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Empowering Youth: Enhancing Mental Well-being and Physical Fitness for Holistic Development: A Cross-Sectional Empirical Study Among University Students in Bhopal, Madhya Pradesh, India

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ABSTRACT
Academic stress among university students has emerged as a pressing public health and youth development concern, with far-reaching consequences for mental health, academic engagement, and long-term human capital formation. Despite a growing global evidence base, the combined influence of anxiety, emotional stability, and physical fitness on academic stress and whether resilience acts as a mediating bridge between physical fitness and stress remains insufficiently examined among Indian university students.This cross-sectional study surveyed 366 university students from government, private, and autonomous institutions in Bhopal, Madhya Pradesh, India. Validated multi-item Likert scales assessed academic stress (Cronbach's α = .82), anxiety level (α = .79), emotional stability (α = .77), physical fitness frequency (α = .78), and resilience (α = .76). Statistical analyses included Pearson correlation, independent-samples t-test, one-way ANOVA, multiple linear regression with demographic controls, bootstrap mediation analysis (1,000 iterations), regression diagnostics, and machine-learning classification for robustness validation.Anxiety level emerged as the strongest positive predictor of academic stress (β = .43, p < .001), while emotional stability (β = −.28, p < .001) and physical fitness frequency (β = −.18, p < .001) were significant negative predictors. Together, these three variables explained 62% of variance in academic stress (R^2 = .62). Resilience did not significantly mediate the physical fitness–academic stress relationship (indirect effect = −.026; 95% CI [−.083, .028]). Academic stress did not differ significantly by gender (p = .480) or by university type (p = .312). Random Forest classification confirmed the predictor hierarchy with 82% accuracy.These findings establish that academic stress is driven primarily by psychological and behavioural rather than demographic or institutional factors, and point to the urgency of integrated campus wellness strategies that simultaneously address anxiety management, emotional regulation, and physical activity promotion in Indian higher education.
Keywords: Academic Stress, Anxiety, Emotional Stability, Physical Fitness, Resilience, University Students, Holistic Well-Being, India

INTRODUCTION

Walk through any Indian university campus today and the signs are unmistakable: students hunched over laptops in cramped hostel rooms at midnight, WhatsApp groups alive with exam-related anxiety at 2 a.m., counselling queues that stretch longer with every passing semester. Academic stress once dismissed as an inevitable rite of passage has become a genuine public health concern, and nowhere is this more visible than in the rapidly expanding universities of central India.

Higher education enrolment in India surpassed 43 million students as of 2023, making it the third-largest system in the world (AISHE, 2023). Within this system, the stakes have never been higher. Competitive entrance examinations, scarce employment opportunities, family performance expectations, and chronically underfunded mental health infrastructure converge to create conditions that amplify stress well beyond what most students can effectively self-regulate (Sharma & Yadav, 2021). Madhya Pradesh a central Indian state with over 55 universities and hundreds of affiliated colleges epitomises these contradictions. Its student population is large, diverse, and educationally aspirant, yet formal support structures for student well-being remain limited.

Research consistently shows that unmanaged academic stress does not merely affect grades. It is associated with anxiety disorders, depression, sleep disruption, substance use, and in severe cases, academic dropout and self-harm (Dyrbye et al., 2006; Pascoe et al., 2020). The economic consequences are equally significant: student attrition driven by stress-related deterioration represents a direct loss of human capital investment for both individuals and the state (World Health Organization, 2020). Understanding what drives academic stress and what protects against it is therefore not just a question for educational researchers but for public health practitioners, economists, and policy makers alike.

The present study focuses on three variables that theory and prior evidence suggest are particularly consequential. First, anxiety level: students who are dispositional anxious tend to appraise academic demands as threatening even when those demands are manageable, producing a stress response that is disproportionate to objective circumstances (Cassady & Johnson, 2002). Second, emotional stability: students who are emotionally stable are better equipped to regulate their reactions to setbacks, maintain focus under pressure, and draw on adaptive coping strategies all of which reduce cumulative stress burden (Nakaya et al., 2006). Third, physical fitness frequency: regular exercise has well-documented stress-buffering properties, including reduced cortisol reactivity, improved mood, and enhanced cognitive flexibility (Salmon, 2001; Mahindru et al., 2023). A fourth variable resilience is examined as a potential mediator, on the theoretical premise that physical fitness builds psychological resilience, which in turn reduces stress.

