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Neurobiological and Cognitive Effects of Academic Stress on Pre-medical Students Ofpunjab Pakistan; A Cross-Section Study

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Research Article

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Abstract

Background

Academic stress begins long before entering into medical school, particularly among students preparing for highly competitive medical entrance examinations such as the Medical and Dental College Admission Test (MDCAT). Sustained long-term academic pressure may activate the hypothalamic-pituitary-adrenal (HPA) axis, increase cortisol secretion, and contribute to neurobiological changes affecting cognition, emotional regulation, and sleep. However, limited evidence exists regarding these effects among pre-medical students in Pakistan.

Objective

To assess academic stress among pre-medical students in Punjab, Pakistan, evaluate its relationship with perceived cognitive difficulties and poor sleep quality, and interpret these findings in the context of current evidence on the neurobiological mechanisms of stress.

Methodology

A cross-sectional questionnaire-based study was conducted among **302 pre-medical students** from Punjab, Pakistan, who had recently completed the MDCAT examination. Participants completed an anonymous self-administered questionnaire comprising demographic information, an Academic Stress Scale, a Cognitive Difficulties Scale, a Sleep Quality Scale, and a Psychological Well-being and Examination Readiness section. Data were analyzed using IBM SPSS Statistics version 32.0.0.0. Descriptive statistics, reliability analysis, and Pearson correlation analysis were performed to evaluate relationships among the study variables.

Results

The mean academic stress score was **43.56 ± 3.99**, indicating a high level of perceived academic stress. Mean scores for perceived cognitive difficulties and sleep quality were **34.06 ± 4.35** and **15.41 ± 3.18**, respectively. Academic stress demonstrated a moderate positive correlation with perceived cognitive difficulties (**$r = 0.542$, $p < 0.001$**) and sleep-related problems (**$r = 0.512$, $p < 0.001$**). Perceived cognitive difficulties were also positively correlated with poorer sleep quality (**$r = 0.510$, $p < 0.001$**). These findings are consistent with current evidence suggesting that prolonged academic stress may adversely influence cognitive functioning through stress-related neurobiological pathways.

Conclusion

Pre-medical students preparing for MDCAT experience considerable academic stress, which is significantly associated with greater perceived cognitive difficulties and poorer sleep quality. The findings support existing evidence that chronic academic stress may have important neurobiological and cognitive consequences even before entry into medical school. Early stress-management interventions, psychological support services, and student well-being initiatives should be incorporated into pre-medical education to promote healthier academic outcomes.

INTRODUCTION

Academic stress is one of the most common psychological challenges experienced by students and occurs when academic demands exceed an individual's perceived ability to cope(1). While a moderate level of stress may enhance motivation and academic performance, persistent or excessive stress has been associated with impaired cognitive function, emotional distress, sleep disturbances, and reduced overall well-being. Medical aspirants preparing for highly competitive entrance examinations are particularly vulnerable because of the prolonged workload, intense competition, and self-imposed expectations as well as those from family and society.(2, 3)

In Pakistan, admission to public-sector medical colleges is primarily determined by performance in the Medical and Dental College Admission Test (MDCAT), one of the country's most competitive examinations. More than 200,000 students compete annually for fewer than 8,000 public-sector medical seats, making success dependent on exceptional academic performance. Unlike many university admission systems that offer multiple intakes each year, MDCAT is conducted only once annually. Consequently, students who fail to achieve their desired score and are not able to get in, often spend an additional year preparing as repeat aspirants. This further increases the psychological burden associated with the entrance exam.(3, 4, 5) Preparation commonly involves prolonged daily study sessions, coaching academies, frequent mock examinations, and continuous revision, often extending over several months or even years.

The physiological response to prolonged academic stress is primarily mediated through activation of the hypothalamic-pituitary-adrenal (HPA) axis and the sympathetic nervous system.(3, 4, 6) Sustained activation of these pathways results in increased secretion of cortisol, the body's principal stress hormone. Although cortisol is essential for normal adaptive responses, chronic elevation has been associated with structural and functional changes in brain regions involved in learning, memory, attention, and emotional regulation, particularly the hippocampus, prefrontal cortex, and amygdala.(1, 6, 7, 8) Experimental and clinical studies have further demonstrated that prolonged stress may impair neuroplasticity, reduce brain-derived neurotrophic factor (BDNF) expression, promote neuroinflammatory processes, and contribute to deficits in executive functioning, working memory, and concentration.(9, 10, 11)

Sleep is another important factor affected by chronic academic stress. Examination-related anxiety, prolonged study schedules, and irregular sleep habits frequently result in reduced sleep quality and

duration.(12, 13) Poor sleep further compromises memory consolidation, attention, decision-making, and learning efficiency, creating a bidirectional relationship in which stress worsens sleep, and inadequate sleep amplifies stress-related cognitive impairment.(12, 14) Together, these neurobiological and behavioral changes may adversely influence students' academic performance and psychological well-being even before they enter medical school.

