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The Relationship of Sleep Quality and Cognitive Failure among University Students: A Quantitative Study

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Abstract

This research investigates the risk factors of poor sleep quality on cognitive performance among university students in Karachi, Pakistan. This study employed a quantitative survey-based approach. N= 202 participants between 18 to 25 years were selected through convenient sampling technique. Sleep Quality Scale (SQS) (Yi, et. al., 2006) was administered to assess quality of sleep and Cognitive Failure Questionnaire (CFQ) developed by Broadbend et. al., 1982 was used to assess cognitive performance among the participants. The collected data was thereafter analyzed using descriptive and inferential statistics via SPSS (Version 22). Correlation and regression analysis were done to investigate the relationship and level of variance between the variables. Results revealed significant relationship between sleep quality and cognitive performance (p <.05) providing valuable insight on the importance of sleep and cognitive performance with regard to young population.

Keywords: attentiveness, cognition, learning, memory, mood changes, sleep deprivation

Introduction

Sleep and cognitive functioning go hand in hand. Adequate cognitive functions including observation, attentiveness, decision-making, thinking, communication, recall, and studying require quality sleep. (Salmani et al., 2020). Insufficient and inconsistent patterns of sleep negatively impact one's mood leading to lethargic and unfocused functioning. (Alotaibi et al., 2020). Sleep strengthens, reorganizes, and integrates memory traces into knowledge networks to build long-term memory (Gloger & Suhr, 2020; Seoane et al., 2020). Sleep deprivation or inconsistent patterns can affect speaking, communication, divergent thinking, response times, perseverance, focused attention, risk evaluation, and tactical planning (Alqurashi et al., 2022). Sleep deprivation is common today, but its cognitive repercussions are unknown. Studies have identified the effects of insufficient sleep in the form of lowered response speed and increased performance variability in simple attention, focus, and observance tests (Sochal et al., 2023). However, sleep deprivation's effects on insight, memory, and executive functioning are less clear. This debate has centered on whether sleep loss reduces attentiveness and concentration, harming certain or all cognitive capacities (Sochal et al., 2023). Approximately 20% of adults suffer from sleep deprivation. According to Costa and Pereira (2019), sleep deprivation disrupts brain cell connectivity, causing mental gaps that impair memory and visual perception. College and university students report 50% daytime tiredness and 70% insufficient sleep. Sochal et al. (2023) reported resting after learning improves memory maintenance by 20-40%.

Undergraduate students enrolled in universities and other such institutions face multiple challenges related to academic performance. This stage of education being highly competitive and demanding in impact student's life significantly. This growing age comes up with multiple social, academic and career related responsibilities and commitments that significantly impact their life patterns. These challenges also instigate a sense of insecurity and anxieties linked to future academic performance and career success (Mahfouz et al., 2020; Moitra, 2021). Concerns related to quality of sleep in this age group have been reported by several studies (Choueiry, 2016). Previous studies provided evidence of link between poor sleep quality and social media addiction (Bhandari, 2017). Studies revealing the impact of sleep quality and cognitive performance have been conducted in similar population in several parts of the world including United States, European nations, and some Asian countries. These studies have mostly focused on the medical

population. This topic is still new and need to be explored in a country like Pakistan which has a rich and diverse cultural heritage. Exploring one of the major concerns like sleep in younger population in Pakistan will unfold other dimension which will facilitate in improving quality of life and academic success among university students. Keeping these factors in context, this study was instigated on university students in Karachi, Pakistan. The major purpose was to assess factors significant for a sound quality of life such as sleep which is directly linked to one's academic and professional success later in life.

