

Navigating Academic Pressure: Neurobiological, Sleep, and Digital Challenges with Mitigation Strategies

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Systematic Review

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Abstract

The academic pressure among students is increasing day by day, due to which problems like mental health issues, sleep disruption, and increased use of mobile phones are arising. This review considers how educational pressure affects the mind, especially the connection between digital strain and sleep. Following PRISMA 2020 guidelines, we searched Google Scholar and PubMed for research papers published between 2020 and 2026. After applying the inclusion/exclusion criteria, 25 papers were selected on which this review is based. This study reveals that continuous academic stress causes the neuroplasticity of the brain to drop, cortisol levels to increase, and the circadian rhythm to be disrupted. Aside from this, screen time and FOMO cause mental exhaustion. If CBT (Cognitive Behavioral Therapy) and techniques like mindfulness are used, then anxiety can be reduced to a significant extent. For the benefit of students, academic pressure is a major danger that affects sleep and digital habits. If mindfulness and similar behavioral therapies are included in educational institutes, then the mental health and performance of students can be improved.

INTRODUCTION

Chronic stress is very common these days. Due to academic pressure and demands, this chronic stress not only affects mental health but also affects the biological system. Student life and maturity are important phases of human life. Prolonged academic stress not only causes depression but also leads to destructive and suicidal thoughts. Excessive academic pressure hyperactivates the HPA axis, which is the main cause of releasing cortisol and adrenaline, thereby affecting the nervous system. An extended high level of cortisol affects the main parts of the brain, especially the prefrontal cortex and hippocampus, decreasing gray matter volume (GMV), which also causes changes in structure (Hinds & Sanchez, 2022; Shang et al., 2024). These affected brain parts, like the prefrontal cortex and hippocampus in students, also affect their working memory and information processing, which causes disturbances in physiological markers, and their exam scores and academic performance are also affected and become low (Almarzouki, 2024).

Academic pressure and exam load affect the sleep quality of students. During examinations, when academic pressure increases, it severely affects sleep more than on normal days. Additionally, severe stress makes students rely on smartphones, increasing their dependency on them. Students start overthinking due to the fear of failure in exams, causing insomnia. Due to a lack of sleep, students feel mentally exhausted and face academic issues and burnout, which causes major disturbances in their attention, memory, and focus, directly affecting their GPAs and exam scores (Heissel et al., 2017; Yasmeen et al., 2024; Majeed et al., 2025).

In modern times, excessive use of social media makes students become addicted to it, which distracts them while doing studies and also affects their thoughts due to their excessive mobile usage, students experience a fear of missing out (FOMO). They start to check their smartphones even while studying (Oliveira & Neta, 2024). Low-quality digital content is one of the results of causing brain rot among students. It is affecting their ability to make decisions. Critical thinking gets affected due to information overload in students (Özbay, 2026; Li & Li, 2024). Research also shows that if students engage in a digital detox, they will feel improvement in sleep, working memory, and mental health (Sullivan et al., 2025; Kurtça & Laçın, 2025).

Recent research shows that during examinations, students bodies undergo specific physiological changes, such as an increased heart rate, changing blood pressure, and an increasing skin surface temperature. This happens because of stress and anxiety, which affect their grades. Some students with a high level of perceived control can

protect their working memory and do not get affected by stress, but when their focus and attention drop due to ambient digital notifications, their overall performance also declines (Upshaw et al.,2022). To reduce stress and test anxiety, some specific techniques such as cognitive-behavioral therapy (CBT) can be used. It is not necessary to take long courses; even 5-day training can be effective in real-life exam scenarios, which is helpful in reducing anxiety and improving academic performance in students (Rajendran et al., 2022; Nwadi et al., 2025).

Therefore, the main objective of this systematic review is to investigate the neuropsychological and cognitive consequences of educational pressure, specifically evaluating the role of sleep disruption and digital strain in students to find practical solutions for their stress.

METHODOLOGY

This systematic review follows the standard PRISMA checklist framework. It ensures transparency and objectivity throughout the literature selection and evaluation process.

Search Strategy and Information Sources

To identify relevant papers for this review, Google Scholar and PubMed were used as the main sources. The literature search was limited to 2020-2026 to get only the latest research papers, ensuring the inclusion of recent research data. Various simple keywords and terms were used in the search bar to find the right related articles. These keywords included "academic stress," "stress anxiety," "FOMO syndrome," "brain rot," "neurobiological stress," and "mindfulness."

Eligibility Criteria

Inclusion criteria:

- Papers published between 2018 and 2026 were selected.
- Only English-language papers were selected.
- Research articles that looked directly at how pressure affects a student's mind and brain were selected.

Exclusion criteria:

- Papers that were published before 2018 were excluded.
- Papers that were not written in the English language were excluded.
- Articles that were not focused on educational pressure stress but on normal life pressure were excluded.
- Literature such as books, chapters, and essays was excluded.

Selection process

The selection of articles followed a simple step-by-step process. Specific keywords were used in PubMed and Google Scholar. This showed a large number of search results. After that, the titles and abstracts of these papers were checked to see if they matched the main topic. Many irrelevant papers were removed during this step. Finally, the remaining articles were read completely to check their full text against the rules. Through this filtering process, exactly 25 research articles were finalized to be analyzed in this review.

