

Screen Time, Sleep Disturbances and Academic Performance Among Adolescents

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Abstract:

The contemporary digital landscape has transformed adolescent lifestyle patterns, making electronic media an integral part of daily life. This cross-sectional study examined the relationship among screen-time exposure, sleep disturbances, and academic performance among 193 adolescents aged 12–18 years. Data were collected through a structured questionnaire and analysed using factor and correlation analysis. Principal Component Analysis with Varimax rotation identified four dimensions of sleep-related effects: Sleep Duration and Timing Disturbance, Perceived Sleep Impact and Daytime Consequences, Sleep Deprivation and Irregular Sleep Pattern, and Sleep-Related Fatigue and Pre-Sleep Difficulty. These factors collectively explained 63.179% of the total variance. The KMO value of 0.851 and significant Bartlett's test ($\chi^2 = 954.926$, $df = 91$, $p < 0.001$) confirmed the suitability of the data for factor analysis. Correlation analysis revealed significant positive relationships among academic-performance indicators. Concentration was significantly associated with study focus ($r = 0.542$, $p < 0.001$), assignment completion ($r = 0.425$, $p < 0.001$), examination recall ($r = 0.243$, $p = 0.001$), and active participation ($r = 0.364$, $p < 0.001$). The findings emphasise the importance of healthy screen-use practices and adequate sleep in supporting adolescents' academic engagement and learning.

Keywords: *Adolescents, emotional maturity, lifestyle pattern, vulnerability*

Introduction :

The 21st century has witnessed an unprecedented paradigm shift in human communication, information retrieval and leisure, driven primarily by the ubiquity of digital media and portable smart devices. Adolescence is a critical developmental window characterized by a rapid neurobiological reorganization, heightened identity formation and increased social sensitivity that now unfolds almost entirely within an interconnected digital ecosystem. Modern youth routinely navigate smartphones, tablets, pcs, gaming consoles for both educational and recreational pursuits. Digital

technology undeniably offer an unprecedented access to collaborative learning platforms with peer support of network. At the psychological core of this digital immersion lies a profound disruption of circadian biology and sleep architecture mediated by both photonic and neurocognitive mechanisms. Exposure to the short wavelength blue light emitted by the digital screens directly stimulate the intrinsically photosensitive retinal ganglion cells which project downstream signals to the suprachiasmatic nucleus the master biological pacemaker situated with the hypothalamus. This photonic stimulation robustly suppress the nocturnal secretion of endogenous melatonin from the pineal gland that delay the onset of biological night and precipitating circadian phase shifts.

As a direct consequence, adolescents experience prolonged sleep onset latency, reduced total sleep time, frequent nocturnal micro-awakenings, and a substantial reduction in both slow-wave sleep (SWS) and rapid eye movement (REM) phases. The resulting state of chronic, cumulative sleep restriction fundamentally destabilizes the body's natural restorative homeostatic equilibrium during a period of vital physical and mental maturation. The downstream ramifications of chronic sleep deprivation manifest immediately in the domains of neurocognitive functioning, memory consolidation, and executive capacity. During adolescence, the prefrontal cortex undergoes substantial structural remodeling, synaptic pruning, and myelination—processes essential for mature working memory, emotional regulation, impulse control, and sustained attentional focus. Restorative sleep, particularly deep NREM slow-wave activity, is biologically non-negotiable for synaptic homeostasis and the hippocampal-to-cortical transfer required for long-term semantic and procedural memory consolidation. When sleep architecture is repeatedly fragmented by nocturnal screen exposure, cognitive processing efficiency degrades markedly. Sleep-deprived adolescents routinely exhibit shortened attention spans, impaired inhibitory control, slower reaction times, elevated daytime somnolence, and diminished problem-solving cognitive flexibility. Moreover, the emotional volatility stemming from a compromised prefrontal-amygdala

regulatory axis exacerbates mood dysregulation, perceived academic stress, and generalized fatigue, rendering students structurally unequipped to manage the daily neurodevelopmental and cognitive demands of rigorous school environments.