Although several studies from Pakistan have investigated stress, anxiety, and depression among university and medical students, relatively few have focused specifically on pre-medical students immediately following MDCAT while simultaneously examining perceived cognitive difficulties and sleep quality within the context of stress-related neurobiological mechanisms. Addressing this gap is important because understanding the burden of stress during this critical transition may help guide early interventions aimed at improving student well-being and academic success.

Therefore, the present cross-sectional study aimed to investigate academic stress among pre-medical students in Punjab, Pakistan, and evaluate its relationship with perceived cognitive difficulties and sleep quality while contextualizing these findings within current evidence regarding the neurobiological mechanisms of stress.

METHODOLOGY

Study Design and Setting

A cross-sectional questionnaire-based study was conducted among pre-medical students from Punjab, Pakistan, who had recently appeared in the Medical and Dental College Admission Test (MDCAT). Data were collected from September 2025 to October 2025 using an anonymous online questionnaire created through Google Forms. Participation was voluntary, and responses were collected after completion of the MDCAT examination to minimize interference with examination preparation.

Pilot Study

Prior to the main study, a **pilot study involving 34 participants** was conducted to assess the clarity, comprehensibility, and internal consistency of the questionnaire. Feedback obtained from pilot participants was used to improve the wording and organization of several questionnaire items before initiating large-scale data collection. Reliability analysis using Cronbach's alpha was also performed during the pilot phase to evaluate the internal consistency of each questionnaire domain.

Ethical Considerations

Ethical approval

was obtained from the Institutional Review Board (IRB) before commencement of the study. Participation was voluntary, and electronic informed consent was obtained from all participants prior to completing the questionnaire. No personally identifiable information was collected, ensuring anonymity and confidentiality throughout the study.

Data Collection Instrument

Data were collected using a structured self-administered questionnaire developed using Google Forms following an extensive review of the literature on academic stress, neurobiology, cognition, sleep, and psychological well-being among students preparing for competitive medical entrance examinations.

The questionnaire consisted of **seven sections**:

1. **Sociodemographic characteristics**, including age, gender, educational background, applicant status (fresh/repeater), academy attendance, average daily study hours, study days per week, and duration of MDCAT preparation.
2. **Academic Stress Scale**, consisting of **10 items** assessing perceived academic stress experienced during MDCAT preparation.
3. **Perceived Cognitive Difficulties Scale**, comprising **8 items** evaluating memory, concentration, attention, learning ability, and mental fatigue.
4. **Sleep Quality Scale**, consisting of **4 items** assessing subjective sleep quality and sleep-related disturbances during the preparation period.
5. **Psychological Well-being and Examination Readiness Scale**, comprising **9 items** assessing confidence, optimism, satisfaction with preparation, perceived preparedness, perceived social support, and overall psychological well-being.
6. **Perceived Sources of Academic Stress**, consisting of multiple-response questions identifying major stressors during MDCAT preparation, including academic workload, parental expectations, competition, financial concerns, uncertainty regarding admission, and related factors.
7. **Stress Management Strategies and Coping Mechanisms**, consisting of multiple-response questions exploring methods adopted by students to manage academic stress, including physical activity, recreational activities, social support, religious practices, counselling, and other coping strategies.

All items in Sections 2–5 were measured using a **five-point Likert scale** ranging from **1 (Strongly Disagree)** to **5 (Strongly Agree)**.

The complete English-language questionnaire developed for this study is provided as Supplementary File 1.

Reliability Analysis

Internal consistency of the questionnaire scales was assessed using **Cronbach's alpha coefficient**. Pilot testing demonstrated satisfactory reliability of the study instrument, supporting its use in the main survey. Following data collection, reliability was reassessed using the final sample of 302 participants. The Academic Stress Scale demonstrated moderate internal consistency (Cronbach's α = 0.607), the Cognitive Difficulties Scale showed modest reliability (α = 0.699), the Sleep Quality Scale demonstrated moderate reliability (α = 0.547). These values were interpreted in conjunction with the exploratory nature of the newly developed questionnaire.