Table 1: Data Extraction of Included Studies

Sr. No	Authors and year	Sample size and characteristics	Methodology/Tools	Key Findings	Gender-specific variation
1.	Rajendran et al. (2022)	14 college students (8 males, 6 females), age range (17-21 years, mean age 20 years), from South India	A wireless Enobia EEG device with 8 electrodes was used. Students were tested 12 minutes before and 3 minutes after the exam	Theta (θ) and (α) waves were high before the exams, showing high exam stress and mental workload. After the exam, it showed that heart rate decreased, recovering from stress.	Male students have more stress than females, but after the exam, males controlled their stress better with a lower heart rate than females.
2.	Hinds & Sanchez (2022)	It is a review paper that focuses on school and college students facing exam stress and anxiety	A review of molecular research on the HPA axis, cortisol pathways, glucocorticoid receptors (GR), and psychological test anxiety interventions.	Due to exam stress, the HPA axis activates, and cortisol levels increase, which can cause things to be forgotten. before exams If stress is high, it affects the main human brain parts, such as the prefrontal cortex, hippocampus, and amygdala. Some treatments include extra exam time, breaks, earplugs, and cognitive behavioral therapy (CBT) to reduce test anxiety and improve scores.	Test anxiety is higher in females than in males, with a 2:1 ratio. This is because females admit easily that they are feeling anxiety compared to males.
3.	Castillo-Navarrete et al. (2024)	160 medical students (under 25 years old). It also includes those students who are taking mental health treatment to show the real college situation	They checked the same students multiple times during the semester break; also, students wore cheap smart wristbands to track sleep, heart rate, and oxygen. Saliva samples were collected 3 times a week to test stress chemicals. (cortisol and alpha-amylase).	When students get stressed, sAS rises in saliva, followed by cortisol. Heavy exam stress destroys sleep, increases HR, causes high BP, hurts memory, and makes students feel lazy.	Female students showed more energy and focus in their studies as compared to males.
4.	Gellisch et al. (2024)	In this review, the data from the best 13 studies were collected in Germany, the UK, Australia, and other countries. The total population consisted of	It is a systematic review. Out of 156 papers, only the 13 best papers were selected. The studies mostly tested heart rate (HR) and salivary cortisol. They also tracked heart rate variability (HRV), alpha-	Cortisol levels only spike during extreme social fear or high-pressure situations, but experienced team leaders show lower stress. Physical stress markers cannot predict quick learning and immediate academic marks.	Testosterone levels increased in both male and female students. Heart rate changes during non-technical training were

		healthy students from medicine, nursing, and physical therapy programs.	amylase, and respiratory rate.	Stress only helps by saving memories of time.	related to gender.
5.	Shang et al. (2024)	32 young healthy participants aged 20-35 were selected. They were divided into 2 equal, different groups. 16 were under chronic stress, and 16 were healthy controls. (8 males and 8 females)	20 stress questionnaires (PSQ) were used to check the previous 2 years' stress. A high-tech 3T MRI scanner was used to take pictures of the brain. The tool CAT12 is used to check grey matter volume (GRV) of the brain.	Long-term stress changed the physical structure and volume of the brain. Stress activates the motor system of the brain, causing anxiety. Due to a small sample size, studies cannot show the detailed changes in the brain parts.	Due to continuous stress in males, their brain volume decreases compared to females, because their volume increased during stress. This happens because females are more likely to show emotions and anxiety compared to males.
6.	Li et al. (2025)	This study includes 46 graduate students suffering from severe depression (MDD). They were divided into 2 different groups. 22 with suicidal thoughts were selected, and 24 without such thoughts.	To check depression and suicidal thoughts, the HAMD-24 and BSI scales were used. They also used a high-tech MRI scanner to take structural and functional brain images (sMRI and fMRI). Some software was also used, such as CAT12 and DPABI, to calculate local brain activity.	Students with suicidal thoughts showed changes in the size of the left hippocampus (reduced volume). The suicidal group had much lower mental activity in the right hippocampus. The connection between the prefrontal cortex and hippocampus was also disrupted.	In this study, both males and females were equally selected so there would be no interference with the results. No specific gender-based brain changes were reported.
7.	Almarzouki (2024)	It is a neuroscientific review paper that includes more than 45 countries' surveys showing millennials and Generation Z students facing heavy academic and peer stress.	In these fMRI scans, hormone levels Cortisol, dopamine, adrenaline, and working memory tests (such as word recall) were analyzed.	Chronic stress causes severe problems for the brain, making the prefrontal cortex and hippocampus smaller. Students were not able to focus on their studies. But if they start training their working memory, it helps improve brain connections. Besides this, mindfulness, meditation, and some other exercises are also helpful to reduce stress.	Specifically not mentioned
8.	Jayaram and	It is a narrative review paper	In this, stress-releasing hormones and brain	Due to the high levels of cortisol, brain parts	Specific gender-based

	Hripriya (2026)	focusing on Indian students. This study shows that after COVID-19, more than 50% of students were suffering from stress.	HPA- axis data were checked. Some surveys from different places in India, salivary and hair cortisol tests, and students' exam grades were compared	such as the hippocampus and prefrontal cortex were not able to work properly. Students face lack of concentration and also forget what they learned due to weak memory. Because of it, students start skipping lectures and become absentees. It brutally affects poor students. Meditation and mindfulness are helpful to reduce cortisol levels.	data is reported in this review
9.	Heissel et al. (2017)	This paper focused on US students. It compares low-income and minority students (especially Black) with high-income and white students.	Examined the HPA axis and sleep duration and quality. Also, past research data, sleep monitoring studies, and neighborhood crime statistics were studied.	Low-income and minority individuals faced more stress, like financial strain. That makes them lose their focus and energy and affects learning in school. If a violent crime happens within one block of a student home, their reading and vocabulary test scores drop due to acute stress. Poor sleep patterns make a student less attentive and more likely to make errors during exams. Solutions requiring changing school start times and introducing mindfulness programs are helpful for restoring cortisol balance.	Males react more biologically to test failure stress as compared to females because they react more to social stress.
10.	Yasmeen et al. (2024)	300 undergraduate university students from Pakistan were selected. The mean age of the participants was 20.6 years.	Stratified random techniques were used. Some standardized tools, such as the Pittsburgh Sleep Quality Index (PSQI), Perceived Stress Scale (PSS), and Connor-Davidson Resilience Scale (CD-RISC), were used. Working memory tests were also used to score cognitive performance.	Less sleep directly damages brain power. Lower cognitive scores ($B = -2.15$) and GPAs ($B = -0.10$) were predicted. Modern temporary caffeine intake helps as a temporary fix, showing a small positive effect on grades. Mental strength acts as a protective shield. Also, students with high resilience scores maintained good grades.	Authors noted this as a limitation and recommended it for future research. There is no specific data mentioned