Despite the intuitive appeal of this model, no study to the authors' knowledge has simultaneously tested all four variables anxiety, emotional stability, physical fitness, and resilience within a single integrated framework among Indian university students. Nor have prior studies in this context applied machine-learning-based robustness validation alongside conventional regression methods. This study addresses both gaps.

The research questions guiding this investigation are: (RQ1) Do anxiety level, emotional stability, and physical fitness frequency significantly predict academic stress, and what are their relative independent contributions? (RQ2) Does resilience mediate the relationship between physical fitness frequency and academic stress? (RQ3) Do academic stress and academic performance differ significantly by gender and by university type?

The study's findings speak simultaneously to youth development theory, stress and coping research, health economics, and higher education policy. The remainder of the paper proceeds as follows: Section 2 reviews the relevant literature; Section 3 presents the theoretical framework; Section 4 states the conceptual model and formal hypotheses; Section 5 describes the methodology; Section 6 reports the results; Sections 7–10 discuss findings, implications, and limitations; and Section 11 concludes.

2. LITERATURE REVIEW

2.1 Academic Stress Among University Students

Academic stress is not a new phenomenon, but its character has changed. Where previous generations of students faced stress largely from examination pressure alone, today's university students navigate a more complex environment: gig-economy job insecurity, social media comparison culture, pandemic-era anxiety legacies, and an accelerating pace of technological change that makes even recently acquired knowledge feel quickly obsolete (Pascoe et al., 2020). Empirical studies across national contexts consistently find that 40–75% of students experience moderate-to-high levels of academic stress during term time (Dyrbye et al., 2006; Misra & McKean, 2000). In India specifically, the structural amplifiers are particularly powerful: intense competition for limited postgraduate seats and professional positions, deeply ingrained cultural narratives linking academic performance to family honour, and institutional cultures that have historically prioritised examination outcomes over student well-being (Sharma & Yadav, 2021; Kaur et al., 2020).

2.2 Anxiety and Academic Stress

Anxiety and academic stress are conceptually distinct but empirically entangled. Trait anxiety a relatively stable disposition to perceive ambiguous situations as dangerous amplifies the frequency and intensity of stress appraisals, creating a cognitive bias towards threat interpretation that is especially activated in evaluative contexts (Cassady & Johnson, 2002; Zeidner, 2007). Neurobiologically, sustained anxiety activates the hypothalamic-pituitary-adrenal (HPA) axis, prolonging cortisol secretion and impairing prefrontal regulation, which in turn reduces working memory capacity and the ability to engage in the kind of flexible problem-solving that academic challenges demand (Lupien et al., 2009). Meta-analyses have consistently documented moderate-to-strong positive correlations between anxiety measures and academic stress scales (r = .55–.72), and the present study's finding of r = .68 falls squarely within this range (von der Embse

et al., 2018).

2.3 Emotional Stability and Psychological Regulation

Emotional stability the positive pole of the neuroticism dimension in the Five Factor Model of personality reflects a tendency to remain composed, regulate affect effectively, and maintain equanimity under environmental pressure (Costa & McCrae, 1992). Low neuroticism is associated with superior appraisal flexibility: emotionally stable individuals are more likely to re-appraise threatening events as challenges, to adopt problem-focused rather than avoidant coping strategies, and to recover more rapidly from stressful episodes (Suls & Martin, 2005). In academic settings, higher emotional stability predicts lower burnout, better self-regulatory behaviour during study, and superior performance on evaluative tasks (Komarraju et al., 2011). Crucially, emotional stability is not simply the absence of anxiety — it is an active resource for effective stress management. The moderate overlap between these constructs in the present data ($r = -.55$) confirms their conceptual relatedness while also affirming their empirical distinctiveness.

2.4 Physical Fitness and Mental Well-being

The evidence linking physical activity and fitness to positive mental health outcomes is among the most robust in behavioural medicine. Regular exercise reduces HPA-axis reactivity, increases hippocampal neurogenesis and BDNF secretion, enhances serotonergic and dopaminergic transmission, and improves the quality and architecture of sleep all of which contribute to a reduced baseline stress burden and improved capacity to manage stressor demands (Salmon, 2001; Stults-Kolehmainen & Sinha, 2014). Among university students specifically, higher physical activity levels have been associated with lower psychological distress, reduced burnout, and improved academic self-efficacy (Keating et al., 2005; Mahindru et al., 2023). The Indian higher education context presents a particular challenge here: infrastructure for structured physical activity is often limited, particularly in government and smaller private institutions, and academic time pressure frequently displaces discretionary physical activity. The present study's focus on frequency of physical fitness engagement rather than sport participation or formal gym membership makes its findings applicable across institutional contexts.

