asleep. This disruption can affect the quality and quantity of sleep and, in effect, poor academic performance (Okano et al., 2019).

It also underlined the gender differences in sleep and school performance. Some studies have demonstrated that female students tend to have better sleep and more regular sleep patterns compared to their male peers. Once the sleep patterns were statistically equal, the female advantage in academic performance disappeared, suggesting that it may be particularly important to encourage male students to develop better sleep habits. However, good sleep could be habits that are worth adopting by all students without consideration for gender. The associations of sleep and school performances are complex and multi-dimensional depending on the individual's difference in sleep needs and also varying with lifestyle and environmental factors. This association

does therefore requires overall consideration along the different involved factors interaction.

4 METHOD

The purpose of this study was to investigate the effects of sleep quality, duration, and consistency on the academic performance of students of different genders, ages, and education levels. The goal of this study is to provide a scientific basis for educational practices to improve sleep quality and thereby improve academic performance.

4.1 Object of Study

Random sampling method was used to investigate the results of a random questionnaire in a high school in Beijing. 156 questionnaires were received. Gender: There are slightly more women than men, and the gender distribution is not exactly equal. Typical study time: Most students study for less than 10 hours. Sleep time per night: Most students sleep between 6 and 8 hours. Feeling tired or lacking energy in the morning: Most students rarely or occasionally feel tired. Sleep quality: Most students consider their sleep quality to be average. Insomnia experience: Most students sometimes or rarely experience insomnia. Academic performance: Most students' academic performance is between "good" and "excellent". Inability to concentrate due to lack of sleep: Most students are rarely or occasionally distracted by this. Cell phone use before bed: Most students do not have the habit of using cell phones before bed. Nap habit: Most students are not used to nap. Feeling sleep deprived before a test: Most students don't feel this way. Reduce sleep time before exams: Most students rarely or occasionally do this. The impact of sleep on learning efficiency: Most students believe that enough sleep has a certain effect on improving learning efficiency.

4.2 Analysis

In order to investigate whether there are significant differences in academic performance among different groups of sleep quality, we used analysis of variance (ANOVA) to study the relationship between sleep quality (qualitative) and academic performance quantitative.

4.3 Descriptive Analysis

Among this group of high school students, the relationship between sleep duration and academic performance can be summarized as: Among students who slept less than six hours, a lower proportion of students received excellent (more than 90 points) and good (70-90 points) grades, and a higher proportion received poor (less than 60 points) grades. Among students who slept six to seven hours, the proportion of students who got excellent and good grades increased, while the proportion of students who got poor grades decreased. The percentage of students who got excellent and good grades remained higher among those who slept 7-8 hours. Almost no students who slept more than eight hours received poor grades, and the highest percentage of students received excellent grades. Overall, with the increase of sleep time, the proportion of students achieving excellent and good grades increased, while the proportion achieving poor grades decreased, showing a positive correlation between sleep time and academic performance.

5 RESULT

Sleep data and academic performance were assigned as less than 6 hours = 1, 6-7 hours = 2, 7-8 hours =3, and more than 8 hours =4. 2 poor (below 60 points) =1, average (60-70 points) =2, good (70-90 points) =3, excellent (above 90 points) =4. Table 1 and figure 1 are obtained

The relationship between academic performance and sleep quality is not linear. Among other things, when academic achievement scores were low, there was cross-draft sleep quality (See Figure 1).

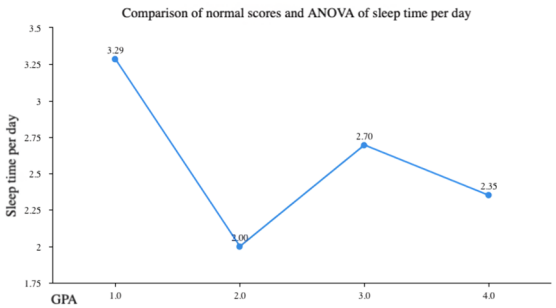

Figure 1 : Relation between academic achievement and students' well-being (Photo/Picture credit: Original).

As can be seen from the table 1, all samples of different ordinary scores have a significant effect on the daily sleep time ($p<0.05$), which means that

different samples of ordinary scores have differences in the daily sleep time. Specific analysis shows that:

Normal scores showed a 0.05 level significance for daily sleep time (F=3.559, p=0.017), and the specific comparison differences showed that the average scores of the groups with significant differences were "1.0>2.0; 1.0>4.0 "(it can also be visually displayed using a line chart).

In summary, it can be seen that different samples of normal performance have significant differences in the daily sleep time.

Table 1. ANOVA results of the relation between academic achievement and students' well-being.

Normal grade (mean ± standard deviation)	Sleep time per day
1. 0(n=7)	3. 29±0. 95
2. 0(n=7)	2. 00±0. 58
3. 0(n=46)	2. 70±0. 94
4. 0(n=40)	2. 35±0. 86
F	3. 559
p	0. 017*

* p<0. 05 ** p<0. 01

6 CONCLUSION

The papers discuss a study that addresses the complex relationship between sleep quality and academic achievement, two very important subjects in the realm of educational research. The core data for the research originate from a random sample survey at a high school in Beijing, with 156 questionnaires, which have value but allow only limited generalizability and representativeness. The limited sample size may not representative of all sleep patterns and academic performance from different demographics and geographical and cultural limitations of the study reduce generalizability of this study to students in the Beijing area alone, perhaps neglecting specific differences in educational systems, ways of life, and cultural influence which may modify the association of sleep and academic performance elsewhere.

The research targets students in high school, not covering a wider age bracket or level of education, such as elementary school students or college students. Moreover, the absence of follow-up data does not allow for the establishment of the long-term effects and stability of the relationship between sleep patterns and academic performance. In this regard, the methodological issue probably prohibits the paper from acquiring in-depth analyses, since its basis only lies in questionnaire surveys and literature reviews, without experimental design or more profound qualitative studies, such as interviews or case studies.

Although these limitations exist, the study shows that good academic performance is achieved by regular sleep, while disrupted sleep patterns impede cognitive skills required for learning. It points out the role of sleep in cognitive development and in the regulation of emotions, important factors for academic performance. Adequate sleep is not only essential for physical and mental health, but it also promotes cognition by enhancing learning and memory.

It significantly provides a conceptual underpinning and guiding framework within which policy planners of educational disciplines place the meaning of sleep in terms of academic successes to develop educationally enlightened interventions. It also underlines the need to understand that initiatives aimed at boosting pupil welfare and achievement have to incorporate multi-faceted approaches to this issue in which sleep does or should stand central. By catching up on lost sleep and practicing healthy sleep habits, students will realize their full potential academically and in general. Such findings might translate into better educational interventions and policies that support the cognitive development and academic performance of students.

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