11.	Almarzouki et al. (2022)	This study includes 83 university students, with 42.2% males and 57.8% females. 61% are from King Abdulaziz University, Saudi Arabia, medical health science students.	A longitudinal study: the same students were examined under 2 different conditions. Firstly, during summer vacation; secondly, during exams. Standardized scales were used, such as the PSQI for sleep tracking, PHQ-9 for depression, GAD-7 for anxiety, KPDS for psychological distress, and SMDS for social media addiction. Objective cognitive tools were also used, such as the computerized CANTAB touch-screen system, to objectively test spatial working memory (SWM) strategies and error rates.	During summer breaks, students were relaxed, but during exams, 77% of students started feeling stressed, became poor sleepers, and started to use sleeping medicines. This study also shows that students with high GPAs had the worst sleep. They took much time to fall asleep, woke up multiple times during the night, and kept worrying about their grades. A special computer test showed their brainpower, which is actually getting stronger. Their sharp brains were hiding their heavy exhaustion, but inside, their bodies and minds were reaching a dangerous breaking point.	The sample consisted of 42.2% male and 57.8% female students.
12.	Majeed et al. (2025)	A total of 422 undergraduate students (44.1% male, 55.9% female) from public and private universities in Lahore were studying in medical, engineering, business, and arts fields.	Cross-sectional study conducted over 8 months. Standard Scales: Sleep quality is measured using the PSQI scale, and academic stress is measured using the PSS-10 scale. Objective Cognitive Tool: Computer-based CANTAB touch-screen tests (RVP for sustained attention, SWM for working memory, SOC for executive function/planning)	62.6% of students were poor sleepers, with an average PSQI score of 9.3 (indicating poor sleep quality). Poor sleep was linked to a clear drop in cognitive performance: the attention score fell from 89.4 to 77.8, working memory from 81.1 to 72.5, and problem-solving from 76.3 to 66.4. Regression analysis showed that both poor sleep ($\beta = -0.48$) and academic stress ($\beta = -0.35$) independently and jointly cause mental fatigue.	The sample had 44.1% male and 55.9% female students, but statistical analysis (regression model) found no significant effect of gender on cognitive performance ($\beta = 0.11$, $p = 0.19$). This means poor sleep and stress affected male and female students' cognitive performance to a similar degree.
13.	Al Hadi et al. (2025)	This was a qualitative study; there is no large sample size. In-	Excessive study loads and tight deadlines led to emotional exhaustion, poor	Due to study load, students face emotional exhaustion and lack of	Since this was a qualitative study (based on interviews)

depth, semi-structured interviews were conducted with university students who experienced academic burnout and had applied mindfulness techniques themselves.

concentration, headaches, and disturbed sleep among students. After students started practicing breathing meditation, body scans, mindful walking, and reflective journaling, their stress decreased, focus improved, and sleep quality got better. The biggest challenges were lack of consistency and lack of time. Perfectionism and overworking also created obstacles for some students, which they overcame through a qualitative approach with the case study method.

Data were collected through semi-structured in-depth interviews to understand students' personal experiences. Thematic analysis (open coding and categorization) was used to analyze the interview data and identify themes.

concentration, but some students who did breathing meditation, body scans, and reflective journaling reported that their concentration increased. The difficult part was consistency.

with no statistical regression or quantitative analysis, no separate gender-based differences were reported in this paper. The effects of mindfulness were found to be similar across both genders