Statistical Analysis

Data were analyzed using **IBM SPSS Statistics version 32.0.0.0**. Descriptive statistics were used to summarize participants' demographic characteristics and questionnaire responses. Categorical variables were presented as frequencies and percentages, whereas continuous variables were expressed as means and standard deviations.

Composite scores were calculated for the Academic Stress, Cognitive Difficulties, and Sleep Quality scales by summing individual item scores. Pearson's correlation coefficient was used to examine relationships among these variables.

Responses from the **Perceived Sources of Academic Stress** and **Stress Management Strategies and Coping Mechanisms** sections were analyzed descriptively using frequencies, percentages, and bar charts to identify the most commonly reported stressors and coping strategies among participants. A **p-value < 0.05** was considered statistically significant. Figure 1 illustrates the participant recruitment and inclusion process.

RESULTS

Participant Characteristics

A total of **302 pre-medical students** who had recently appeared in the Medical and Dental College Admission Test (MDCAT) participated in the study.

The majority of participants were **19 years old (43.7%)**, followed by **20 years (33.8%)**, **18 years (10.9%)**, **21 years (6.6%)**, and **17 years (5.0%)**. Females constituted **50.7% (n = 153)** of the sample, males **48.3% (n = 146)**, while **1.0% (n = 3)** preferred not to disclose their gender.

Almost all participants (**99.7%**) had completed **FSc (Pre-Medical)**, whereas only one participant (0.3%) had an A-Level educational background.

More than half of the respondents (**55.0%**) were repeat MDCAT applicants, while **45.0%** were first-time applicants. Most students (**78.1%**) attended a private coaching academy during their preparation.

Regarding study habits, **50.0%** reported studying **8–12 hours daily**, whereas **30.1%** studied **4–8 hours**, **13.6%** studied **12 hours or more**, and **6.3%** studied fewer than four hours per day. Most participants studied **5–6 days per week (51.3%)**, followed by **daily study (35.8%)**. The most common preparation duration was **6–12 months (41.7%)**, followed by **less than 3 months (31.5%)**, **3–6 months (16.6%)**, and **more than 12 months (10.3%)**. The demographic characteristics of participants are presented in Table 1.

Table 1
Demographic characteristics of study participants (N = 302)

Characteristic	n	%
Age (years)		
17	15	5.0
18	33	10.9
19	132	43.7
20	102	33.8
21	20	6.6
Gender		
Female	153	50.7
Male	146	48.3
Prefer not to say	3	1.0
Educational Background		
FSc (pre-medical)	301	99.7
A-Level	1	0.3
Applicant Status		
First-time applicant	136	45.0
Repeater	166	55.0
Academy Attendance		
Yes	236	78.1
No	66	21.9
Daily Study Hours		
< 4 hours	19	6.3
4–8 hours	91	30.1
8–12 hours	151	50.0
≥ 12 hours	41	13.6
Study Days per Week		
1–2 days	8	2.6

Characteristic	n	%
Age (years)		
3–4 days	31	10.3
5–6 days	155	51.3
Every day	108	35.8
Duration of Preparation		
< 3 months	95	31.5
3–6 months	50	16.6
6–12 months	126	41.7
> 12 months	31	10.3

Descriptive Statistics of Study Variables

The mean Academic Stress, Cognitive Difficulties, and Sleep Quality scores were **43.56 ± 3.99, 34.06 ± 4.35**, and **15.41 ± 3.18**, respectively. Higher scores on the Academic Stress, Cognitive Difficulties, and Sleep Quality scales represented greater perceived stress, cognitive difficulties, and poorer sleep quality, respectively. Descriptive statistics are presented in Table 2

Table 2
Descriptive statistics of the study variables (N = 302)

Variable	Possible Score	Mean	SD	Minimum	Maximum
Academic Stress	10–50	43.56	3.99	26	50
Cognitive Difficulties	8–40	34.06	4.35	14	40
Sleep Quality	4–20	15.41	3.18	4	20

Reliability Analysis

The Academic Stress Scale demonstrated moderate internal consistency (Cronbach's α = .61), whereas the Cognitive Difficulties Scale demonstrated acceptable internal consistency (α = .70). The Sleep Quality Scale demonstrated modest internal consistency (α = .55). Internal consistency of study scales is presented in Table 3.