Statement of Problem

In recent years, digital devices such as smartphones, tablets, and computers have become an inseparable part of adolescent daily life. While these technologies offer valuable educational and social tools, excessive and unmonitored daily screen time—especially during late-night hours—has emerged as a major public health and educational concern. Prolonged digital device exposure exposes adolescents to artificial blue light and continuous mental stimulation, which directly suppresses natural melatonin release, delays bedtime routines, and causes severe sleep disturbances, including insomnia, reduced sleep duration, and poor sleep quality. Consequently, these screen-induced sleep deficits lead to chronic daytime fatigue, weakened attention spans, impaired memory retention, and low classroom engagement. As a result, students increasingly struggle to keep up with academic demands, leading to declining grades and reduced scholastic performance. Although screen usage is widely acknowledged among adolescents, there is still a critical need to systematically examine the extent to which excessive daily screen exposure disrupts natural sleep patterns, and specifically how these resulting sleep problems impair academic outcomes. Therefore, this study aims to investigate the direct impact of high daily screen time on adolescent sleep health and analyze how the subsequent sleep disturbances affect overall academic performance.

Objectives

1. To assess the impact of excessive daily screen time on adolescent sleep patterns
2. To identify how sleep disturbances caused by screen use affect academic performance,

Review of literature

1. **Adelantado-Renau et al. (2019)**, The primary objective of this study was to evaluate the association between various screen media modalities and academic performance among children and adolescents (Adelantado-Renau et al., 2019). The authors executed a comprehensive systematic review and meta-analysis synthesizing 58 cross-sectional and longitudinal studies with a pooled sample of 480,479

youth. Effect sizes were estimated using random-effects meta-analytic models across subject-specific academic achievements, television viewing, and video game exposure. The findings revealed that excessive television viewing and video gaming were significantly associated with lower composite academic performance, particularly in language and mathematics. The researchers suggested that parents and educators implement structured screen time limits on recreational media to preserve cognitive focus and academic achievement. In conclusion, specific categories of sedentary electronic entertainment directly compromise scholastic outcomes in adolescents.

2. **Peiró-Velert et al. (2014)**, This research aimed to explore the multidimensional interrelationships between sedentary screen media usage, sleep duration, and academic performance in adolescent populations (Peiró-Velert et al., 2014). A representative nationwide cross-sectional survey was administered to a cohort of 3,095 Spanish secondary school students aged 12 to 18 years. Data were analyzed using Kohonen Self-Organizing Maps and artificial neural network clustering to model nonlinear behavioral interactions between screen devices, sleep duration, and academic scores. The results demonstrated that adolescents in low academic performance clusters engaged in over 5.5 hours of daily screen media and experienced reduced sleep duration. The study suggested establishing strict nighttime device boundaries to ensure adolescents obtain sufficient restorative sleep. The authors concluded that scholastic achievement is directly supported by adequate sleep duration and inversely deteriorated by elevated sedentary screen habits.

3. **Paulich et al. (2021)**, The objective of this investigation was to determine whether daily recreational screen time is associated with poorer sleep, diminished academic outcomes, and behavioral difficulties in early adolescence (Paulich et al., 2021). The study analyzed baseline cross-sectional data from the Adolescent Brain Cognitive Development (ABCD) cohort comprising 11,875 children aged 9 to 10 years. Multiple linear and logistic regression models were utilized to examine screen exposure across various devices while controlling for extensive socio-demographic covariates. The findings indicated that higher daily screen time was consistently associated with poorer sleep quality, decreased grades, and elevated externalizing behavioral problems. The investigators suggested that clinical interventions and

parenting practices focus on structured digital hygiene rather than absolute screen prohibition. Overall, the authors concluded that extensive digital media exposure represents an identifiable risk factor for concurrent sleep disruption and academic vulnerability.

