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The Impact of Sleep Quality on Academic Performance in Undergraduate Students: Examining the Roles of Sleep Duration, Sleep Quality, Sleep Efficiency and Sleep Disturbance

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ABSTRACT

Dreams serve important functions in student school performance that affects concentration, decision-making and cognitive efficiency. This study investigated the predictive relationship between sleep quality, sleep duration, sleep efficiency, and sleep disturbance in academic achievement. Of the 501 students, data were collected using the Pittsburgh Sleep Quality Index and GPA self-assessment. After excluding people who consumed sleep-related drugs, the final sample included 469 participants. Descriptive analyses were shown by a mean score of 3.15 (and S.D= 0.53). Correlation results show that lower sleep quality, longer sleep duration, and sleep disturbance are significantly associated with lower GPA. Simple linear regression confirms that sleep quality (β=-.119, p=0.009), sleep duration (β=-.100, p=0.028), sleep disturbance (β=-.098, p=0.031) are negative predictors of GPA. In the multiple regression model, only sleep duration remained a significant predictor (β=-.096, p=0.044) after demographic control. Gender and academic years also had a significant impact on average scores, with female students and students working better in last semesters.

Keywords: *Sleep quality, sleep duration, sleep efficiency, sleep regularity, academic performance, undergraduate students, GPA, cognitive functioning*

INTRODUCTION

Getting enough sleep plays a vital role in helping individuals think clearly, regulate their emotions, and maintain both physical and mental health. Adequate rest is essential not just for physical well-being, but also for supporting brain functions such as memory, focus, and the ability to learn. Sleep-related issues are frequently observed among undergraduate students, often due to academic pressure, social commitments, and inconsistent daily routines. It is widely recognized that insufficient and poor-quality sleep can hinder students' ability to learn efficiently and perform well academically. Research indicates that university students commonly experience poor sleep habits and disrupted sleep patterns, leading to sleep deprivation and affecting everyday functioning. Those residing in hostels often face additional

challenges that can further disrupt their sleep (Qin & Brown, 2017). Adults also frequently experience sleep difficulties and daytime fatigue as they attempt to meet daily obligations while contending with delayed sleep tendencies (Crowley et al., 2007; Alfonsi et al., 2020).

Giannotti et al. (2002) proposed that Sleep-deprived students are often found to experience various health issues, such as depression, fatigue, and problems with attention, memory, learning, focus, and decision-making. Sleep duration is how many hours you sleep each night, and it really matters more than most people think. Getting enough rest helps you feel better, think clearly, and stay healthy. Sleep quality is all about how restful and refreshing your sleep feels. It's not just about how many hours you're in bed, but whether you stay asleep, wake up feeling good, and have the energy to get through the day. Sleep efficiency is a measure of how well you actually sleep while you're in bed. It's the percentage of time you spend sleeping compared to the total time you spend lying in bed. Sleep regularity means going to bed and waking up around the same time each day. When your sleep schedule stays steady, your body gets into a healthy rhythm. One study explores how academic performance is linked to sleep quality. They concluded that students who sleep poorly receives bad grades which means that reduced sleep quality results in reduction in academic performance (Ahrberg et al., 2012).

Cross-sectional study design was conducted on undergraduate students to examine how sleep quality impacts academic performance. Sample size of 300 was collected using non-probability purposive sampling. Results shows that students who have better sleep quality had CGPA >3.5 and students who have poor sleep quality had CGPA< 3.5 (Rafi et al., 2021). One study conducted on college students investigates the quality, duration and consistency of sleep effects academic performance. Using wearable trackers, they investigated that those students who had better sleep quality, longer sleep duration and consistence sleep patterns performed good academically, while sleep one night before the exams did not impact exam scores (Okano et al., 2019). Similarly, one research in a Singapore residential college investigates that sleep disturbance, sleep duration, sleep quality and sleep efficacy were significantly associated with academic performance and psychological well-being (Armand et al., 2021).