Table 3
Internal consistency of study scales

Scale	Items	Mean ± SD	Cronbach's α
Academic Stress	10	43.56 ± 3.99	.61
Cognitive Difficulties	8	34.06 ± 4.35	.70
Sleep Quality	4	15.41 ± 3.18	.55
Note. Cronbach's alpha values were calculated using the final sample (N = 302).			

Correlation Analysis

Pearson correlation analysis demonstrated statistically significant positive relationships among the principal study variables.

Academic Stress was moderately positively correlated with Cognitive Difficulties (**r = 0.542, p < 0.001**), indicating that students reporting higher stress levels also reported greater cognitive impairment.

Academic Stress also demonstrated a moderate positive correlation with Sleep Quality scores (**r = 0.512, p < 0.001**), suggesting that greater stress was associated with poorer perceived sleep quality.

Similarly, Cognitive Difficulties were positively correlated with Sleep Quality scores (**r = 0.510, p < 0.001**).

These findings are presented in Table 4, which indicate that higher perceived academic stress was consistently associated with increased cognitive difficulties and poorer sleep among MDCAT aspirants.

Table 4
Pearson correlations among Academic Stress, Cognitive Difficulties, and Sleep Quality (N = 302)

Variable	1	2	3
Academic Stress	-		
Cognitive Difficulties	0.542***	-	
Sleep Quality	0.512***	0.510***	-
Note. Pearson correlation coefficients are reported.			
***p < 0.001			

Psychological Well-being and Examination Readiness

Responses to the Psychological Well-being and Examination Readiness questionnaire are presented in Table 5 and showed that a large proportion of participants disagreed with positive statements regarding preparedness, confidence, optimism, and satisfaction with their MDCAT preparation.

Table 5
Responses to the Psychological Well-being and Examination Readiness items (N = 302)

Item	Strongly Disagree n (%)	Disagree n (%)	Neutral n (%)	Agree n (%)	Strongly Agree n (%)
I am satisfied with my current preparation for MDCAT	91 (30.1)	137 (45.4)	55 (18.2)	9 (3.0)	10 (3.3)
I remain optimistic about achieving my academic goals	56 (18.5)	83 (27.5)	97 (32.1)	42 (13.9)	24 (7.9)
Overall, I feel happy despite the demands of exam preparation	62 (20.5)	157 (52.0)	53 (17.5)	15 (5.0)	15 (5.0)
I feel adequately prepared for MDCAT	90 (29.8)	114 (37.7)	48 (15.9)	32 (10.6)	18 (6.0)
I am confident in my ability to perform well in the examination	91 (30.1)	56 (18.5)	89 (29.5)	47 (15.6)	19 (6.3)
I believe my preparation is sufficient to achieve my desired score	67 (22.2)	141 (46.7)	76 (25.2)	15 (5.0)	3 (1.0)
My MDCAT preparation has been a positive learning experience	107 (35.4)	121 (40.1)	43 (14.2)	21 (7.0)	10 (3.3)
I have received adequate support from family, teachers, or mentors	64 (21.2)	72 (23.8)	69 (22.8)	57 (18.9)	40 (13.2)
Overall, I am satisfied with my MDCAT preparation journey	78 (25.8)	104 (34.4)	88 (29.1)	20 (6.6)	12 (4.0)

Note. Percentages are based on the total sample (N = 302).

Overall Self-Assessment of Stress, Sleep, Cognitive Function, and Examination Readiness

Participants' self-assessment suggested high levels of perceived stress alongside low ratings of sleep quality, concentration, memory, examination readiness, and overall preparation experience. (Table 6). Most respondents reported **high or very high levels of academic stress**, with **61.3%** rating their stress at the highest level and **27.5%** at the second-highest level. In contrast, perceptions of sleep quality were generally poor, with **68.2%** rating their sleep quality at the lowest level and only **4.3%** reporting good or excellent sleep. Self-perceived cognitive functioning was also adversely affected. Approximately **74.5%** of participants rated their concentration as poor or below average, while **82.1%** reported poor or below-average memory performance. Similarly, participants expressed low confidence in their examination readiness, with **62.9%** assigning the lowest rating and **27.8%** the second-lowest rating. Overall

preparation experience was also viewed negatively, as **57.3%** rated their experience at the lowest level and **32.1%** at the second-lowest level. Collectively, these findings are indicated in Table 6 which indicate that the majority of pre-medical students perceived substantial stress accompanied by impaired sleep, reduced cognitive functioning, limited examination readiness, and an overall unfavorable preparation experience.

