Bulletin of Business and Economics, 14(1), 39-43
https://bbejournal.com
https://doi.org/10.61506/01.00577

The effect of Sleep Deprivation on Cognitive Performance

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Abstract
A lack of sleep, or sleep deprivation (SD), is a widespread phenomenon that can induce adverse changes in cognitive performance. Sleep deprivation can have significant effects on memory and cognitive function, which is a major concern for students. Correlational research design was used to conduct this quantitative research. Survey was administered with closed ended questionnaires as method of data collection. Convenient sampling technique was employed to select the sample of study 100 (male=50, female=50) college students. Findings of the study reveal that there is significant positive correlation between sleep deprivation, forgetfulness distractibility and false triggering. Moreover, females reported greater level of sleep deprivation, forgetfulness distractibility and false triggering as compared to male students. The study might also suggest that organizations (like schools, workplaces, or healthcare settings) consider the cognitive impacts of sleep deprivation in their policies. For instance, allowing for more breaks, nap opportunities, or prioritizing sleep education might enhance cognitive performance in high-stakes environments.
Keywords: Sleep deprivation, cognitive performance

1. Introduction

Sleep deprivation (SD) is a common condition and an important health concern. In addition to metabolic and cardiovascular risks, SD associates with decreases in cognitive performance (Csipo et al., 2021). Sleep deprivation (SD) can be divided in partial and total SD. Partial SD refers to a night of reduced or interrupted sleep, and total SD to no sleep for at least one night during the normal sleep/wake cycle. Total SD is frequently studied, which could be due to the easier monitoring of brain activity as longer periods of SD cause increased impaired cognitive functioning. Studies show that consistently restricting sleep overtime is more harmful in comparison to a single night of total SD (Lo et al., 2012). Sleep disorders recently emerged as one of the top health concerns of the twenty-first century Hilmisson et al., 2019), as chronic insomnia itself affects approximately 10% of the population (Schutte-Rodin et al., 2008). According to recent reports from the National Sleep Foundation, appropriate sleep duration should constitute between 7 to 9 h for young and middle aged adults of 18 to 65 years of age (Hirshkowitz et al., 2015).

Every sleep duration that is less than 7 h is considered a short sleep duration. Centers for Chronic Disease Control and Prevention report that prevalence of short sleep duration among young and middle-aged adults ranges from 32 to 39% (Makarem et al., 2019). In addition to elevated risks of chronic somatic diseases, short sleep duration is strongly associated with decreases in cognitive performance, which may have a significant implication on work productivity and incidence of accidental injuries in a working class of adults (Costa & Pereira, 2019). These effects do not necessarily occur only as a result of chronic sleep deprivation, as a recent meta-analytic review concluded that impairments in several cognitive domains can be observed even after short-term sleep restriction (Lowe et al., 2017; Rasheed, 2020). Loss of sleep may affect several domains of cognitive functioning, however, reaction time and working memory are reported to be the most sensitive to short-term sleep deprivation (Peng et al., 2020). Working memory is the cognitive domain that is responsible for temporarily holding information available for manipulating, processing, and is also involved in the transition of information to long-term memory (Kwong et al., 2020: Ibrahim & Rasheed, 2024).

Modern lifestyle and factors associated with work are the most frequent causes of sleep deprivation, a large number of people are affected by the sleep deprivation. A vital component of human health and wellbeing is sleep. While we sleep, a number of physiological and neuropsychological activities take place (Curcio et al., 2006). Several research conducted in the recent years have demonstrated the importance of sleep following learning for memory consolidation. According to recent epidemiological data, one in three workers presently sleep fewer than 6 hours each night on average (Roth, 2005). At the moment, little is known about how sleep deprivation affects both cognitive and emotional functioning. It is crucial that science advances our understanding of how inadequate sleep affects cognitive and emotional performance as more and more people experience inadequate sleep (Hossain & Shapiro, 2002).

Sleep is crucial for memory formation, according to recent research on human memory (Yoo et al., 2007). The front line of the healthcare team is typically made up of health professionals (such as doctors, nurses, and community health workers) works for long shifts lasting more than 12 hours that severely impair sleep. It is widely accepted that the performance decline during extended wakefulness is the result of a complicated interaction between an endogenous circadian rhythm and a sleep-wake-dependent homeostatic process. Healthcare staff performance suffers specifically when they are sleep deprived. Additionally, it affects the efficacy of actual and simulated maintenance jobs by increasing complexities and error rates (Philibert, 2005).