14.	Alotaibi et al. (2020)	Total sample size: 282 preclinical medical students. Age: 61% were 21–24 years old, and 36.5% were 18–21 years old. Status: Most students were single (97.9%), unemployed (79.1%), and living with their families (95.4%). Academic level: 39% first-year, 25.9% second-	Quantitative cross-sectional study. PSQI (Pittsburgh Sleep Quality Index) to assess sleep quality (mean score: 8.13 ± 3.46) and K10 (Kessler Psychological Distress Scale) to measure distress/stress levels (mean score: 23.72 ± 8.55). Statistical analysis: done using the chi-square test (for associations) and Multivariable Stepwise Binary Logistic Regression Analysis (to identify predictors), with significance level set at $P < 0.05$	77% of students had poor sleep quality, with an average sleep duration of 5.87 hours. 51.4% of students slept between 12 AM and 2 AM, and more than 43% took daytime naps. 63.5% of students experienced distress, with over 41% having moderate to severe distress. Main Associations: Students with severe distress had much higher rates of poor sleep quality (94.1%). Students who took daytime naps had higher rates of poor sleep quality (81.9%)	The difference in poor sleep quality between males and females was roughly equal, with no major statistical difference found. However, distress levels were found to be more prevalent among females compared to males
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		year, 35.1% third-year		compared to those who didn't nap (70.5%). Surprisingly, GPA showed no statistically significant relationship with sleep quality or distress.	
		$\beta = .569, p < .001$			
15.	Zhang et al. (2024)	426 valid questionnaires were collected from 3 universities in Anhui and Zhejiang provinces, China. 77 males (18.1%) and 349 females (81.9%). 326 students were from rural areas (76.5%), and 100 students were from urban areas (23.5%). This was a longitudinal study conducted in 3 rounds (October 2023 to April 2024, with a 3-month gap between each round).	Longitudinal survey with mediation analysis. College Student Stress Scale (30 items), Epworth Sleepiness Scale (ESS) for sleep quality and daytime sleepiness (8 items), Mobile Phone Addiction Scale (17 items), Rumination Scale (12 items) Social Anxiety Scale (6 items), Coping Strategies Questionnaire for emotion-focused coping (8 items). Used Structural Equation Modeling (SEM) and Bootstrap resampling (1,000 iterations) to test complex paths and mediation.	Stress directly worsens sleep quality ($\beta = 0.53, P < 0.001$), confirming Hypothesis 1. Stress also worsens sleep quality through 7 different indirect pathways. Rumination, emotion-focused coping, and mobile phone addiction each act as independent mediators. Stress increases rumination/coping, which increases mobile phone addiction, which then worsens sleep. High competition in Chinese society increases stress, which pushes students toward phone addiction and overthinking (rumination), ultimately worsening their sleep.	Social anxiety and mobile phone addiction showed a statistically significant difference between males and females ($P < 0.05$), with females scoring higher on both. No significant difference was found between males and females in stress, sleep quality, rumination, or emotion-focused coping strategies ($P > 0.05$). Urban and rural students showed a clear statistical difference in stress, social anxiety, and rumination scores ($P < 0.05$).
16.	Kurtça and Laçın (2025)	323 pre-service special education teachers were selected. Tools such as the Smartphone-	It is a quantitative research design. To check direct and indirect effects, Structural Equation Modeling (SEM) with	People get easily distracted by their phones. It directly increases both their short video flow ($\beta = .569, p < .001$) and short video addiction	There is no separate gender-based specific data mentioned.

		Related Distractibility Scale, Short Video Flow Scale (SVFS), and Short Video Addiction Scale (SVAS). To check direct and indirect effects, Structural Equation Modeling (SEM) with bootstrapping was applied	bootstrapping was used.	($\beta = .263, p < .001$). Getting lost in flow state bridges a gap between phone distractibility and video addiction ($\beta = .343, 95\% \text{ CI } [.249, .418], p < .001$). The statistical model is quite strong, which explains 42% of the variance in short flow and 52% of the variance in video addiction.	
17.	Sullivan, E. et al. (2025)	82 participants (both genders); 62% were females. 13-18 years old, and they were students of UK schools. Participants were assigned to three parallel groups: S/SM Detox Group: N = 26 (total smartphone and social media abstinence). S/SM + Brick Phone Group: N = 26 (access to a basic Nokia 110 device for calls and texts). Control Group: N = 30 (normal smartphone and social media use). Some tools were also used.	Participants were randomly divided into groups for a 21-day digital detox. Some tools were used as wearables: Garmin Vivosmart 5 watches to track sleep length and heart rate, computer games to test memory and attention, and questionnaires to check sleep, mood, and depression. Linear mixed-effects models were used to compare changes from before to after the experiment.	Sleep improvement happens; the detox group participants reported sleeping longer, 45 minutes more for the detox group and 45 minutes more for the brick-Phone group, compared to 14 minutes for the control, and having less daytime sleepiness. However, smartwatches show no significant changes in sleep. Also, the detox groups showed greater reductions in stress and symptoms compared to the control group. Working memory improved by 10% in the brick phone detox group. None of these improvements in sleep or well-being lasted at the two-month follow-up test. Participants faced challenges like boredom (27%), missing their smartphones (48%), and fear of missing out (36%). Even with these challenges, 83% of participants supported government action or restrictions on social media.	The study included 62% female participants out of the total enrolled sample and did not report any separate gender-based variations between males and females.
18.	Upshaw et al. (2022)	A total of 73 college students (38 male, 35 female)	Students performed the Navon letter task; 976 different voices were played to them.	People behaved slowly in response to smartphone notifications,	This sample includes 38 males and 35 females. The