Table 6
Participants' self-assessment of stress, sleep, concentration, memory, examination readiness, and preparation experience (N = 302)

Variable	Rating 1 n (%)	Rating 2 n (%)	Rating 3 n (%)	Rating 4 n (%)	Rating 5 n (%)
Perceived stress level	8 (2.6)	11 (3.6)	15 (5.0)	83 (27.5)	**185 (61.3)**
Perceived Sleep quality	**206 (68.2)**	59 (19.5)	24 (7.9)	5 (1.7)	8 (2.6)
Perceived Concentration	**117 (38.7)**	108 (35.8)	59 (19.5)	12 (4.0)	6 (2.0)
Perceived Memory	**128 (42.4)**	120 (39.7)	38 (12.6)	12 (4.0)	4 (1.3)
Perceived Examination readiness	**190 (62.9)**	84 (27.8)	22 (7.3)	5 (1.7)	1 (0.3)
Perceived Overall preparation experience	**173 (57.3)**	97 (32.1)	24 (7.9)	8 (2.6)	0 (0.0)

Note. Ratings ranged from 1 to 5. For current stress level, higher ratings indicate greater perceived stress. For sleep quality, concentration, memory, examination readiness, and overall preparation experience, higher ratings indicate more favorable self-assessments. Percentages are based on the total sample (N = 302).

Perceived Sources of Academic Stress

Participants identified multiple factors contributing to academic stress during MDCAT preparation. The most frequently reported stressors included the extensive academic workload, intense competition for limited medical college seats, parental expectations, uncertainty regarding admission outcomes, and prolonged preparation periods. The distribution of reported stressors is illustrated in Table 7.

Table 7
Themes Identified from Participants' Open-Ended Responses Regarding Their Greatest Challenge During MDCAT Preparation

Theme	Example participant responses
Academic workload	"Vast syllabus"; "Too many chapters"; "Heavy workload."
Time management	"Managing my routine"; "Not enough time"; "Time management."
Psychological distress	"Fear of failure"; "Stress"; "Anxiety"; "Pressure."
Competition	"Competition"; "Limited seats"; "High merit."
Concentration difficulties	"Can't focus"; "Consistency"; "Procrastination."
Sleep disturbance	"Poor sleep"; "Sleep schedule ruined"; "Insomnia."
Family/social expectations	"Parents' expectations"; "Society pressure."
Other	"Summer heat"; "Financial problems"; "Health issues."
Note. Responses were analyzed qualitatively and grouped into common themes.	

DISCUSSION

The present cross-sectional study investigated perceived academic stress and its relationship with cognitive difficulties, sleep quality, and psychological well-being among pre-medical students in Punjab, Pakistan, immediately following the Medical and Dental College Admission Test (MDCAT). The findings indicate that the majority of participants experienced high levels of academic strain, accompanied by considerable cognitive difficulties, poor sleep quality, and low confidence regarding examination readiness. The neurobiological mechanisms (HPA axis activation, cortisol, neuroplasticity, etc.) are discussed in the context of existing evidence rather than being directly measured in this study(15, 16). Furthermore, academic pressure demonstrated moderate positive correlations with both perceived cognitive difficulties and poor sleep quality, suggesting that students reporting greater stress also experienced greater impairment in these domains.(17, 18)

These findings are consistent with previous research demonstrating that prolonged academic stress adversely affects cognitive performance and psychological well-being among students preparing for highly competitive examinations.(19, 20, 22). Experimental and clinical studies have shown that chronic tension activates the hypothalamic-pituitary-adrenal (HPA) axis and sympathetic nervous system, resulting in sustained cortisol secretion and altered neurotransmitter activity. Although these physiological responses are adaptive during acute trauma, persistent activation may negatively influence hippocampal-dependent memory, prefrontal cortical executive functioning, and amygdala-mediated emotional regulation, ultimately impairing attention, learning, decision-making, and emotional resilience. (15, 16, 21)

The high level of perceived stress observed among MDCAT aspirants may reflect the unique academic environment surrounding medical admissions in Pakistan. Every year, hundreds of thousands of students compete for a limited number of medical college seats, creating an intensely competitive atmosphere. In addition to the extensive syllabus and demanding study schedules, students frequently encounter coaching academy pressures, repeated assessments, parental expectations, financial burden, and uncertainty regarding admission outcomes. These factors collectively expose students to prolonged psychological stress over several months, and in some cases years.