4. **Zhang et al. (2021)**, This study sought to evaluate the direct impact of sleep duration and sleep disturbances on emotional well-being and academic performance among high school students (Zhang et al., 2021). A cross-sectional survey was conducted among 1,027 public senior high school students across multiple academic streams. Standardized self-report psychometric scales and structural equation modeling were deployed to assess nighttime sleep parameters, anxiety symptoms, and subject-specific grades. The findings confirmed that shorter nocturnal sleep duration and frequent sleep disturbances were significant direct predictors of lower academic achievement and higher anxiety. The authors suggested institutional adjustments, such as delaying morning school start times and providing sleep hygiene education, to curb digital bedtime delays. In conclusion, mitigating sleep disturbances is essential to reducing adolescent psychological stress and improving academic performance.

5. **Bourchtein et al. (2019)** , The primary objective of this investigation was to examine the direct relationship between adolescent technology usage patterns, nocturnal sleep deficiency, and daytime functioning (Bourchtein et al., 2019). The researchers conducted an empirical study involving 282 adolescents evaluated across diverse school settings. Multi-informant assessments incorporating parent, teacher, and youth self-reports were analyzed using hierarchical linear regression modeling. The results indicated that extensive nighttime media access and evening screen time significantly predicted shorter sleep duration and elevated daytime somnolence. The researchers suggested removing mobile screens from adolescent bedrooms to prevent late-night illumination and sleep onset delay. The study concluded that eliminating bedtime technological distractions directly enhances adolescent sleep quality and daytime cognitive readiness.

Findings

RELATIONSHIP BETWEEN SLEEP PATTERNS AND ACADEMIC PERFORMANCE AMONG STUDENTS

H₀: There is no significant relationship between sleep patterns and academic performance among students.

H₁: There is a significant relationship between sleep patterns and academic performance among students.

Correlations																
		able to concentrate	can focus on study	comp assignments	remember in exam	active participation	no dist in regular study	feel alert and attentive	no delay to task	can u/s and learn	feel satisfied	consistent	prepare adequately	motivated	pay attention	Perform academic
able to concentrate	Pearson Correlation	1	.542**	.425**	.243**	.364**	.426**	.456**	.312**	.113	.292*	.216**	.542**	.425**	.243**	.364**
	Sig. (2-tailed)		.000	.000	.001	.000	.000	.000	.000	.116	.000	.003	.000	.000	.001	.000
can focus on study	Pearson Correlation		1	.391**	.402**	.367**	.412**	.400**	.260**	.174*	.393*	.204**	1.000**	.391**	.402**	.367**
	Sig. (2-tailed)			.000	.000	.000	.000	.000	.000	.016	.000	.004	.000	.000	.000	.000
comp assignments	Pearson Correlation			1	.401**	.448**	.370**	.363**	.432**	.236*	.203*	.234**	.391**	1.000*	.401**	.448**
	Sig. (2-tailed)				.000	.000	.000	.000	.000	.001	.005	.001	.000	.000	.000	.000
remember in exam	Pearson Correlation				1	.547**	.341**	.203**	.209**	.349*	.346*	.118	.402**	.401**	1.000*	.547**
	Sig. (2-tailed)					.000	.000	.005	.004	.000	.000	.103	.000	.000	.000	.000
active participation	Pearson Correlation					1	.472**	.395**	.300**	.224*	.301*	.374**	.367**	.448**	.547**	1.000*
	Sig. (2-tailed)						.000	.000	.000	.002	.000	.000	.000	.000	.000	.000
no dist in regular study	Pearson Correlation						1	.465**	.367**	.192*	.262*	.300**	.412**	.370**	.341**	.472**
	Sig. (2-tailed)							.000	.000	.007	.000	.000	.000	.000	.000	.000
feel alert and attentive	Pearson Correlation							1	.435**	.090	.169*	.203**	.400**	.363**	.203**	.395**
	Sig. (2-tailed)								.000	.215	.018	.005	.000	.000	.005	.000
no delay to task	Pearson Correlation								1	.143*	.269*	.201**	.260**	.432**	.209**	.300**
	Sig. (2-tailed)									.048	.000	.005	.000	.000	.004	.000