		participated; their average age was 19 years, and 80% were white. Due to some technical issues, 69 students were selected for behavioral analysis and 54 students for ERP analysis. Everyone used smartphones every single day, and no mental illness was recorded among them.	Reaction time and errors were recorded. To check brain activity, EEG was recorded from a Biosemi Active Two system, from which ERPs (P2, N2, or P3 components) were checked. To check smartphone addiction, the Smartphone Addiction Proneness Scale (SAPS) questionnaire was used.	especially on frequent trials. The P2 wave was small because of addiction due to sounds; there is no change in N2 cognitive in those students who are addicted to smartphones.	data is discussed across both genders; no specific gender-based comparison is reported.
19.	Oliveira et al. (2024)	A total of 142 medical students (average age 23 years, 68.3% females, which means 97 girls participated). Everyone was addicted to smartphones. Some of them also used sleep medicines (9.2%), wakefulness medicines (14.8%), traditional smoking (5.6%), and cigarettes (15.5%).	Data were collected through electronic questionnaires. Different tools were used, such as the FOMO scale to measure FOMO, PSQI to check sleep quality, BAI to check anxiety symptoms, BDI to check depression symptoms, and SAS-SV to check smartphone addiction.	High levels of FOMO and phone addiction were recorded. More than 83% of students were suffering from bad sleep quality, and the major reason for it was anxiety. At least 17% of students were suffering from depression. There was a direct relation between FOMO and phone addiction and anxiety and depression, which means severe smartphone usage leads to severe mental health problems.	Gender imbalances were recorded. 68.3% of females participated, but the researcher claimed that when gender was added as a control variable, no difference in results was recorded, which means the overall findings were not dependent on gender specification.
20.	Özkan Özbay (2026)	The study included 15 undergraduate students (with a mean age of 23 years, 53.3% males) from a public university across various faculties. These students were chosen using maximum variation sampling; they owned a smartphone for at least a year, used mobile internet	Face-to-face data were gathered through semi-structured interviews that lasted 30 to 45 minutes. For analysis, Moustakas' phenomenological method was applied along with the MAXQDA 2020 software to help map out themes and codes.	The analysis brought out five major themes: how students perceive and define brain rot, the cognitive and emotional impacts it has, the negative consequences on their social life and academic performance, the coping mechanisms they use, and the broader psychosocial effects of growing digitalization.	Half of the participants (53.3%) were male; the paper did not point out any separate comparative or statistical differences based on gender.

		regularly, and spent a minimum of one hour every day consuming digital content.			
21.	Z.li and H.li (2024)	This paper is a literature review and analytical study that focused on secondary school children who are living in the digital era, examining their psychological growth patterns, social interactions, and emotional development.	This study reviews previous academic research regarding digital socialization, internet and media literacy, cyberbullying, and mental health. It also points out that studies largely rely on questionnaire surveys and interviews.	Some of the challenges, including Information overload, misinformation, cyberbullying, technology dependence/addiction, real-life loneliness, and mental health problems (such as anxiety, depression, and sleep disorders), and some of the opportunities such as mobile knowledge base, convenient cross-region communication, and the cultivation of innovative thinking and practical problem-solving skills were recorded.	There are no specific gender-based responses recorded regarding secondary school children's social and emotional development.
22.	Lin et al. (2019)	The research involved 59 healthy male college students with an average age of 22 years.	The study used the Hindrance and Challenge Stress Scale for academic stress, Pallant's Perceived Control of Internal States Scale (PCOISS), and the Big Five Inventory neuroticism scale as independent variables. Working memory was estimated using a numerical n-back task (2-back and 3-back), while event-related potentials (ERPs) were recorded using 64-site electroencephalograms (EEGs) to analyze Fz P2 and Pz P3 amplitudes.	The effect of academic stress on the attention processes of working memory during high workloads (3-back) and perceived control. Specifically, for students with low perceived control, academic stress was negatively associated with P2 amplitudes, whereas students with high or mean levels of perceived control showed no significant influence, which highlights a protective buffering effect.	The sample was restricted entirely to male college participants.
23.	Kang et al. (2023)	In this study, 10 undergrad students from the University of Houston participated. They were tracked during three major exams (2 midterms and 1	Students wore E4 wristbands that measure skin temperature, heart rate, or electrodermal activity (EDA). After filtering data, every signal's 5 statistics (mean, standard deviation, minimum, maximum, and median)	The result shows the k-nearest neighbor (KNN) algorithm gives the best performance and gets 0.81 ROC-AUC; besides this, Support Vector Machine (SVM) gives ROC-AUC, showing that there is a connection between	The study tracked ten undergraduate students, comprising nine males and two females, across three major exams.

		final); one student was excluded due to disability accommodation.	were inserted into machine learning classifiers (such as KNN or SVM) to predict more than 80 scores.	physical stress signals and exam performance. Some limitations include the data being small and only basic statistics being extracted.	
24.	Nwadi et al. (2025)	A total of 483 Technical and Vocational Education and Training (TVET) and Business education students (average age around 18.5 to 18.8 years) from two universities in Southeast Nigeria participated.	Some tools, like SGAATS (for anxiety), VEMS (for mindfulness), VESSFM (for subjective fitness), and MEAT (for academic achievement), were analyzed using repeated-measures ANOVA, and MANCOVA was used.	It shows a massive reduction in anxiety, such as stress reduction, and significantly lowered academic test anxiety among the students compared to the control group, supported by strong statistical results ($F = 1168.52, p = .001, \eta^2 = 0.752$). Also, the students who participated in the program experienced a substantial increase in their academic achievement ($F = 1381.64, p < .001, \eta^2 = 0.746$). The intervention also notably enhanced students' mindfulness levels, physical/mental subjective fitness, and overall psychological well-being ($F = 768.40, p < .001, \eta^2 = 0.758$). All of the positive changes and improvements remained steady and sustained even during the follow-up assessments after the program ended. This shows that the training program greatly lowered student test anxiety, significantly boosted their grades and mindfulness, and improved their overall well-being, with results staying strong over time.	It includes 2 groups. Both groups had a similar mix of male and female students (about 53-64% male and 45-46% female). Statistical tests proved that gender did not affect the final results.
25.	Sun et al. (2025)	A total of 61 valid first-year high school students (29 in the experimental group, 32 in the control group)	During exams, the experimental group did mindfulness training of 8 minutes for 5 days, while the control group just rested. To check mindfulness and	Five days of brief mindfulness training enhanced overall mindfulness levels (particularly observing and describing skills). Test anxiety	The study sample consisted of 35 males and 26 females. There is no specific

aged 17–18 years old.	anxiety, the FFMQ and SAI were used	reductions were observed after just a single 8-minute session.	gender-specific comparison that was noticed.
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Results and Thematic Synthesis

Overview of Findings:

After reviewing and analyzing the 25 selected research papers, it is clear that various biological, behavioral, and environmental factors have a great impact on students academic performance and mental health. To understand and organize these findings, the data has been categorized into four main themes:

- (1) The neurobiological foundations of academic stress,
- (2) The relationship between sleep disruption and cognitive performance,
- (3) The modern digital frontier and virtual distractions.
- (4) Protective factors and stress mitigation strategies.