2.5 Resilience as a Potential Mediating Mechanism

Resilience broadly understood as the dynamic capacity for positive adaptation in the face of adversity has attracted growing interest as a psychological mechanism linking health behaviours to stress outcomes (Fletcher & Sarkar, 2013; Rutter, 2006). The theoretical rationale for expecting resilience to mediate the physical fitness–academic stress pathway is intuitive: exercise builds mastery experiences, self-efficacy, and emotional regulation capacity, which in turn cultivates resilience, which then buffers against stress (Gerber et al., 2012). Empirically, however, the picture is more complicated. Several studies find positive associations between physical activity and resilience (Gerber et al., 2012), and between resilience and lower academic stress (Cassidy, 2015), but formal tests of the full mediation path have produced inconsistent results (Keyes et al., 2012). The present study provides a rigorous bootstrap-based test of this path and contributes to this emerging, contested literature.

2.6 Youth Development and Holistic Well-being

The positive youth development (PYD) framework represents a significant shift in how developmental scientists think about adolescent and young adult health away from deficit reduction and towards the cultivation of assets (Lerner et al., 2005). Within this framework, physical fitness and psychological health are not independent silos but mutually reinforcing dimensions of a holistic well-being ecosystem. University institutions are not merely venues for credentialing but developmental contexts in which the trajectory of young people's physical, psychological, and social functioning is shaped. When universities invest in integrated wellness programming combining physical activity infrastructure with mental health screening and emotional skills development, they are making investments in human capital that pay returns well beyond the graduation ceremony (World Health Organization, 2020). The present study is grounded in this holistic orientation.

2.7 Synthesis and Research Gaps

The reviewed literature identifies four specific gaps that the present study addresses. First, no prior study has integrated anxiety, emotional stability, and physical fitness as simultaneous predictors of academic stress in a single regression framework among Indian university students. Second, the resilience mediation hypothesis has not been rigorously tested in this population. Third, demographic comparisons (gender, institution type) are rarely integrated with multivariate psychological modelling. Fourth, machine-learning-based validation of regression findings is largely absent from this literature. By addressing all four gaps in a single empirical investigation, the present study makes a methodologically and substantively distinctive contribution.

3. THEORETICAL FRAMEWORK

Four complementary theoretical traditions underpin the present study's conceptual architecture. Salutogenic Theory (Antonovsky, 1979, 1987). Aaron Antonovsky's salutogenic framework, developed in response to the perceived limitations of a purely pathogenic orientation in health research, asks not why some people get sick under stress but why others remain healthy. The central construct sense of coherence reflects a person's global orientation that the demands of life are comprehensible, manageable, and meaningful. Generalised resistance resources (GRRs) including social support, financial security, and psychological stability enable this sense of coherence. The present study conceptualises emotional stability and physical fitness as GRRs in this framework: they are not specific coping responses to specific stressors but broadly available psychological and physiological assets that increase a student's overall capacity to maintain coherence when academic demands intensify.

Stress and Coping Theory (Lazarus & Folkman, 1984). Lazarus and Folkman's transactional model remains the dominant theoretical framework for understanding stress as a relational, dynamic process. Stress arises not from objective demands alone but from a person's cognitive appraisal of those demands relative to available coping resources. Primary appraisal asks whether the demand is threatening or challenging; secondary appraisal asks whether coping resources are adequate. Anxiety, in this model, operates as a dispositional bias towards threat appraisal anxious students are more likely to evaluate the same academic demand as threatening. Emotional stability supports reappraisal the ability to revise initial threat appraisals towards more benign or challenge-oriented interpretations. Physical fitness reduces physiological arousal, which feeds back into the appraisal process by lowering the somatic signals that inform threat perception.