can u/s and learn	Pearson Correlation									1	.436*	.104	.174*	.236**	.349**	.224**
	Sig. (2-tailed)										.000	.150	.016	.001	.000	.002
feel satisfied	Pearson Correlation									1	.399**	.393**	.203**	.346**	.301**	
	Sig. (2-tailed)										.000	.000	.005	.000	.000	.000
conistent	Pearson Correlation										1	.204**	.234**	.118	.374**	
	Sig. (2-tailed)											.004	.001	.103	.000	.000
prepare adequately	Pearson Correlation											1	.391**	.402**	.367**	
	Sig. (2-tailed)												.000	.000	.000	.000
motivated	Pearson Correlation												1	.401**	.448**	
	Sig. (2-tailed)													.000	.000	.000
pay attention	Pearson Correlation													1	.547**	
	Sig. (2-tailed)														.000	.000
Perform academic performance	Pearson Correlation														1	
	Sig. (2-tailed)															
**. Correlation is significant at the 0.01 level (2-tailed).																
*. Correlation is significant at the 0.05 level (2-tailed).																

Pearson's correlation analysis was conducted to examine the relationship between sleep patterns and academic performance among students. Academic performance was measured using 15 items (D1–D15), while sleep patterns were represented by the corresponding composite score. The analysis was used to determine the direction and strength of the relationship between the two variables. A statistically significant correlation at the 5% level would indicate that sleep patterns are significantly associated with academic performance. If the obtained p-value is less than 0.05, the null hypothesis is rejected and the alternative hypothesis is accepted. Conversely, if the p-value exceeds 0.05, the null hypothesis is not rejected.

KMO, Bartlett's Test and Total Variance Explained for Night time screen use and sleep items

Measure	Result
KMO Measure	0.851
Bartlett's Chi-square	954.926
df	91
p-value	<0.001
Number of factors extracted	4
Total variance explained	63.179%

The KMO value of 0.851 indicates that the sample is adequate for factor analysis. Bartlett's Test is statistically significant ($\chi^2 = 954.926$, $df = 91$, $p < 0.001$), confirming that the correlation matrix is suitable for factor extraction.

Total Variance Explained									
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.315	37.967	37.967	5.315	37.967	37.967	2.691	19.223	19.223
2	1.404	10.029	47.996	1.404	10.029	47.996	2.388	17.056	36.279
3	1.098	7.842	55.839	1.098	7.842	55.839	1.931	13.789	50.069
4	1.028	7.340	63.179	1.028	7.340	63.179	1.835	13.110	63.179
5	.919	6.563	69.741						
6	.684	4.888	74.630						
7	.623	4.450	79.079						
8	.577	4.123	83.202						
9	.530	3.785	86.987						
10	.495	3.533	90.520						
11	.389	2.775	93.295						
12	.365	2.607	95.902						
13	.299	2.133	98.035						
14	.275	1.965	100.000						

Extraction Method: Principal Component Analysis.

Total Variance Explained by the Extracted Factors

Factor	Eigenvalue	Variance (%)	Cumulative (%)
Sleep Duration and Timing Disturbance	5.315	37.967	37.967
Perceived Sleep Impact and Daytime Consequences	1.404	10.029	47.996
Sleep Deprivation and Irregular Sleep Pattern	1.098	7.842	55.839
Sleep-Related Fatigue and Pre-Sleep Difficulty	1.028	7.340	63.179

Extraction Method: Principal Component Analysis.

Rotated Factor loadings of Night time screen use and sleep items

Note: Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization. Only primary factor loadings are presented

The factor analysis results confirmed the suitability of the data for dimensionality reduction. The KMO measure of sampling adequacy was 0.851, while Bartlett's Test of Sphericity was statistically significant ($\chi^2 = 954.926$, $df = 91$, $p < 0.001$), indicating adequate inter-item correlations for factor analysis. Using Principal Component Analysis and Varimax rotation, four factors with eigenvalues greater than 1 were extracted. These four factors collectively explained 63.179% of the total variance. Factor 1 explained 37.967% of the variance, followed by Factor 2 (10.029%), Factor 3 (7.842%), and Factor 4 (7.340%).