Theme 1: Neuro-Biological Foundations of Academic Stress

Exam Stress and Brain Waves:

Rajendran et al. (2022) used wireless EEG devices on college students and found that before exams, stress levels are high in them, which is measured through the θ waves that increase, showing changes; also, after the test, the α , β , and θ waves show a shortage, and a low heart rate shows that the brain is shifting towards cognitive relaxation. The study also shows that prestressed markers are high as compared to females, but right after the test, their physiological response comes to a normal state as compared to females.

HPA Axis and Hormones:

Hinds & Sanchez (2022) and Jayaram & Hripriya (2026) clearly show that academic pressure activates the HPA axis in the body. Cortisol is released from the hypothalamus, which signals the pituitary gland to release ACTH; then adrenaline and cortisol are released from the adrenal glands into the blood. Normal cortisol helps to maintain focus, but if the stress rate goes high, then the constant cortisol and glucocorticoids affect the hippocampus and prefrontal cortex. Due to this chronic stress, neurogenesis and synaptic plasticity stop, and working memory is blocked, which makes it difficult for a student to perform well in exams. In India, due to chronic stress, more than 50% of students, because of their imbalanced diurnal cortisol variations, have their circadian rhythm sleep cycle also affected badly.

Brain Anatomy and Gray Matter Impact (MRI Studies):

Shang et al. (2024) reported that, due to chronic stress, cortical morphology in the brain affects males and females differently. Due to high stress, in males, the sensory-motor zone, such as the bilateral precentral gyri, and

their gray matter volume (GMV) decrease, but in females, GMV increases. Further, Li et al. (2025) demonstrate that when academic pressure reaches extreme psychological decompensation, such as major depressive disorder and suicidal ideation, the left side of the hippocampus GMV is reduced. Right insula and brain wave (ALFF) activity slow down, and the connection between the hippocampus and prefrontal cortex breaks, which stops emotional regulation and impulse control.

Connection between stress and cognition:

According to Almarzouki (2024) and Gellisch et al. (2024), the connection between stress and memory is like an inverted U-shape. A little bit of mild and moderate stress helps to lock memory, but severe stress not only blocks memories but also affects knowledge recall badly. Gellisch et al. (2024) also noticed that physical stress markers such as salivary cortisol and alpha-amylase do not predict direct test grades but show long-term cognitive and emotional processes in detail.

Theme 2: The Sleep Cognition Performance Triangle

Stress Disparity Model and Neuroendocrine Feedback Loop:

Heissel et al. (2017) demonstrate through the stress disparity model how socioeconomics and environmental stress lead to discrepancies and biological pathways. Due to chronic stress, hypocortisolism (flattened diurnal cortisol curve or suppressed CAR) forms. Along with it, a bidirectional neuroendocrine sleep feedback loop starts, where afternoon cortisol affects sleep quality, and fragmented sleep makes the HPA axis hyperreactive, increasing cortisol, which blocks glucocorticoid receptors (GR), which are important for knowledge synthesis. Delay in pubertal circadian phase: sleep deprivation increases in adolescence.

Sleep Deprivation, Caffeine, and Academic Strain:

Yasmeen et al. (2024) studied undergraduate students in Pakistan and found that sleep deprivation ($B = -2.15$) and psychogenic stress ($B = -1.20$) both cumulatively affect GPA ($B = -0.10$) and cognitive performance. In this study, caffeine consumption and psychological resilience ($B = 0.25$) work as a compensatory buffer that provides temporary alertness. Majeed et al. (2025) conducted a study on students from Lahore, which shows that 62.6% of students were poor sleepers. They showed a 10-12 point deficit in sustained attention (RVP), spatial working memory (SWM), and executive problem solving (SOC). According to multiple regression, objective sleep quality (PSQI = -0.48) and cognitive compromise are the biggest independent predictors.

The High-Achieving Cognitive Paradox and Burnout:

According to Almarzouki et al. (2022), in a longitudinal study during the academic term in the summer, students become 77% poorer sleepers than 64% of poor sleepers, but the CANTAB test shows shocking results: due to high stress in the academic term, Spatial Working Memory (SWM) strategies become better. Students with high GPAs have low memory errors, but in them, the high use of prolonged sleep latency, nocturnal disturbances, and sedative hypnotics was recorded, which shows that they hide high-performance burnout or neural strain. Alotaibi et al. (2020) did a study in Riyadh on medical students that showed that they are suffering from 77% poor sleep quality and 63.5% severe psychological distress. Due to stress, their nap timing increases, which leads to nocturnal sleep latency or fragmentation, but there is still no negative effect because of developing coping mechanisms.

Mindfulness and Complex Chain Mediation Pathways:

Al Hadi et al. (2025) show in their qualitative study that due to chronic overworking or sleep deprivation, physical fatigue, somnolence, and attention deficits occur. Jon Kabat-Zinn's mindfulness principles (such as breathing meditation, body scans, and mindful journaling) help reduce somatic distress and improve cognitive focus. Zhang et al. (2024), through structural equation modeling (SEM), show us that academic stress on sleep architecture has a negative impact ($\beta = -0.53$). Due to stress, obsessive rumination, maladaptive emotion-focused coping, and nocturnal smartphone dependence increase, which cause severe sleep fragmentation.