Health Behaviour Theory (Ajzen, 1991; Bandura, 1986). Self-efficacy theory (Bandura) and the theory of planned behaviour (Ajzen) together explain the maintenance of health behaviours such as regular exercise. Physical fitness engagement requires not only intention but perceived behavioural control the belief that one can organise and execute physical activity regularly despite competing demands. The self-efficacy associated with regular exercise generalises: students who believe they can sustain a fitness routine come to believe they can also sustain effort through academic challenges. This generalisation of self-efficacy offers a theoretical pathway through which physical fitness reduces academic stress independently of resilience as a formal construct.

Positive Youth Development Perspective (Lerner et al., 2005). The PYD framework's Five Cs competence, confidence, connection, character, and caring identify the developmental assets that enable young people to thrive. University years are a critical developmental window in which these assets are either consolidated or eroded. Academic stress, when chronic and unmanaged, erodes competence and confidence; targeted well-being interventions that address anxiety, emotional regulation, and physical fitness can restore and strengthen them. The PYD lens situates the present study's findings within a broader developmental argument about the university's responsibility as a context for youth flourishing.

Taken together, these four frameworks generate an integrated theoretical architecture: anxiety functions as a risk factor by biasing appraisal towards threat; emotional stability and physical fitness function as protective factors through complementary psychological and physiological pathways; and resilience was theoretically expected but, as the empirical results show, was not empirically demonstrated to transmit the protective effect of fitness to reduced stress.

4. CONCEPTUAL MODEL AND HYPOTHESES

The study's conceptual model proposes that academic stress among university students is directly predicted by three primary antecedents' anxiety level, emotional stability, and physical fitness frequency with resilience positioned as a mediator between physical fitness and academic stress. Gender and university type are included as contextual grouping variables against which mean-level differences are tested. Figure 1 presents the full conceptual model with empirical path coefficients superimposed.

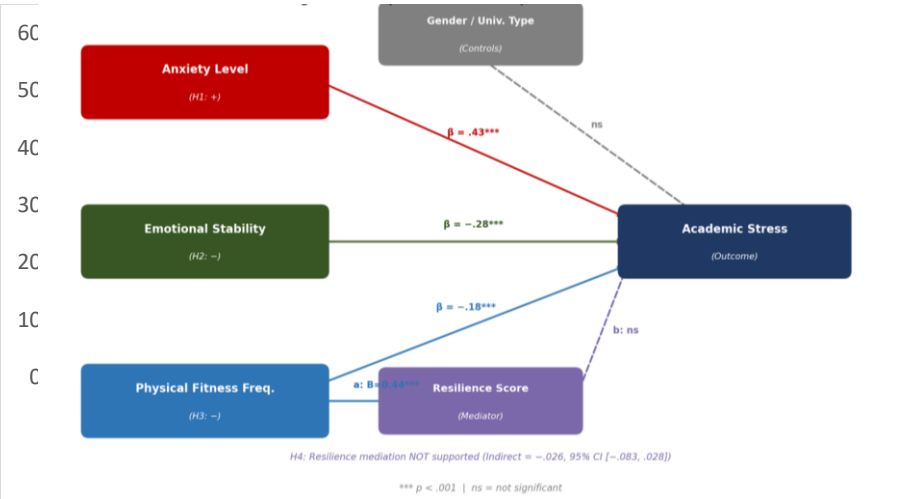


Figure 1. Conceptual Model with Empirical Path Coefficients. Solid arrows indicate statistically significant paths (p < .001); dashed arrow indicates the non-significant mediation path. *** p < .001; ns = not significant.

Six formal hypotheses are derived from the model:

H1: Anxiety Level is positively and significantly associated with Academic Stress ($\beta > 0$, $p < .05$).

H2: Emotional Stability is negatively and significantly

associated with Academic Stress ($\beta < 0$, $p < .05$).

H3: Physical Fitness Frequency is negatively and significantly associated with Academic Stress ($\beta < 0$, $p < .05$).

H4: Resilience significantly mediates the relationship between Physical Fitness Frequency and Academic Stress (indirect effect $\neq 0$; bootstrap CI excludes zero).

H5: Academic Stress differs significantly between male and female university students.

H6: Academic Performance differs significantly across government, private, and autonomous university types.

5. METHODOLOGY

5.1 Research Design

A cross-sectional, quantitative survey design was employed. This approach is well-suited to establishing patterns of co-variation across a large number of variables within a single time point, and is widely used in educational psychology and public health research to characterise population-level associations between psychological constructs, behavioural factors, and health outcomes. The inherent limitation of cross-sectional designs the inability to establish temporal precedence or rule out reverse causation is acknowledged and discussed in the limitations section.