A cross-sectional study conducted on university students explored how sleep duration influences academic achievement. Findings revealed a significant positive association between the number of hours slept and students' GPA, indicating that maintaining a consistent sleep routine is associated with better academic outcomes (Gomes et al., 2011). Similarly, research carried out among undergraduate students examining the link between sleep quality and academic success found that higher sleep quality is associated with improved academic performance, as reflected by a positive correlation between the two variables (Anitha et al., 2022). Another investigation focused on the impact of irregular sleep and wake patterns on students' academic results. Utilizing wearable activity monitors, the study determined that longer sleep duration, fewer sleep disturbances, and higher sleep quality were all positively linked to enhanced academic achievement (Phillips et al., 2017). While many studies focus solely on sleep quality, other aspects such as sleep duration, regularity and efficiency may also play significant roles in determining academic outcomes. Understanding these dimensions can offer a more complete picture of the sleep academic performance relationship.

Over the past decade, we have studied the relationship between sleep and school performance in college students. Nevertheless, limited research has studied many aspects of sleep to determine separate contributions to academic success among students. The purpose of this study is to understand how different aspects of sleep, such as duration, quality, efficiency, and *disturbance*, are related to student academic achievement. A more detailed understanding of these sleep-related factors can provide valuable information about improving student academic achievement and general well-being. Furthermore, such

results can help develop interventions or target strategies aimed at stimulating healthier sleep behaviors in college students.

Research problem

While several studies have indicated a relationship between sleep quality and academic performance, the specific impact of sleep quality, duration, efficiency, and disturbance on academic outcomes, particularly in undergraduate students, remains unclear. This research aims to assess how these sleep variables predict academic performance, operationalized as GPA, among undergraduate students.

Hypotheses

Each hypothesis is designed to align with regression analysis, where we will examine how various sleep factors predict academic performance (GPA):

H1: Sleep quality significantly predicts academic performance (measured by GPA) among students.

H2: Sleep duration significantly predicts academic performance (measured by GPA) among students.

H3: Sleep efficiency significantly predicts academic performance (measured by GPA) among students.

H4: Sleep disturbance significantly predicts academic performance (measured by GPA) among students.

Rationale

Sleep plays a crucial role in overall academic achievement yet its significance remains underappreciated in higher education settings (Alfonsi, et al., 2020). Research indicates that poor sleep quality, irregular sleep patterns and insufficient sleep duration negatively impacts academic performance among undergraduate students (Wheaton, Chapman, & Croft, 2016). Additionally, sleep efficiency has been linked to improved learning outcomes, while irregular sleep schedules contribute to daytime sleepiness and impaired cognitive performance (Suardiaz-Muro, et al., 2020). Given these associations, this study aims to explore the multidimensional impact of sleep duration, sleep quality, sleep efficiency and sleep disturbance on academic performance, providing insights into how optimizing sleep behaviors can enhance educational outcomes.

Objectives

This study aims to explore the impact of sleep quality and academic performance among undergraduate students. The study specifically targets the following objectives:

Objective 1: To explore the degree to which the quality of sleep serves as a predictor of academic achievement, specifically GPA, among undergraduate students.
Objective 2: To evaluate how the number of hours slept influences GPA in undergraduate students.
Objective 3: To analyze the association between sleep efficiency and academic performance, as reflected by GPA, in undergraduate students.
Objective 4: To determine the predictive role of sleep-related difficulties on the academic outcomes (GPA) of undergraduate students.

METHODOLOGY

Study Design

This study used cross-approach and applied regression analysis to study various aspects of sleep, namely the quality, duration, efficiency and disturbance of measured academic achievement.

Ethical Considerations

Before participating, people received detailed information about the purpose of the study, participation and rights. Informed consent was obtained in electronic form. To maintain confidentiality, all responses were anonymized and ensured that participants remained confidential. Participation was completely voluntary, allowing respondents to escape from the study at any stage without addressing negative outcomes.

Sampling

Initially, this study attracted 500 students using convenience sampling. Following exclusion criteria, those who showed sleep-related medication use were excluded from the analysis. As a result, the final dataset included 469 students, providing broad responses and appropriate data for reliable statistical assessments.

Inclusion criteria

This study included participants aged 18-35 who were actively enrolled in the academic program during data collection.

Exclusion criteria

Students diagnosed with sleep disorders or those using sleep medications were not included in the study.