Theme 3: The Modern Digital Frontier and Virtual Distractions

Smartphone Distractibility or Short-Video Flow State:

Kurtça & Laçın (2025) studied 323 special education students in central Türkiye and found that smartphone distractibility directly triggered short-video flow states and clinical addiction. According to Csikszentmihalyi's Flow Theory and CUIT, attentional distractibility creates an algorithmic flow experience that destroys consistency and creates a strong habit of using these platforms for a long time.

Digital Abstinence (21-Day Detox):

Sullivan et al. (2025) did a 21-day digital abstinence trial on 82 UK adolescents. For those with the brick phones, sleep duration increased by about 45 to 49 minutes, daytime sleepiness and stress decreased, and spatial working memory improved by about 7% to 10%. But after 2 months, all of these benefits ended, and previous digital consumption started again because there was no long-term habit formation framework or any transitional plan.

Neurocognitive Effects of Smartphone Notifications:

Upshaw et al. (2022) discovered that smartphone notifications decreased response latencies and increased neuronal conflict in the Anterior Cingulate Cortex (ACC) due to the notification sound. As a result, maintaining focus on your primary work requires a significant amount of mental effort. The P2 ERP wave is reduced in people who are severely dependent on their phones, indicating that their brain finds it difficult to block out digital distractions.

FOMO, Stimulant Sedation Cycle, and Medical Students:

Oliveira & Neta (2024) investigated Brazilian medical students and found that 83.8% of the students experienced clinical sleep disorders. Their addiction score was higher than the threshold. FOMO drives excessive screen monitoring, which affects sleep badly. Students are caught in a "stimulant sedation cycle" due to hyperconnectivity, where they use stimulants during the day to focus and exogenous sedatives or vape at night to sleep.

Brain Rot and Digital Dementia:

According to Özbay's (2026) qualitative study, brain rot is characterized by severe mental fog and cognitive disintegration, which can be defined as the unrelenting intake of short-form digital information. Students are experiencing static-filled TVs and depleted batteries. They are also experiencing difficulty in focusing, academic procrastination, and a lag in their use of search engines due to digital dementia.

Education 4.0 and Virtual-Real Split:

Li & Li (2024) show through a theoretical framework that education 4.0 and big data learning are good assets, but they can also put students at severe socio-emotional risks. This results in a virtual-real split, where digital followers are abundant but the risks of real-world isolation and Internet Addiction Disorder increase.

Theme 4: Protective Factors and Stress Mitigation Strategies

Perceived Control and Frontocentral P2 Shield (EEG Data):

Lin et al. (2019) found that when students face high academic stress, the ones who feel that they have more control over the situation, they are better protected from the negative effects of stress on their attention. In students who feel less control, the part of the brain responsible for focusing and paying attention (measured by P2 amplitude in EEG) gets much weaker whenever stress increases. Students with a strong sense of control keep this part of their brain working normally even with stress. This helps them to stay focused and manage their attention better.

Working Memory and State Anxiety Threshold in SLD Students: Wang et al. (2024) studied Chinese university students, including those with Specific Learning Difficulties (SLD). They found that having a good working memory acts like a protective shield against exam anxiety. If an SLD student's working memory is above a certain level (the 48th percentile), then feeling anxious does not harm their grades. But if their working memory falls below this limit, anxiety can cause their grades to drop a lot. So, strong working memory can help students handle test stress better.

CBT and MBSR Dual Modality Interventions (RCT): Nwadi et al. (2025) worked with students in Nigeria and gave them a 14-week program that combined Cognitive Behavioral Therapy (CBT) and Mindfulness Based Stress Reduction (MBSR). After this treatment, students' anxiety dropped from a severe level to almost none, their mindfulness improved, and their academic performance got much better. This combined approach works by helping students see stressful situations as manageable challenges instead of scary threats.

Ultra-Brief 8-Minute Mindfulness Protocols: Sun et al. (2025) did a short 5-day trial with high school seniors. Their students listened to an 8-minute mindfulness audio each day. Even after just one session, students' test anxiety went down quickly. Their mindfulness increased, and their exam performance became more stable. This shows that even very brief self-regulation exercises can give fast benefits.

Summary of Main Findings

A total of 25 papers were selected to understand how easily stress, academic pressure, sleep, and digital distractions can affect students mentally and physically.

After reviewing all the papers, a single clear message stood out. First, constant stress is bad for the brain. It makes the body produce too many stress hormones. This damages the parts of the brain which helps us remember things and make decisions. Second, this stress ruins sleep. It creates a bad cycle. Stress makes it hard to sleep, and a lack of sleep makes brain power and school grades even worse. Third, phones make things worse. Watching short videos, getting distracted by phones, and fearing that we are missing out (FOMO) break our attention spans. It makes us addicted to our screens. Finally, there is good news. Studies also show that we can

protect ourselves. Feeling in control, practicing mindfulness, going to therapy, and training our memory act like shields. They lower anxiety and help the brain work normally again.

Limitations and Research Gaps

Although this review provides a comprehensive look at academic stress, sleep, and digital distractions, there are a few important limitations in the current literature:

Lack of Objective Data:

Most studies rely only on questionnaires (surveys) rather than using objective tools like smart wearable trackers or real-time measurements. This can lead to self-reporting errors.

Small and Biased Samples:

Many studies have very small sample sizes or focus only on a specific group of students like medical students or one particular region, making it hard to apply these results to everyone.