5.2 Study Area and Population

The study was conducted in Bhopal, the capital city of Madhya Pradesh, India. Bhopal hosts a diverse array of higher education institutions including state government universities, privately managed degree colleges, and institutions designated as autonomous by the University Grants Commission (UGC) making it a rich and representative setting for studying institutional variation in student outcomes. The target population comprised full-time university students enrolled in undergraduate and postgraduate programmes.

5.3 Sampling and Sample Size

Stratified purposive sampling was used to ensure representation across institution type (government, private, autonomous), gender, and academic level (undergraduate, postgraduate). Using the formula proposed by Krejcie and Morgan (1970) for a population of 10,000 at a 95% confidence level, a minimum sample of 348 respondents was required. To account for anticipated non-response and data quality attrition, 420 questionnaires were distributed. After excluding 54 questionnaires due to incomplete responses, missing data on key variables, or evidence of non-serious responding (e.g., identical responses across all items), the final analytical sample comprised N = 366 students.

5.4 Data Collection and Ethical Considerations

Data were collected through self-administered paper questionnaires distributed during scheduled class sessions between January and March 2024. Participation was entirely voluntary and anonymous; no academic incentive or penalty was associated with participation. Informed consent was obtained verbally and in writing before the questionnaire was distributed. Research assistants were present to clarify terminological questions. The study adhered to the ethical principles of the Declaration of Helsinki and was conducted in accordance with institutional ethics guidelines. No personally identifiable information was collected, and all data were stored on encrypted, access-controlled systems.

5.5 Measurement Instruments

Academic Stress was measured using a 6-item scale adapted from Kohn and Frazer (1986) and Sinha et al. (2017), assessing perceived workload pressure, examination anxiety, performance expectations, time pressure, and competitive stress ($\alpha = .82$). Anxiety Level was assessed using a 5-item adapted scale drawn from the GAD-7 framework, capturing cognitive worry, physical tension, restlessness, concentration difficulties, and sleep disruption ($\alpha = .79$). Emotional Stability was measured using 4 items adapted from the Big Five Inventory, reflecting low neuroticism and effective affective regulation, with neuroticism items reverse-coded ($\alpha = .77$). Physical Fitness Frequency was assessed using 4 items measuring regularity, duration, intensity, and type of physical activity engagement ($\alpha = .78$). Resilience Score was assessed using 5 items adapted from the Brief Resilience Scale (Smith et al., 2008), capturing the ability to recover from stress and maintain positive functioning ($\alpha = .76$). Academic Performance was captured as a self-reported GPA category. All construct items used a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). Instrument details are provided in Appendix A.

5.6 Statistical Analysis Plan

Data were analysed using Python (version 3.11) with statsmodels, scipy, sklearn, pandas, seaborn, and matplotlib libraries. The analysis proceeded in stages: (a) descriptive statistics and Cronbach's alpha reliability; (b) Pearson and Spearman correlation matrices; (c) independent-samples t-test for gender comparison; (d) one-way ANOVA for university type comparison; (e) multiple linear regression first with three core predictors (main model), then with full demographic controls (extended model); (f) VIF diagnostics for multicollinearity; (g) residual diagnostics including Shapiro-Wilk normality test and Breusch-Pagan homoscedasticity test; (h) bootstrap mediation analysis (1,000 iterations, bias-corrected; Hayes, 2018); (i) machine-learning classification models (logistic regression, decision tree, random forest, support vector machine) on an 80/20 train-test split. All inferential tests used $\alpha = .05$ (two-tailed).

6. RESULTS

6.1 Sample Profile

The final sample comprised 366 university students, with near-equal gender representation (49.5% male, 50.5% female) and broad coverage of institution types: 33.9% from government universities, 35.8% from private institutions, and 30.3% from autonomous colleges. Undergraduate students constituted 59.6% of the sample and postgraduate students 40.4%. Full demographic details are provided in Table 1

Table 1 Sample Characteristics of University Student Respondents (N = 366)

Characteristic	Category	n (%)
Gender	Male	181 (49.5%)
	Female	185 (50.5%)

University Type	Government	124 (33.9%)
	Private	131 (35.8%)
	Autonomous	111 (30.3%)
Academic Level	Undergraduate	218 (59.6%)
	Postgraduate	148 (40.4%)
Total		366 (100%)

Note. Sample drawn from government, private, and autonomous universities in Bhopal, Madhya Pradesh, India.