Data collection technique

The study utilized an online survey distributed via email or WhatsApp to the selected students. The survey was used to collect data on various aspects of sleep including sleep quality, duration, efficiency and disturbance, along with participant's GPA. Informed consent was obtained electronically before participation to ensure that students understand the purpose of the study and their rights.

Demographic Variables

Participants also provided information on the following demographic variables such as age, gender, study hours, employment status, and academic year to control for their potential influence on the outcomes.

Instruments

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI) developed by Buysse et al. (1989) which is a widely used tool for assessing sleep quality over a one-month period and includes sleep duration, disturbances and efficiency. Academic performance was evaluated through self-reported GPA from the current academic term. Additionally, demographic information was collected using a short questionnaire, which included details such as age, gender, study habits, employment status, and academic year.

DATA ANALYSIS

Data were analyzed using SPSS software. Initially, separate simple linear regression analyses were carried out to explore the individual influence of sleep quality, sleep duration, sleep efficiency, and sleep disturbance on students' GPA. Subsequently, a multiple regression analysis was employed to evaluate the collective effect of these sleep-related factors on academic performance, while accounting for possible confounding variables such as age, gender, number of study hours, employment status, and year of study.

RESULTS

Participants Exclusion

In total, 501 participants conducted the survey. Thirty-two people who declared they had taken sleep-related medications according to the study's exclusion criteria were excluded from the analysis. The final analytical sample consisted of 469 participants who were not currently taking sleep-related medications.

Table 1: Participant Exclusion Based on Sleep Medication Use (N = 501)

Sleep-medication use	n	%
No	469	93.6%
Yes	32	6.4%
Total	501	100%

A total of 32 participants who indicated the use of sleep-related medication were excluded from further analysis, leading to a final sample size of 469.

Descriptive statistics for continuous variables

Descriptive statistics for all continuous variables included in the study are summarized in Table 2. Participants' age ranged from 18 to 28 years of age, with an average age of 20.76 (and = 1.79). The average mean of total points (CGPA) is 3.15 (and = 0.53), estimated covered between 1.00 and 4.00. On average, students said they were studying 2.05 hours a day (and = 1.03). The daily **training period is 1-5 hours.**

Table 2: Descriptive statistics for continuous variables (n = 469)

Variables	M	SD	Min	Max
Age	20.76	1.79	18	28
CGPA	3.15	.53	1.00	4.00
Study Hours	2.05	1.03	1	5

Note. M = Mean; SD = Standard deviation; CGPA = Cumulative Grade Point Average. Study hours refer to the average number of hours students reported studying per day.

Descriptive Statistics for Categorical Variables

Frequencies and percentages for demographic and lifestyle characteristics are presented in Table 3. The final sample included 274 female participants (58.4%) and 195 male participants (41.6%). Most participants were single (77.4%), and the majority belonged to nuclear families (62.3%). Regular religious observance was reported by 51.2% of the participants, while 14.5% reported seldom offering prayers. In terms of physical activity, 30.9% of students reported not exercising at all, whereas 13.0% exercised daily and 26.2% did so a few times per week. Only a small proportion of the sample reported daily cigarette use (3.8%) or substance use (6.6%). Suicidal ideation was reported by 26.4% of participants, while 29.4% reported experiencing current psychological distress. All participants were enrolled in undergraduate programs, with the highest proportion from Psychology (25.2%), Engineering (22.2%), and Cyber Security (8.1%). The most frequently represented universities included GIKI (36.9%), NUMS (11.3%), and COMSATS (2.8%). In terms of academic progress, most participants were enrolled in the 2nd semester (27.5%) and 6th semester (20.5%). The majority reported a CGPA between 2.5 and 3.8, with the highest concentration around 3.0 (11.7%). Regarding living arrangements, half of the participants lived with family (50.5%), while 46.5% lived in hostels. Study habits varied, with 37.7% of students studying 1–2 hours per day, and 34.8% studying less than 1 hour daily.