Literature Review

Even though sleep appears to be a passive process, numerous studies have demonstrated the potential capacity of brain to remain active even during sleep. This aids in the consolidation of previous memories and the formation of new connections, both of which naturally improve performance on a variety of tasks (Martinez, 2023). Downplaying the significance of getting sufficient rest is unimaginable. We sleep for one-third of our lives. To sustain ideal circumstances, cells and organisms need sleep for cell repair and balance. It is also necessary for brain activities including nerve cell communication to rest and restore brain structure intern keeping us strong. Poor quality sleep or sleep deprivation impairs all these major functions of the brain and other physiological processes. Diabetes, high blood pressure, heart arrhythmia, stroke, obesity, and cancer are all increased by chronic disturbance in sleep (Thompson et al., 2023). Additionally, the effects on the brain can be catastrophic as lack or poor quality of sleep has been linked to the progression of Alzheimer's disease. Memory, cognitive function, and emotion have all been studied in relation to sleep deprivation. It has been debated in cases of sleep deprivation whether simple order thinking tasks suffer more from sleep deprivation than complex order ones. According to these studies, sleep deprivation or poor quality of sleep may have a greater impact on memory and alertness than on complex higher-order thinking. However, there are no tests to validate this notion. Despite no findings on higher-order thinking, research demonstrates that sleep deprivation affects simple and sustained attention and speed (Martinez, 2023).

Theoretical Framework

According to the active system consolidation theory, new recollections are reactivated and rearranged at the system level during sleep, strengthening

some neural representations. However, the synaptic homeostasis theory suggests that synaptic connections are broadly de-potentiated during sleep, with some memory representations being de-potentiated less or not at all, resulting in stronger memories (Pekçetin, 2021). Experimental evidence supports both hypotheses without contradiction. The active system consolidation theory is endorsed by other studies providing evidence for cognitive enhancement during sleep supporting the synaptic homeostasis hypothesis and is independent of mechanical factors.

The Circadian and homeostatic are considered essential for quality sleep for a healthy individual. These processes significantly impact the amount of sleep. According to the circadian process theory, sleep patterns can be regulated by the circadian clock working inside a human body. The major task is to monitor the sleep-wake cycle apart from maintaining a balance and homeostasis of body mechanisms. Dis-regulated sleep patterns affect body's homeostatic potential resulting in compromised brain functioning (Dijk & Archer, 2009). Disturbed sleep patterns often end up with poor brain functioning, hampering the essential executive brain processes such as memory, judgement and decision- making. It weakens the neural connectivity between the amygdala and the medial prefrontal cortex leading to disruption in neural pathways linked to controlling emotions (Yoo et al., 2007).

Additional findings suggest a relationship between poor sleep quality and impairment in higher order functioning such as decision making and judgment. Individuals with disturbed sleep patterns were observed to take longer to respond or act for the given situations indicating difficulty in cognitive integration (Killgore et al., 2007).

Hypothesis

There will be a significant relationship between sleep quality and cognitive failure among university students.

Methodology

Research Design

This study utilized a quantitative survey-based approach as a research design. The data was collected by convenient sampling technique using structured self-report questionnaires.

Participants

For this study convenient sampling technique was used to select (N=202) participants aged between 18 till 25 years from different universities of Karachi, Pakistan.

Inclusion Criteria

Individuals ranging from 18 –25 years of age and individuals enrolled in universities.

Exclusion Criteria

Individuals below 18 and above 25 years of age and individuals with any kind of physical or mental illnesses.

Instrument Selection

This study uses Sleep Quality Questionnaire (Shin & Shin, 2006) SQS to measure the quality of sleep in individuals aged between 18 – 59 years. It is composed of 28 items, with six sub domains measuring sleep quality including daytime symptoms, restoration after sleep, problems initiating and maintaining sleep, difficulty waking, and sleep satisfaction. Higher ratings indicate more serious sleep issues. It is a self-report scale which is available on demand from the developers. It takes around 5 and 10 min for administration. SQS demonstrates an internal consistency of .92, a test-retest reliability of .81.

The Cognitive Failure Questionnaire (Broadbend et al., 1982). CFQ, a self-report tool constituting 25 items, assesses the prevalence of cognitive failure in the past six months including absent mindedness, perceptual errors, disturbance in memory, attention and motor functioning in adults between 16–85. High scores indicate a higher probability of cognitive failures. The scale displays a satisfactory test-retest reliability of 0.71. A demographic information form was developed by the researcher to acquire the demographic details of the participants, these include age, gender, level of education, etc.