Sleep is essential for various physiological processes, including memory consolidation, attention, learning, and emotional regulation, all of which play a crucial role in academic performance. In recent years, sleep deprivation has become increasingly prevalent among students due to academic pressures, social commitments, excessive screen time, and poor time management. Many students struggle to maintain healthy sleep habits, often sacrificing sleep for studying, socializing, or recreational activities. As a result, the lack of adequate rest has raised concerns about its potential impact on cognitive functions such as memory, attention, problem-solving, and decision-making—key skills needed for academic success.

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Existing research has demonstrated that sleep deprivation negatively affects attention span, memory retention, and the ability to concentrate, all of which are vital for learning and academic achievement. Students who experience chronic sleep deprivation may also face long-term consequences, such as reduced academic performance, increased stress levels, and a higher risk of mental health issues. However, the extent of the cognitive impairments caused by sleep deprivation and the specific mechanisms underlying these effects remain an area of ongoing investigation. This study aims to explore the relationship between sleep deprivation and cognitive performance among students, focusing on how inadequate sleep affects key cognitive functions such as attention, memory, and problem-solving abilities. By understanding these effects, the study hopes to inform educational practices and provide insights into strategies that can help students improve their cognitive performance by prioritizing proper sleep.

1.1. Statement of the Problem

Sleep deprivation has become a prevalent issue among students due to academic pressures, extracurricular activities, and the growing use of technology. As students often sacrifice sleep to meet various demands, it raises concerns about how this chronic lack of sleep may affect their cognitive performance. Cognitive functions such as attention, memory, problem-solving, and decision-making are critical for academic success, and insufficient sleep could undermine these abilities. Despite the known effects of sleep deprivation on cognitive processes, there is a need for further investigation into how varying degrees of sleep deprivation impact the performance of students in educational settings. This research aims to explore the relationship between sleep deprivation and cognitive performance, identifying the extent to which it influences learning outcomes and academic achievement. Understanding these effects can help develop strategies to mitigate the negative consequences of sleep deprivation among students, ultimately improving their overall well-being and academic performance.

1.2. Rationale of the Study

The rationale for studying the effect of sleep deprivation on cognitive performance among students is rooted in the importance of sleep for overall brain function and academic success. Cognitive performance encompasses key mental processes such as memory, attention, problem-solving, and decision-making—all of which are critical for students, particularly in the context of learning and exams. Sleep plays a vital role in consolidating memories, regulating emotional responses, and maintaining mental clarity. However, students often face disruptions in their sleep patterns due to academic pressures, social activities, or poor sleep habits. This can result in sleep deprivation, which has been shown to impair cognitive functions. By investigating the relationship between sleep deprivation and cognitive performance, this study aims to provide a clearer understanding of how insufficient sleep affects students' ability to process and retain information, stay focused, and perform well academically. The findings could potentially guide strategies to improve students' health and academic outcomes, such as promoting better sleep hygiene practices or designing interventions to combat sleep deprivation in student populations. In essence, the rationale of the study is to highlight the critical link between sleep and cognitive ability, particularly in students, and to shed light on the broader implications of sleep deprivation on learning and academic performance.

1.3. Objectives of the Study

- To measure the relationship between sleep deprivation and cognitive performance
- To check the mean score difference of sleep deprivation and cognitive performance

1.4. Significance of the Study

The study of *Sleep Deprivation on Cognitive Performance* is highly significant due to the widespread impact of insufficient sleep on daily functioning. Understanding how sleep deprivation affects cognitive performance can inform policies, health guidelines, and improve overall quality of life. Here are some key points that highlight the importance of such a study.

Impact on Mental Functions: Sleep deprivation is known to impair various cognitive functions, such as memory, attention, decision-making, problem-solving, and learning. This can lead to reduced productivity at work or school and increased error rates in tasks requiring complex thinking.

Public Health Concerns: Chronic sleep deprivation has been linked to numerous health problems, including an increased risk of cardiovascular diseases, diabetes, and even neurological disorders like Alzheimer's. Cognitive decline associated with poor sleep can also lead to reduced independence in older adults and contribute to the overall healthcare burden.

Safety and Risk Management: Sleep deprivation is a significant factor in accidents, particularly in high-risk settings like driving, aviation, healthcare, and manufacturing. Understanding the cognitive deficits caused by lack of sleep can help in designing better policies for shift workers, drivers, and other groups where alertness is critical for safety.

Work and Educational Performance: Sleep deprivation can significantly lower both academic and professional performance. Students and workers often face cognitive impairments, affecting concentration, creativity, and efficiency. This could have long-term societal impacts if the trend of sleep deprivation continues to rise.

Mechanisms behind Cognitive Decline: Research in this area also uncovers the biological and neural mechanisms by which sleep deprivation impairs cognition. This is important for developing potential treatments or interventions, such as optimizing sleep schedules or using cognitive training to mitigate the effects of sleep loss.