Table 3: Frequencies and Percentages for Categorical Variables (N = 469)

Variable	Category	n	%
Gender	Male	195	41.6%
	Female	274	58.4%
Marital Status	Single	363	77.4%
	In a relationship	56	11.9%
	Engaged	25	5.3%
	Married	11	2.3%
	Divorced	2	.4%
	Widowed	2	.4%
	Separated	1	.2%
	Prefer not to answer	9	1.9%
Family Structure	Nuclear family	292	62.3%
	Extended family	75	16.0%
	Single-parent family	29	6.2%
	Joint family	61	13.0%
	Prefer not to answer	12	2.6%
Prayers	Seldom	68	14.5%
	Occasionally	125	26.7%
	Regularly	240	51.2%
	Prefer not to answer	36	7.7%
Physical fitness	Yes, daily	61	13.0%
	Yes, a few times a week	123	26.2%
	Yes, occasionally	140	29.9%
	No, I do not practice physical exercise	145	30.9%
Smoking	Yes	18	3.8%
	No	451	96.2%
Substance Use	Yes	51	6.6%
	No	438	93.4%
Suicidal Ideation	Yes	124	26.4%
	No	311	66.3%
	Prefer not to answer	34	7.2%
Psychological distress	Yes	138	29.4%
	No	331	70.6%
Education	BS/BA/MSc	469	100%
Department	Design	16	3.4%
	Psychology	118	25.2%
	Computer science	19	4.1%
	MBBS/BDS	08	1.7%
	PHARM-D	08	1.7%
	Engineering	104	22.2%
	Management sciences	64	13.6%
	Accounting and finance	04	.9%
	Human nutrition and dietetics	15	3.2%
	BBA	31	6.6%
	English	31	6.6%
	Medicine	05	1.1%

	LLB	04	.9%
	Cyber security	38	8.1%
	Aviation management	04	.9%
University	Comsats	13	2.8%
	NUMS	53	11.3%
	CUST	32	6.8%
	GIKI	173	36.9%
	IIUI	23	4.9%
	UOP	12	2.6%
	University of Wah	30	6.4%
	Pak Austria Facchuchole	02	.4%
	IST	04	.9%
	Bahria university	17	3.6%
	NUML	08	1.7%
	Foundation University	04	.9%
	Tashkent Medical Academy	01	.2%
	Riphah University	02	.4%
	SZABIST	01	.2%
	CASE	01	.2%
	UOL	01	.2%
	TMUC	01	.2%
	Fatima Jinnah Women University	02	.4%
	AIR University	21	4.5%
	NUST	03	.6%
	Allama Iqbal Open University	01	.2%
	Abasyn University	06	1.3%
	Iqra University	01	.2%
	NCA	02	.4%
	Shifa Tameer e Millat	01	.2%
	Other/Unspecified	54	11.5%
Academic Year	1st Semester	73	15.6%
	2nd Semester	129	27.5%
	3rd Semester	60	12.8%
	4th Semester	59	12.6%
	5th Semester	08	1.7%
	6th Semester	96	20.5%
	7th Semester	14	3.0%
	8th Semester	30	6.4%
GPA/CGPA	1.0	04	.9%
	1.4	01	.2%
	1.5	01	.2%
	1.9	02	.4%
	2.0	10	2.1%
	2.1	02	.4%
	2.2	05	1.1%

	2.3	06	1.3%
	2.4	04	.9%
	2.5	21	4.5%
	2.6	13	2.8%
	2.7	18	3.8%
	2.8	24	5.1%
	2.9	26	5.5%
	3.0	55	11.7%
	3.1	20	4.3%
	3.2	35	7.5%
	3.3	28	6.0%
	3.4	20	4.3%
	3.5	30	6.4%
	3.6	32	6.8%
	3.7	31	6.6%
	3.8	32	6.8%
	3.9	21	4.5%
	4.0	09	1.9%
Current living situation	Hostel	218	46.5%
	With family	237	50.5%
	With roommate/shared apartment	14	3.0%
Study hours	Less than 1 hour	163	34.8%
	1-2 hours	177	37.7%
	3-4 hours	92	19.6%
	5-6 hours	18	3.8%
	More than 6 hours	19	4.1%

Note: Percentages are based on the valid sample (N = 469). Categories such as gender, marital status, family structure, physical activity, and other demographic or behavioral characteristics were self-reported. GPA values reflect student's cumulative grade point average on a 4.0 scale. Missing or "Prefer not to answer" responses are included where applicable.