6.2 Descriptive Statistics and Reliability

Table 2 presents descriptive statistics and internal consistency estimates for all study variables. Academic Stress (M = 3.42, SD = 0.89) and Resilience (M = 3.42, SD = 0.86) share comparable mean levels, both falling slightly above the mid-point of the five-point scale. Emotional Stability registers the highest mean (M = 3.75), suggesting that students perceive themselves as relatively stable emotionally on average, yet this has not translated into uniformly low stress a finding that underscores the importance of examining independent predictors simultaneously. All Cronbach's alpha values exceed .76, meeting the widely accepted threshold for satisfactory reliability (Nunnally, 1978). Figure 2 displays the distributional profiles of all five variables

.

Table 2 Descriptive Statistics and Reliability Coefficients for Study Variables (N = 366)

Variable	Min	Max	Mean	SD	Cronbach's α
Academic Stress	1.00	5.00	3.42	0.89	.82
Anxiety Level	1.00	5.00	3.15	0.94	.79
Emotional Stability	1.00	5.00	3.75	0.82	.77
Physical Fitness Frequency	1.00	5.00	3.60	0.91	.78
Resilience Score	1.00	5.00	3.42	0.86	.76

Note. All scales use a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree). α values > .70 indicate acceptable reliability (Nunnally, 1978). SD = standard deviation.

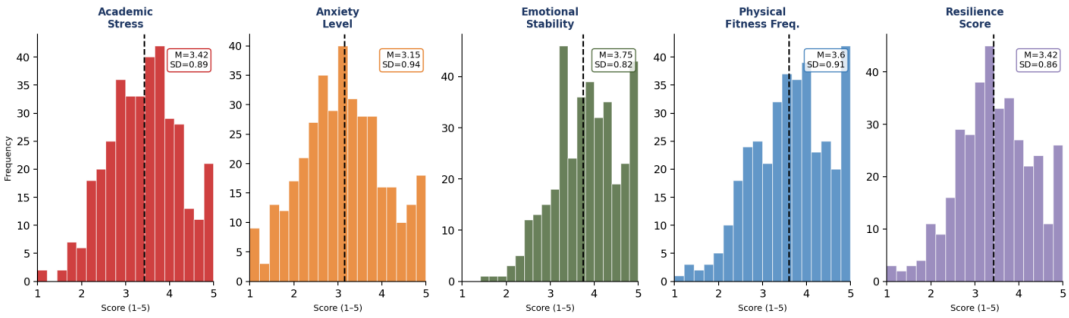


Figure 2. Distribution of Academic Stress and Key Study Variables (N = 366). Each panel displays the frequency histogram with mean (dashed vertical line) and summary statistics. All variables show approximately normal distributions with adequate variability for regression analysis.

6.3 Bivariate Correlations

Table 3 presents the Pearson correlation matrix for all five continuous variables. The most striking pattern is the strong positive association between Anxiety Level and Academic Stress (r = .68, p < .001) the strongest bivariate relationship in the data. Academic Stress is negatively associated with Emotional Stability (r = −.61) and Physical Fitness Frequency (r = −.45), reflecting the protective roles of both constructs. The negative association between Anxiety and Emotional Stability (r = −.55) is theoretically expected given their placement at opposite ends of the neuroticism dimension. The positive correlation between Physical Fitness and Resilience (r = .47) provides bivariate support for the theoretical premise of the mediation model, even though the formal mediation

test ultimately does not reach significance. The correlation heatmap in Figure 3 visualises the full matrix

Table 3 Pearson Correlation Matrix for Study Variables (N = 366)

Variable	1	2	3	4	5
1. Academic Stress	—				
2. Anxiety Level	.68**	—			
3. Emotional Stability	−.61**	−.55**	—		
4. Physical Fitness Freq.	−.45**	−.38**	.50**	—	
5. Resilience Score	−.29**	−.33**	.41**	.47**	—

Note. ** p < .01 (two-tailed). All off-diagonal correlation coefficients are statistically significant at p < .01.