Compared with reports from other countries, Pakistani pre-medical students may experience an even greater psychological burden because medical admission is often regarded as a defining milestone rather than simply an educational opportunity. Many aspirants have consistently achieved high academic performance throughout school and may encounter significant emotional distress when faced with the uncertainty and intense competition associated with MDCAT. The qualitative responses obtained in this study support this observation, with participants frequently identifying the extensive syllabus, time management challenges, fear of failure, competition, prolonged preparation, and disrupted sleep as their principal stressors.

Sleep quality was also markedly affected.(23, 24) Most participants reported poor sleep, and sleep quality demonstrated a moderate positive correlation with perceived academic pressure. These findings agree with previous evidence showing that chronic stress disrupts circadian regulation through prolonged HPA axis activation and elevated cortisol levels.(25, 26, 27) Inadequate sleep further compromises memory consolidation, attention, executive functioning, and emotional regulation, potentially creating a cycle in which increased tension leads to poorer sleep, thereby further impairing academic performance and increasing psychological distress(28, 29).

Similarly, participants reported considerable cognitive difficulties, particularly involving concentration and memory. The observed association between stress and cognitive difficulties supports current neurobiological models suggesting that prolonged exposure to stress adversely influences multiple interconnected neural systems involved in learning and cognition(30, 31, 32). Although the present study relied on self-reported measures rather than objective neuropsychological testing, the findings closely parallel evidence demonstrating that chronic academic worry is associated with reduced cognitive efficiency and diminished academic performance.

The findings of this study have important implications for educational institutions, coaching academies, parents, and policymakers. Academic preparation should be accompanied by strategies that protect students' psychological well-being rather than focusing exclusively on examination performance. Incorporating structured study schedules, scheduled rest periods, sleep hygiene education, physical activity, mindfulness-based stress reduction, and accessible psychological counselling into pre-medical preparation programs may reduce the adverse consequences of prolonged academic stress. Equally important is promoting the understanding that success in a single competitive examination should not define an individual's self-worth or future potential.

One of the major strengths of this study is that it examined students immediately after completion of MDCAT, allowing stress-related experiences to be captured while still fresh in participants' memory. The relatively large sample size, inclusion of students from across Punjab, and assessment of academic hassle, cognitive difficulties, sleep quality, psychological well-being, and qualitative stressors provide a comprehensive overview of the multidimensional effects of examination-related stress.

However, several limitations should be considered when interpreting these findings.

LIMITATIONS

The present study has several limitations. First, its cross-sectional design precludes causal inferences regarding the relationships between academic stress, cognitive difficulties, and sleep quality. Second, data were collected using an online self-administered questionnaire, making the findings susceptible to recall bias, response bias, and social desirability bias. Third, convenience sampling was employed, and participants were recruited only from Punjab, which may limit the generalizability of the findings to other provinces or educational settings within Pakistan. Additionally, all study variables were based on self-reported perceptions rather than objective neuropsychological assessments or physiological biomarkers such as salivary cortisol, limiting direct evaluation of the neurobiological mechanisms discussed in the literature. Finally, the psychological well-being and examination readiness questionnaire demonstrated modest internal consistency and therefore should be interpreted primarily as a descriptive measure rather than a validated psychometric scale.

Future longitudinal studies incorporating objective cognitive testing, validated psychological instruments, and biological stress markers are warranted to better elucidate the temporal relationship between academic stress and neurobiological functioning among pre-medical students.

Conclusion

Academic stress among MDCAT aspirants in Punjab, Pakistan is associated with substantial perceived cognitive difficulties, poor sleep quality, and reduced psychological well-being. These findings highlight the need for early identification of psychological distress and the integration of evidence-based stress management, counseling, and well-being programs into pre-medical education. Supporting students before they enter medical school may not only improve examination outcomes but also foster healthier, more resilient future healthcare professionals.