Pearson Correlation

Pearson correlation coefficients were calculated to explore the associations between GPA and both sleep-related and demographic variables. The results revealed a statistically significant negative correlation between GPA and sleep duration ($r = –.100$, $p < .05$), sleep disturbance ($r = –.098$, $p < .05$), and overall sleep quality ($r = –.119$, $p < .01$). These findings suggest that increased sleep duration, higher levels of disturbance, and poorer sleep quality were modestly linked to lower academic performance. In contrast, no significant correlation was found between sleep efficiency and GPA ($r = –.019$, $p = .678$).

Regarding the demographic variables, gender showed a significant negative correlation with GPA ($r = –.292$, $p < .01$), indicating that female students generally achieved higher GPAs compared to their male counterparts. Additionally, both academic year ($r = .303$, $p < .01$) and age ($r = .150$, $p < .01$) demonstrated positive correlations with GPA, suggesting that older students and those in more advanced stages of their academic programs tended to perform better. However, study hours were not significantly related to GPA ($r = .049$, $p = .285$).

Table 4: Correlations Between GPA and Predictor Variables (N = 469)

Variable	GPA/CGPA
GPA/CGPA	–
Sleep duration	−.100*
Sleep disturbance	−.098*
Sleep quality	−.119**
Sleep efficiency	−.019
Age	.150**
Gender	−.292**
Study hours	.49
Academic Year	.303**

Note: Values represent Pearson correlation coefficients. $p < .05$ (*), $p < .01$ (**).

Simple Linear Regression Analyses

Sleep Quality (Hypothesis 1)

A simple linear regression was conducted to examine whether overall sleep quality significantly predicted academic performance, measured by GPA. The results indicated that the model was statistically significant, $F(1, 467) = 6.89$, $p = .009$, with an R^2 of .014. This suggests that overall sleep quality accounted for approximately 1.4% of the variance in GPA. The standardized regression coefficient was negative and statistically significant ($\beta = –.119$, $p = .009$), indicating that poorer overall sleep quality was associated with lower GPA.

Table 5: Simple Linear Regression Predicting GPA from Overall Sleep Quality (N = 469)

Predictor	β	*t*	*p*	R^2
Sleep Quality				
	–.119	–2.63	.009**	.014

Note. $p < .01$ (**). Higher sleep quality scores indicate poorer sleep.

Sleep Duration (Hypothesis 2)

A simple linear regression was conducted to determine whether sleep duration significantly predicted academic performance, as measured by GPA. The model was statistically significant, $F(1, 467) = 4.86$, $p = .028$, with an R^2 of .010. This indicates that sleep duration explained approximately 1% of the variance in GPA. The standardized regression coefficient was negative and statistically significant ($\beta = –.100$, $p = .028$), suggesting that longer sleep duration was associated with slightly lower GPA scores.

Table 6: Simple Linear Regression Predicting GPA from Sleep Duration (N = 469)

Predictor	β	*t*	*p*	R^2
Sleep Duration				
	–.100	–2.20	.028*	.010

Note. $p < .05$ (*). Higher sleep duration values reflect more hours of sleep per night.

Sleep Efficiency (Hypothesis 3)

A simple linear regression was conducted to assess whether sleep efficiency predicted academic performance (GPA). The model was not statistically significant, $F(1, 467) = 0.17$, $p = .678$, and explained virtually none of the variance in GPA ($R^2 = .000$). The standardized regression coefficient was not

significant (β = –.019, p = .678), indicating that sleep efficiency was not a significant predictor of academic performance in this sample.

Table 7: Simple Linear Regression Predicting GPA from Sleep Efficiency (N = 469)

Predictor	β	*t*	*p*	R^2
Sleep Efficiency				
	–.019	–0.42	.678	.000

Note. No significant relationship was found between sleep efficiency and GPA.

Sleep Disturbance (Hypothesis 4)

A simple linear regression was conducted to determine whether sleep disturbance significantly predicted academic performance (GPA). The model was statistically significant, $F(1, 467) = 4.69$, $p = .031$, with an R^2 of .010. This indicates that sleep disturbance explained approximately 1% of the variance in GPA. The standardized regression coefficient was negative and significant (β = –.098, p = .031), suggesting that higher levels of sleep disturbance were associated with lower GPA.