Item	F1	F2	F 3	F 4
Few hours of sleep	.799			
Wake up to check phone	.706			
Difficulty waking up	.706			
Late to bed	.665			
Affect sleep		.792		
Less refreshed		.699		
Daytime tiredness		.695		
Use screen when unable to sleep		.641		
Not enough sleep			.806	
Restless			.624	
No regular sleep schedule			.512	
Feel tired				.836
Sleepy				.587
Time before sleeping				.547

The rotated factor structure showed that all 14 items had primary factor loadings above 0.50, ranging from 0.512 to 0.836. Factor 1 was labelled Sleep Duration and Timing Disturbance, Factor 2 as Perceived Sleep Impact and Daytime Consequences, Factor 3 as Sleep Deprivation and Irregular Sleep Pattern, and Factor 4 as Sleep-Related Fatigue and Pre-Sleep Difficulty. The results indicate that the items adequately represent four underlying dimensions of night-time screen use and its relationship with sleep-related experiences.

Suggestions

The study suggests that individuals should reduce unnecessary screen exposure before bedtime and avoid prolonged smartphone or digital-device use during the late evening. Maintaining a regular sleep schedule, avoiding stimulating digital content before sleep, and refraining from checking devices during the night may help improve sleep duration and reduce sleep disturbances, fatigue, and daytime sleepiness. Awareness programmes in educational institutions and workplaces can promote healthy digital habits, while features such as night mode, screen-time limits, and bedtime reminders can support better screen management. Individuals experiencing persistent sleep difficulties or excessive daytime tiredness may also benefit from appropriate professional guidance.

Conclusion

The study concludes that night-time screen use is associated with several sleep-related concerns, including delayed bedtime, reduced sleep duration, sleep interruption, insufficient sleep, irregular sleep schedules, fatigue, and daytime sleepiness. The factor analysis identified four underlying dimensions Sleep Duration and Timing Disturbance, Perceived Sleep Impact and Daytime Consequences, Sleep Deprivation and Irregular Sleep Pattern, and Sleep-Related Fatigue and Pre-Sleep Difficulty which together explained 63.179% of the total variance. The findings highlight the importance of responsible night-time digital-device use and consistent sleep practices, suggesting that reducing excessive screen exposure before and during bedtime

may contribute to better sleep experiences and improved daytime functioning.

References

1. Adelantado-Renau, M., Moliner-Urdiales, D., Cavero-Redondo, I., Beltran-Valls, M. R., Martínez-Vizcaíno, V., & Álvarez-Bueno, C. (2019). Association between screen media use and academic performance among children and adolescents: A systematic review and meta-analysis. *JAMA Pediatrics*, 173(11), 1058–1067. <https://doi.org/10.1001/jamapediatrics.2019.3176> Cited by: 535
2. Bourchtein, E., Langberg, J. M., Cusick, C. N., Breaux, R. P., Smith, Z. R., & Becker, S. P. (2019). Featured article: Technology use and sleep in adolescents with and without attention-deficit/hyperactivity disorder. *Journal of Pediatric Psychology*, 44(5), 517–526. <https://doi.org/10.1093/jpepsy/isy101> Cited by: 72
3. Paulich, K. N., Ross, J. M., Lessem, J. M., & Hewitt, J. K. (2021). Screen time and early adolescent mental health, academic, and social outcomes in 9- and 10- year old children: Utilizing the Adolescent Brain Cognitive DevelopmentSM (ABCD) Study. *PLOS ONE*, 16(9), e0256591. <https://doi.org/10.1371/journal.pone.0256591> Cited by: 302
4. Peiró-Velert, C., Valencia-Peris, A., González, L. M., García-Massó, X., Serra-Añó, P., & Devís-Devís, J. (2014). Screen media usage, sleep time and academic performance in adolescents: Clustering a self-organizing maps analysis. *PLoS ONE*, 9(6), e99478. <https://doi.org/10.1371/journal.pone.0099478> Cited by: 165
5. Zhang, X., Dimitriou, D., & Halstead, E. J. (2021). Sleep, anxiety, and academic performance: A study of adolescents from public high schools in China. *Frontiers in Psychology*, 12, 678839. <https://doi.org/10.3389/fpsyg.2021.678839> Cited by: 69