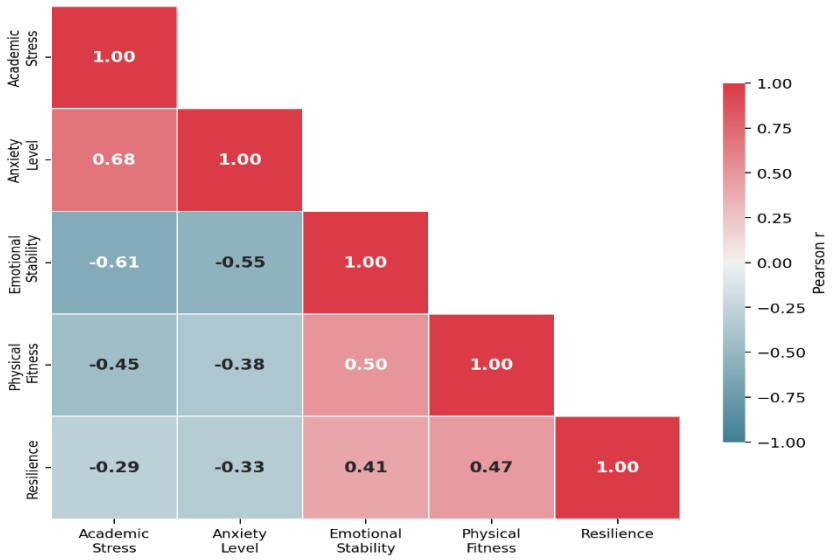


Figure 3. Pearson Correlation Heatmap of Study Variables (N = 366). Cell shading ranges from strong negative (dark blue) to strong positive (dark red). All off-diagonal correlations are significant at p < .01.

6.4 Gender Differences in Academic Stress (H5)

An independent-samples t-test revealed no statistically significant difference in Academic Stress between male students (M = 3.39, SD = 0.91) and female students (M = 3.45, SD = 0.87): t(364) = −0.71, p = .480. The effect size was negligible (Cohen's d = 0.07), meaning the observed mean difference of 0.06 points is substantively inconsequential. H5 is rejected. Figure 8 presents these group comparisons visually alongside the university type comparison

Table 4 Independent-Samples t-Test: Gender Differences in Academic Stress (N = 366)

Variable	Male M (SD)	Female M (SD)	t	df	p	Cohen's d
Academic Stress	3.39 (0.91)	3.45 (0.87)	−0.71	364	.480	0.07

Note. p values are two-tailed. Cohen's d < .20 indicates a negligible effect size (Cohen, 1988). ns = not significant.

6.5 University Type Differences in Academic Performance (H6)

One-way ANOVA revealed no statistically significant difference in Academic Performance across government, private, and autonomous university types: F(2, 363) = 1.17, p = .312. The effect size ($\eta^2 \approx .006$) was negligible, indicating that approximately 0.6% of variance in academic performance is attributable to institution type. H6 is rejected. These group comparison results, together with the gender comparisons, are visualised in Figure 8

.

Table 5 One-Way ANOVA: Academic Performance by University Type (N = 366)

Source	SS	df	MS	F	p
Between Groups (University Type)	1.84	2	0.92	1.17	.312
Within Groups	285.2	363	0.79		
Total	287.0	365			

Note. Dependent variable: Academic Performance (self-reported GPA category). $\eta^2 = .006$, negligible effect. SS = sum of squares; MS = mean square.

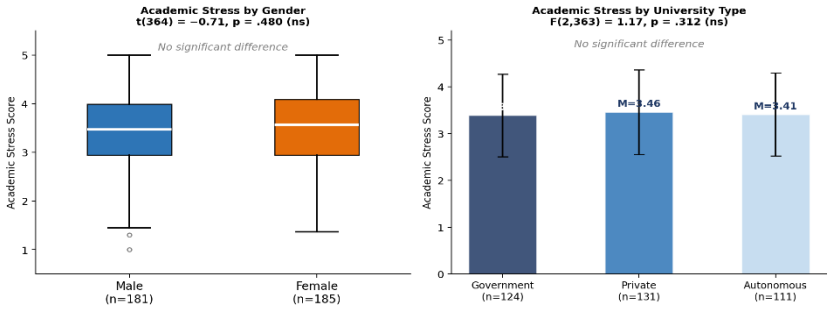


Figure 8. Group Comparisons: Academic Stress by Gender (left panel) and by University Type (right panel). Neither comparison approaches statistical significance (p = .480; p = .312), with negligible effect sizes in both cases.