Table 8: Simple Linear Regression Predicting GPA from Sleep Disturbance (N = 469)

Predictor	β	*t*	*p*	R^2
Sleep Disturbance				
	–.098	–2.17	.031*	.010

Note. $p < .05$ (*). Higher sleep disturbance scores reflect more frequent disruptions in sleep.

Four separate simple linear regressions were conducted to examine whether sleep-related variables predicted academic performance, measured by GPA. The results showed that overall sleep quality (β = –.119, p = .009), sleep duration (β = –.100, p = .028), and sleep disturbance (β = –.098, p = .031) were all statistically significant negative predictors of GPA, though each accounted for a small proportion of variance (R^2 ranging from .010 to .014). In contrast, sleep efficiency did not significantly predict GPA (β = –.019, p = .678). These findings suggest that poorer sleep quality, shorter or longer sleep duration, and more frequent disturbances are associated with lower academic performance among undergraduate students.

Multiple Regression Analysis

Multiple linear regression analyses were performed to determine whether predicted sleep factors and demographic characteristics predicted academic outcomes measured using GPA. The regression model was found to be statistically significant, $F(9, 459) = 10.24$, $p < .001$, explaining approximately 16.4% of the variation in GPA ($R^2 = .164$, Adjusted $R^2 = .148$).

Among the sleep-related predictors, sleep duration showed a significant negative association with GPA (β = –.096, p = .044), suggesting that longer sleep duration was modestly linked to reduced academic performance. In contrast, sleep quality (β = –.058, p = .190), sleep disturbance (β = –.070, p = .109), and sleep efficiency (β = –.001, p = .980) did not significantly predict GPA when controlling for the other variables in the model.

As for demographic factors, both gender (β = –.213, $p < .001$) and academic year (β = .221, $p < .001$) emerged as significant predictors of GPA. These results indicate that female students and those in later stages of their degree programs tended to achieve higher academic performance. However, age (p = .578),

study hours (p = .332), and employment status (p = .054) did not significantly contribute to the prediction of GPA in the overall model.

Table 9: Multiple Regression Predicting GPA from Sleep and Demographic Variables (N = 469)

Predictor	β	t	*p*
Age	.027	0.56	.578
Gender	–.213	–4.69	< .001
Study hours	.042	0.97	.332
Employment status	–.084	–1.93	.058
Academic Year	.221	4.44	< .001
Sleep Duration	–.096	–2.02	.044*
Sleep Disturbance	–.070	–1.60	.109
Sleep Quality	–.058	–1.31	.190
Sleep Efficiency	–.001	–0.02	.980

Note. p < .05 (*), p < .01 (**)

DISCUSSION

The central objective of this research was to examine how sleep-related variables—namely sleep quality, sleep duration, sleep efficiency, and sleep disturbance—predict academic performance, measured through GPA, in undergraduate students. The hypotheses were tested using both simple and multiple regression analyses, yielding important insights into the potential influence of sleep patterns on academic success.

Hypothesis 1 proposed that sleep quality would significantly predict academic performance. This hypothesis was supported by the findings. Results from the simple linear regression revealed a statistically significant negative association between poor sleep quality and GPA (β = –.119, p = .009), with sleep quality explaining approximately 1.4% of the variance in academic performance.

This finding of the research corresponds with vast literature suggesting that poor sleep quality impairs cognitive functioning, memory consolidation, attention, and learning efficiency (Curcio et al., 2006). A meta-analysis done by Pilcher and Huffcutt (1996) further affirmed that cognitively and academically better performance is being performed by individuals with better sleep quality. Hence proved that this result is congruent with previous research and highlights that more academic struggle is experienced by students with lower sleep quality.