Cross-Sectional Designs:

Most research is done at a single point in time, so it is difficult to prove a direct cause-and-effect link, for example, whether stress causes bad sleep, or bad sleep causes stress. Also, long-term follow-ups for digital detox or stress relief programs are missing.

Uncontrolled Variables and Brain Mechanisms:

Factors like exact caffeine intake, background lifestyle habits, and how different apps (like TikTok vs. Instagram) uniquely affect brain dopamine are still underexplored. Additionally, deep cellular level data on stress damage is limited.

Conclusion

In conclusion, this review highlights that students face a heavy and interconnected cycle of stress. Academic pressure hyperactivates biological stress systems, which directly ruins sleep quality and overall cognitive performance. Furthermore, modern digital distractions such as infinite scrolling, smartphone dependence, and FOMO worsen this mental exhaustion. However, the literature also proves that protective factors like mindfulness practices, cognitive behavioral strategies (CBT), and strong perceived control can successfully act as shields to restore mental balance.

Future Recommendations

Future studies in this field should focus on the following key areas:

Adopting Objective Measurement Tools:

Future studies should avoid relying solely on self-reported surveys. Instead, use objective tools, such as smart wearable trackers or actigraphy, to measure sleep and real-time stress accurately.

Conducting Long-Term Longitudinal Tracking:

Researchers need to conduct long-term studies to see if digital detox programs and stress relief habits actually create permanent positive changes, rather than temporary relief.

Diverse and Balanced Samples:

Future research should include larger, more diverse student populations across different regions and academic fields (not just medical students) to make the findings universally applicable.

Exploring Biological and Algorithmic Impacts:

More empirical work is required to understand how specific digital algorithms (like short-video platforms) uniquely impact brain dopamine pathways, alongside tracking biological markers like cortisol over time.

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Figures

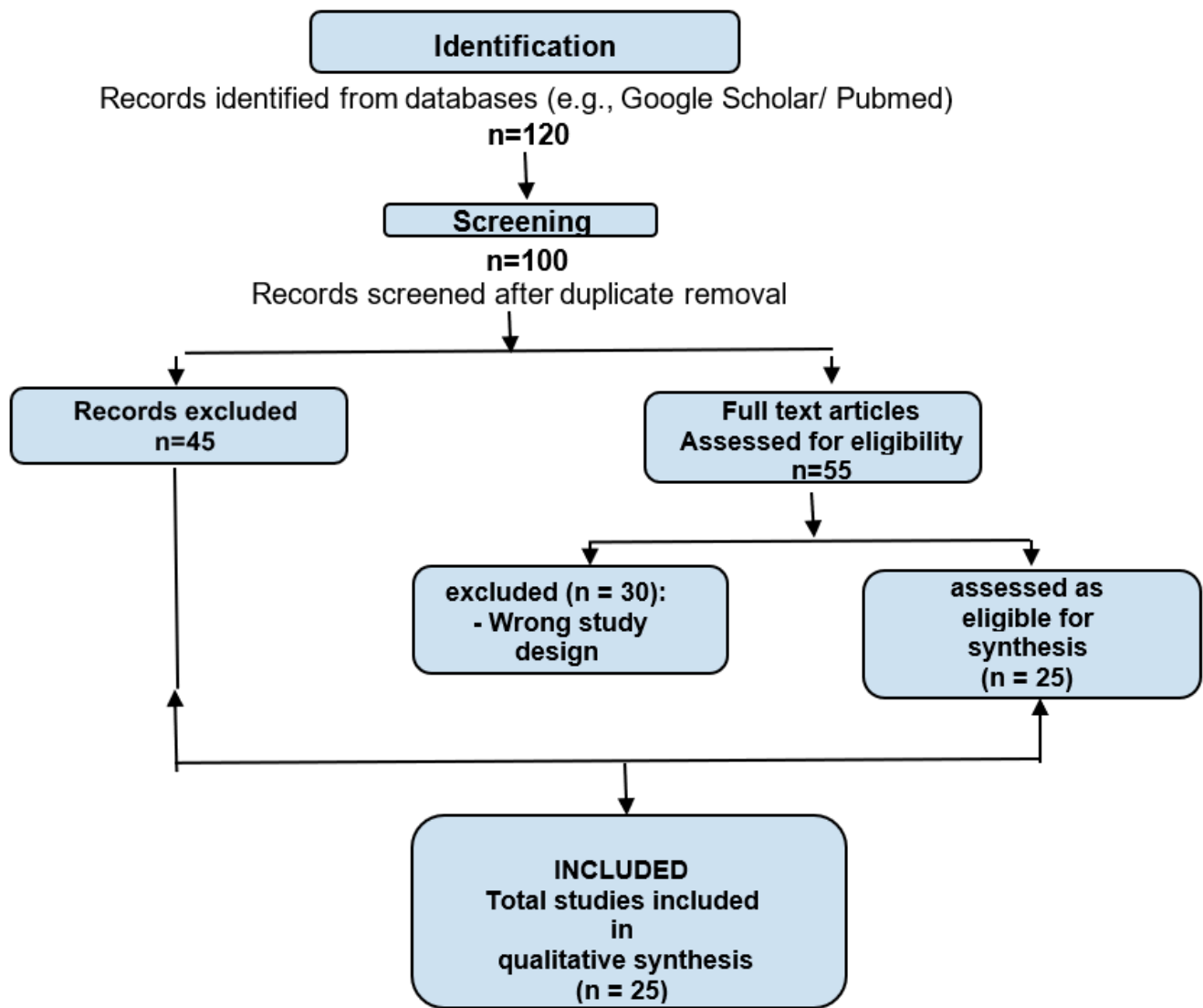


Figure 1

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