Procedure

A letter of consent indicating the purpose of study, and the relevant details of the approved scales were provided to the authorities of the randomly selected

universities in Karachi. After getting permission from the relevant bodies, the process was initiated. All the necessary ethical requirements were met before approaching the participants. The administration was conducted on a one-on-one basis, any queries during the process were satisfied there and then by the researcher. Data acquired was thereafter scrutinized for possible discrepancies and analyzed using standard statistical software for social sciences (SPSS- 22).

Ethical Consideration

This study was conducted after considering the relevant ethical formalities. All the measures were utilized with the consent of the respective authors. The participants were pre-informed about their volunteer participation and withdrawal from the research at any time during the study period. They were also guided about concerns related to confidentiality of the information given.

Data Analysis

The acquired data was analyzed via the Statistical Package for Social Sciences, version 22 (SPSS, V.22). Results were evaluated using descriptive and inferential statistics. Pearson's product moment coefficient of correlation ('r') was calculated, and regression analysis was done to spot the relationship, directionality and effectiveness of the variables sleep quality and cognitive failure.

Results

Table 1

Demographic Characteristics of Participants (N=202)

Characteristics	F	%
Age		
18	30	14.8
19	23	11.3
20	19	9.5
21	20	9.9
22	25	12.4
23	30	14.8
24	25	12.5
25	30	14.8
Gender		
Female	91	44.2
Male	108	52.4
Prefer not to say	3	1.4
Education		
Graduate	60	29.7
Post-graduate	12	5.9
Under-graduate	130	64.4
Employment		
Employed	102	50.4
Unemployed	100	48.5

Table 1 shows the frequency and percentage of the distribution of 202 survey participants based on age, gender, education and employment status

Table 2

Reliability Analysis

Research Measures	No. of items	α
Sleep Quality Questionnaire	28	.67
Cognitive Failure Questionnaire	25	.76

Table 2 displays Cronbach alpha reliability coefficient of the measures. The reliability of both the measures falls into the acceptable range.

Table 3

Correlations between Sleep Quality and Cognitive Failure among university students (N=202)

	Cognitive Failure	
	r	**p**
Sleep Quality	-.141*	.045

Results of correlation displayed in table 3 indicates significant correlation ($p<0.05$) between sleep quality and cognitive failure among the participants.

Table 4

Simple Linear Regression between Sleep Quality and Cognitive Failure (N=202)

Model	R	R2	Adj. R2	Std. Error of the Estimate
1	.141a	.020	.015	2.849

Table 5

Simple Linear Regression between Sleep Quality and Cognitive Failure (N=202)

	Model	Sum of Square	df	Mean Square	F	Sig.
1	Regression	32.879	3	32.879	4.052	.045
	Residual	1614.822	199	8.115		
	Total	1647.701	202			

Table 6

Regression Coefficients of Sleep Quality and Cognitive Failure (N=202)

Variables	B	SE	β	t	p
Constant	17.970	1.218		14.758	.000
Sleep Quality	-.044	.022	-.141	-2.013	.045

Table 4,5, & 6 display the impact of quality of sleep on cognitive failure. R^2 of .02 indicate that the predictor variable explained 2% variance in the outcome variable with F (1, 199) = 4.05, $p<.05$. Therefore, the results disclose that sleep quality predicts cognitive failure (β= -.141, $p<.05$).

Discussion

A healthy sleep pattern is essential for healthy physiological functioning. It stimulates brain cells leading to high-quality cognitive functioning. Sleep deprivation or inadequate sleep pattern demotes thinking, problem solving, and other significant brain mechanisms aggravating the ageing process (Khan & Al-Jahdali, 2023).