Abbreviations

• BDNF
Brain–Derived Neurotrophic Factor
• CFQ
Cognitive Failures Questionnaire
• HPA

Hypothalamic–Pituitary–Adrenal
• IBM
International Business Machines
• IRB
Institutional Review Board
• MDCAT
Medical and Dental College Admission Test
• SPSS
Statistical Package for the Social Sciences

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Institutional Review Board of Sahiwal Medical College, Sahiwal, Pakistan, before commencement of the study. All procedures were conducted in accordance with the principles of the Declaration of Helsinki and relevant institutional guidelines. Electronic informed consent was obtained from all participants prior to participation. Participation was voluntary, and all responses were collected anonymously to ensure confidentiality.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are not publicly available because they contain potentially identifiable participant information but are available from the corresponding author on reasonable request.

Competing interests

The author declares that there are no competing interests.

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Authors' contributions

Manhil Ahmed Khan conceived and designed the study; developed the questionnaire; collected, analyzed, and interpreted the data; conducted the literature review; wrote the manuscript; and approved the final version of the manuscript.

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Figures

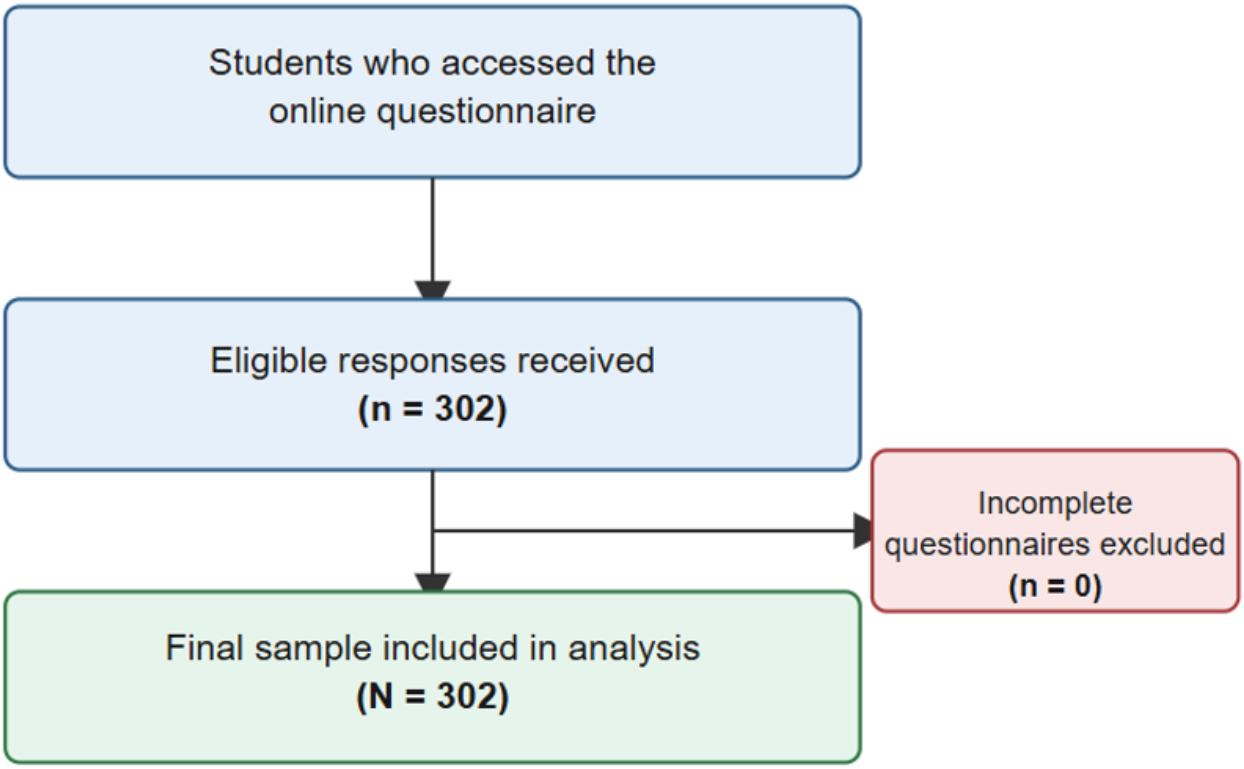


Figure 1

Flow diagram of participant recruitment and inclusion.

Supplementary Files

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- SupplementaryFile1StudyQuestionnaire.pdf.pdf