Mental Health: There is a bi-directional relationship between sleep and mental health, where sleep deprivation can exacerbate symptoms of anxiety, depression, and stress, and vice versa. Exploring the link between cognitive impairment and mental health due to sleep deprivation can guide therapeutic strategies.

Policy Implications: Findings from these studies can influence workplace policies, school start times, public health recommendations, and even legal considerations (e.g., how long drivers or pilots should be awake before being allowed to perform their duties). In summary, studying the effects of sleep deprivation on cognitive performance is crucial not only for individual well-being but also for broader societal benefits such as public safety, productivity, and mental health. The findings can shape interventions to improve sleep habits and mitigate the cognitive effects of sleep loss.

2. Method

2.1. Participants

Correlational research design was used to conduct this quantitative research. Survey was administered with closed ended questionnaires as method of data collection. Convenient sampling technique was employed to select the sample of study 100 (male=50, female=50) college students

2.2. Instrument

Sleep Quality Scale: Sleep Quality Scale was developed by (Shahid et al., 2012). Consisting of 28 items, the SQS evaluates six domains of sleep quality: daytime symptoms, restoration after sleep, problems initiating and maintaining sleep, difficulty waking, and sleep satisfaction. The scale has been validated in individuals aged 18–59 years. Using a four-point, Likert-type scale, respondents indicate how frequently they exhibit certain sleep behaviors (0 = "few," 1 = "sometimes," 2 = "often," and 3 = "almost always"). Scores on items belong to factors 2 and 5 (restoration after sleep and satisfaction with sleep) and are reversed before being tallied. Total scores can range from 0 to 84, with higher scores demoting more acute sleep problems.

The Cognitive Assessment Questionnaire: The cognitive assessment questionnaire, originally called the cognitive failures questionnaire (CFQ) was developed by Broadbent et al. (1982) to assess the frequency with which people experienced cognitive failures, such as absent-mindedness, in everyday life - slips and errors of perception, memory, and motor functioning. A study by Rast et al. (2008) indicates that the CFQ items load on three different factors. Adding scores across the relevant items will yield subscale scores representing these dimensions of forgetfulness: Forgetfulness (Items 1, 2, 5, 7, 17, 20, 22, and 23): a tendency to let go from one's mind something known or planned, for example, names, intentions, appointments, and words. Distractibility (Items 8, 9, 10, 11, 14, 19, 21, and 25): mainly in social situations or interactions with other people such as being absentminded or easily disturbed in one's focused attention. False Triggering (Items 2, 3, 5, 6, 12, 18, 23, and 24): interrupted processing of sequences of cognitive and motor actions.

3. Results

Table 1: Shows the relationship between Sleep deprivation and Cognitive Performance

Variables	Sleep Deprivation	Forgetfulness	Distractibility	False Triggering
Sleep Deprivation	1	.682**	.497**	.501**
Forgetfulness		1	.391**	.649**
Distractibility			1	.428**
False Triggering				1

Table 1 shows the significant positive correlation between sleep deprivation, forgetfulness distractibility and false triggering.

Table 2: Mean score difference of sleep deprivation, forgetfulness distractibility and false triggering (n=100)

Variable	Gender	N	M	Std.Deviation	df	t-test	p-value
Sleep deprivation	Male	50	10.3647	7.03218	48	7.273	<.001
	Female	50	17.8541	9.05342			
Forgetfulness	Male	50	23.0432	8.09543	48	8.051	<.001
	Female	50	39.6754	11.90132			
Distractibility	Male	50	14.0932	6.02313	48	4.902	<.001
	Female	50	26.0948	9.81329			
False triggering	Male	50	11.0120	5.09120	48	6.401	<.001
	Female	50	18.0154	7.08127			

Table 2 shows the significant mean score difference in term of sleep deprivation, forgetfulness distractibility and false triggering between male and female students. Female reported greater level of sleep deprivation, forgetfulness distractibility and false triggering as compared to male students.

4. Discussion

Sleep deprivation can have significant effects on memory and cognitive function, which is a major concern for students. Adequate sleep is critical for both memory retention and overall academic performance. Students who regularly experience sleep deprivation are likely to face greater challenges with learning and remembering course material. Findings of the study reveal that there is significant positive correlation between sleep deprivation, forgetfulness distractibility and false triggering. Moreover, females reported greater level of sleep deprivation, forgetfulness distractibility and false triggering as compared to male students.