Hypothesis 2 suggested that academic performance would be significantly predicted by sleep duration. The hypothesis was also *accepted*. Although the effect size was small, the regression analysis revealed a significant negative association between sleep duration and GPA (β = –.100, *p* = .028). Interestingly, the direction of the relationship suggested that longer sleep duration was associated with slightly lower GPA. This seemingly counter intuitive finding may reflect the concept of oversleeping which has also been linked to poorer academic outcomes due to factors such as depression, irregular sleep-wake schedules, or reduced time for study-related activities (Lemola et al., 2013). Other studies (Gaultney, 2010) have noted that both short and long sleep durations can be detrimental to academic performance, suggesting that optimal not maximal sleep is key for student success.

Hypothesis 3 posited that sleep efficiency would be a potential determiner of educational achievement. Moreover, the findings do not advocate this hypothesis. The regression analysis showed no meaningful relationship between sleep efficiency and GPA (β = –.019, p = .678). As sleep efficiency denotes the

extent of time undergone sleeping relative to time spent in bed, it may not fully reflect the broader disturbances or qualitative aspects of sleep that can impact cognitive performance. This result supports our findings by Lund et al. (2010), who debated that as sleep duration and quality are closely associated to academic outcomes, sleep efficiency alone may not significantly impact GPA until it results in significant daytime impairments. It is also possible that students counterbalance for lower sleep efficiency by rescheduling their study routines, thereby buffering the potential negative impact.

Hypothesis 4 suggested that sleep disturbance significantly demonstrates educational achievement , and this hypothesis was *accepted*. The regression results demonstrated a significant inverse association between sleep disturbance and GPA ($\beta = –.098$, $p = .031$), indicating that frequent disruptions in sleep are associated with lower academic outcomes. This agrees with previous research, including that by Orzech et al. (2011), who found that fragmented sleep patterns that are characterized by waking during the night and experiencing difficulties falling back asleep, can diminish focus, attention span, and motivation. Such sleep disruptions may also contribute to raised daytime fatigue, emotional instability, and poor academic performance.

Hypothesis 1, 2 and 4 showed statistical significance, it is crucial to note that the effect sizes were modest, with each variable accounting for only about 1% to 1.4% of the variance in GPA. These outcomes suggest that while sleep factors do play a role in academic performance, they are among many potential contributors. This becomes even more evident when analyzing the multiple regression results, which contributed for 16.4% of the change in GPA. When controlling for demographic and other sleep variables, only sleep duration remained a significant predictor ($\beta = –.096$, $p = .044$), while statistical significance of sleep quality and sleep disturbance was lost. This reduction may be due to shared variance among sleep variables or stronger predictive power of demographic factors such as gender and academic year.

Significant negative predictor was gender ($\beta = –.213$, $p < .001$), with female pupils doing well academically than their male counterparts. This was supported by previous literature suggesting that female students often report higher GPAs and greater academic motivation (Voyer & Voyer, 2014). Similarly, academic year was positively associated with GPA ($\beta = .221$, $p < .001$), indicating that students in later semesters had higher academic performance potentially due to increased experience, study habits, or the academic filtering of lower-performing students over time.

GPA was not substantially linked to with study hours ($r = .049$, $p = .285$), nor were they a significant predictor in the multiple regression model. This disapprove common assumptions but connect with findings from Nonis and Hudson (2006), who noted that the quality, not quantity, of study time is a more critical determinant of academic performance. It is possible that students reporting high study hours may not be using their time effectively or could be compensating for poor sleep or stress.

Students who were taking sleep-related medications (n = 32) were excluded was a methodological strength, as it minimized the confounding effects of pharmacological influences on patterns of sleep and educational performance. Moreover, the use of a large sample (N = 469) across diverse academic programs and institutions improved the generalizability of findings within the undergraduate population in Pakistan.

In summary, this study offers empirical evidence supporting the predictive influence of quality sleep, extent of sleep time, and sleep disturbance on educational achievement, with the most notable and consistent outcome being a modest yet sufficient inverse association between extended sleep duration and GPA. Hypotheses 1, 2, and 4 were validated by the findings, whereas Hypothesis 3 was not supported. The results highlight that while sleep-related variables do play a role in academic performance, their effects are likely intertwined with various demographic and psychological factors. To attain a more

enhanced comprehension of sleep effect on educational outcomes, future research should adopt longitudinal approaches and consider strong mediators such as level of stress, psychological health status and academic engagement.

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