The purpose of this study was to investigate the significance of good quality sleep and cognitive functioning in young Pakistani population. The findings of this study contribute to the existing body of research highlighting the detrimental effects of sleep deprivation on cognitive performance. The analysis provides empirical evidence supporting the hypothesis that sleep deprivation impairs cognitive functioning. The results align with prior studies that have consistently demonstrated the adverse effects of sleep deprivation on attention, memory, decision-making, and executive function. Previous studies by Thompson et al. (2022) show a similar result that Sleep is a key physiological function for homeostasis, or the self-regulating processes that take place in a cell or organism to maintain ideal conditions, as well as cell repair. It is also necessary for many other processes in the brain, including communication between neurons.

The correlation between sleep quality and cognitive performance implies that insufficient sleep negatively impacts various cognitive processes. According to Al-Salmani et al. (2020) those who were more sleep deprived did not demonstrate an improvement in their positive affect following an accomplishment, whereas those who had sufficient sleep felt better after their accomplishment.

The results of this study are aligned with those of Najafi et al. (2023), who found significant connection between sleep and learning. It was highlighted that sleep after learning increases human memory retention by 20-40%. Our brains can fully absorb information while we sleep. Moreover, it also inspires creativity. Inadequate sleep disrupts neural processes responsible for memory consolidation, impairs attentional control, and compromises cognitive flexibility and problem-solving abilities. Sleep deprivation has also been linked to decreased prefrontal cortex activity, which is critical for higher-order cognitive functions.

Results of the correlation test in this study concluded that there is a significant

negative relationship between sleep quality and cognitive performance. Increase in sleep deprivation would result in the decrease of the cognitive performance of an individual. This explanation could be further explained by Alotaibi et al. (2020) that sleeping is a valuable use of time. While the brain is asleep, it is actively processing information from the previous day and getting ready for the demands of the next. Consolidating, reorganizing, and incorporating memory traces into pre-existing knowledge networks, it is the process by which long-term memory is -formed during sleep. Following slumber, these functions restore the ability to learn new things and retain knowledge that has already been acquired. The fact that sleep continues to be regarded as a commodity in this society is concerning. In multiple ways, getting enough sleep is essential. Rather, sleep should be considered an effective employee that supports the best possible functioning of our brains.

The findings from this study have implications that go beyond the specific academic setting and touch on more general concerns about the success and well-being of students. Students who understand how important getting enough sleep is for their cognitive performance will make good sleep habits a top priority and an essential part of their academic success.

Conclusion and Recommendations

The purpose of the study was to investigate the connection between university students' cognitive performance and sleep quality. Sleep quality and cognitive performance were found to have a significant correlation. This finding proposes that more elevated levels of lack of sleep were related with lower mental execution among the members. In conclusion, this study demonstrates that sleep deprivation negatively affects university students' cognitive performance. The results emphasize the significance of addressing sleep deprivation as a potential influence on cognitive performance in educational environments.

Lack of sample representativeness limits this investigation. The collection of aggregated data from several universities rather than a single foundation or population. Therefore, the results may not be applicable to a particular group of students or educational framework. The diverse age and educational backgrounds of the members posed challenges in reaching consensus for meeting choices. Limitations arise from the utilization of self-report measurements to evaluate both sleep deprivation and cognitive performance. Recall and social desirability biases

can affect self-report assessments due to their subjectivity.

Create extensive sleep education initiatives targeting university students. These efforts should emphasize the need for rest for cognitive functioning, well-being, and academic achievement. Educate individuals on the optimal duration of sleep, the importance of practicing good sleep hygiene, and the potential risks associated with sleep loss. To help students establish consistent sleep schedules, encourage them to adhere to a fixed bedtime and wake-up time, including on weekends. Implement sleep diagnostic and counseling services to provide individualized suggestions and consultations for pupils. Enforce policies that promote the practice of taking short power naps during the day for students with unpredictable schedules or significant academic workloads. Regular exercise, a balanced diet, and avoiding caffeine, especially before bedtime, can improve sleep.

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