Exposure to partial and total sleep deprivation impairs human cognitive functions such as sustained attention and working (Pilcher & Huffcutt, 1996). Regarding physical health complaints, the data show that complaints are common in all groups (weekly or more often) and these were related to working environment . In this study, sleep deprivation was linked to problems with learning, focus, and social interactions. The cognitive abilities of the nurses who worked in shifts at the conclusion of the day shift and night shift were compared. Lower levels of scores was observed in cognitive domains, mental skills, vigilance, simple reaction time and working memory. Recent studies suggest that the possibility that sleep loss impacts on parietal function may play a particularly significant role in influencing later cognition (Thomas et al., 2000). Dorsolateral prefrontal cortex is known to be linked to working memory and episodic memory (Vandewalle et al., 2009). Number of data confirmed the connection between memory processes and sleep (Stickgold & Walker, 2007). During the day shift, we observed

better visual working memory compared to the night shift. Thus, as a result, sleep deprivation also enslaves memory (Lo et al., 2016). In keeping with the findings of a study conducted among medical interns in the United States, it was found that mathematical tasks were solved more slowly during the night shift (Raidy & Scharff, 2005; Ismail & Ali, 2020). Additionally, it was found that the slower mean simple reaction time of the night shift due to Sleep Deprivation (Gunzelmann et al., 2009). Additionally, lack of sleep seems to be linked to a general decrease in target recognition and an increase in false alarms, although it's likely that these findings are just the result of diminished attention and vigilance. By altering vigilance state transitions and sleep states, sleep deprivation can affect the hypothalamic suprachiasmatic nucleus's activity (Deboer et al. 2003). Working memory issues, delayed cognitive processing, and poor outcomes on the psychomotor vigilance test (PVT) have all been found in studies on sleep deprivation (Wei et al., 1999; Henry, 2024). Studies have demonstrated that lack of sleep reduces reaction speeds generally, which boosts the time spent on task and produces more errors of execution and absence. Vigilance tests performed during sleep deprivation have also been shown to be susceptible to both circadian and homeostatic drives (Lim & Dinges, 2008; Musa, 2024). Additionally, several studies have shown that working the night shift increases the likelihood that cognitive impairment will occur compared to working the day shift (Doran et al., 2001). Despite working the same amount of time as a day shift, it is crucial to remember that persons who experience sleep deprivation are more vulnerable to its many negative effects (Williamson & Feyer, 2000).

5. Conclusion

The conclusion of a study on the effect of sleep deprivation on cognitive performance generally finds that sleep deprivation has a significant negative impact on various cognitive functions. These may include attention, memory, problem-solving, decision-making, and overall mental clarity. Lack of sleep reduces the ability to maintain attention and focus, making it harder to stay engaged with tasks and complete them effectively. Sleep deprivation affects both short-term and long-term memory. Findings of the study reveal that there is significant positive correlation between sleep deprivation, forgetfulness distractibility and false triggering. Moreover, females reported greater level of sleep deprivation, forgetfulness distractibility and false triggering as compared to male students. Sleep deprivation can cause slower response times, making tasks that require quick thinking and action more difficult. Sleep deprivation can also affect mood, leading to irritability, anxiety, and stress, which further contribute to cognitive decline.

5.1. Contributions of the Study

The study provides valuable insights into the relationship between sleep patterns and cognitive function, particularly within a student population.

Understanding Cognitive Decline Due to Sleep Loss: By examining the impact of sleep deprivation on students, the study sheds light on how lack of sleep affects mental processes like attention, memory, learning, problem-solving, and decision-making. This is crucial because cognitive abilities directly influence academic performance, and identifying the specific areas affected by sleep deprivation can help in designing targeted interventions.

Implications for Academic Performance: The study contributes to understanding how sleep deprivation impairs students' ability to process information, retain knowledge, and perform tasks effectively. This is important for educators and institutions who can use the findings to adjust teaching methods or exam schedules to reduce the negative effects of sleep loss.

Health and Well-being Focus: The research highlights the role of sleep in maintaining overall mental and physical health, stressing how insufficient sleep can lead to chronic cognitive issues and even emotional or psychological distress. This brings attention to the need for better sleep hygiene practices and support systems for students.

Policy Recommendations: The findings can inform university and school policies related to academic schedules, assignment deadlines, and exam timing to reduce sleep deprivation-related stress and improve performance. It may also influence guidelines for promoting better sleep habits among students.

Development of Coping Mechanisms: By understanding the cognitive effects of sleep deprivation, the study could help identify strategies or coping mechanisms that students can use to mitigate some of the negative impacts. This might include time management techniques, napping strategies, or relaxation practices before exams.

Future Research Directions: The study contributes to the ongoing conversation around sleep and its cognitive effects, opening avenues for future research into specific cognitive domains most affected by sleep deprivation, long-term consequences, and potential interventions. In summary, this study contributes by raising awareness of the significant impact of sleep deprivation on cognitive functions, informing academic practices, guiding health recommendations, and providing a foundation for future research into sleep-related interventions for students.

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