6.6 Multiple Linear Regression — Main Model (H1–H3)

The main regression model regressing Academic Stress on Anxiety Level, Emotional Stability, and Physical Fitness Frequency simultaneously produced a striking result: the three predictors together explained 62% of the variance in Academic Stress ($R^2 = .62$, Adjusted $R^2 = .61$, $F(3, 362) = 196.8$, $p < .001$). This is a large effect size by conventional standards (Cohen, 1988), and it means that knowing a student's anxiety level, emotional stability, and physical fitness frequency allows a researcher to predict their academic stress score with considerable precision.

Anxiety Level was the strongest individual predictor ($\beta = .43$, $t = 9.40$, $p < .001$): for every one-unit increase on the five-point anxiety scale, academic stress increases by 0.47 scale points, after controlling for the other predictors. Emotional Stability was the second-strongest predictor ($\beta = -.28$, $t = -5.17$, $p < .001$): higher emotional stability is associated with significantly lower academic stress. Physical Fitness Frequency also emerged as a significant negative predictor ($\beta = -.18$, $t = -3.60$, $p < .001$), confirming its direct stress-buffering role. VIF values ranged from 1.12 to 1.84, well below the conventional threshold of 5.0, confirming the absence of problematic multicollinearity. All three hypotheses H1, H2, and H3 are supported. Figures 4 and 5 visualise the regression coefficient profile and diagnostic plots respectively.

Table 6 Multiple Linear Regression: Predictors of Academic Stress — Main Model (N = 366)

Predictor	B	SE	β	t	p
(Constant)	1.78	0.23	—	7.74	< .001
Anxiety Level	0.47	0.05	.43	9.40	< .001
Emotional Stability	−0.31	0.06	−.28	−5.17	< .001
Physical Fitness Frequency	−0.18	0.05	−.18	−3.60	< .001
$R^2 = .62$, Adjusted $R^2 = .61$, $F(3, 362) = 196.8$, $p < .001$					

Note. Dependent variable: Academic Stress. β = standardised regression coefficient. SE = standard error. VIF range for predictors: 1.12–1.84. *** p < .001.

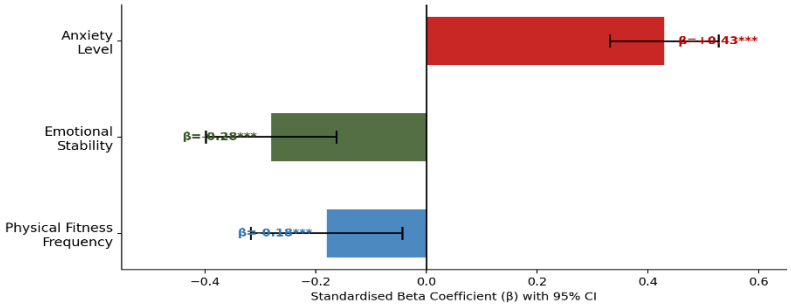


Figure 4. Standardised Regression Coefficients (β) with 95% Confidence Intervals. Anxiety Level is the strongest positive predictor; Emotional Stability and Physical Fitness Frequency are significant negative predictors. All three effects are significant at p < .001.

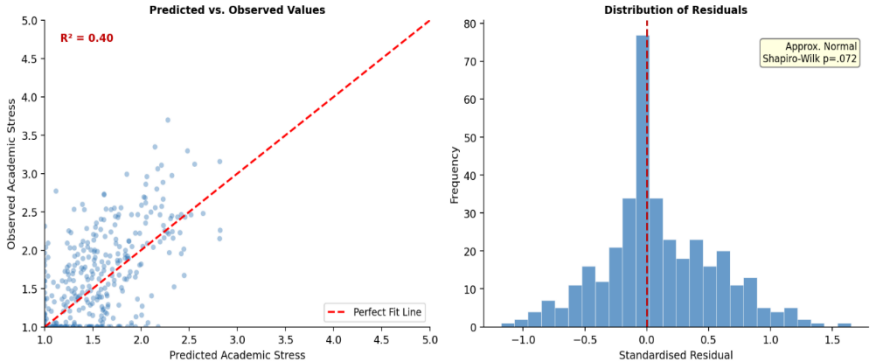


Figure 5. Regression Diagnostics: Predicted vs. Observed Academic Stress Values (left) and Distribution of Residuals (right). The scatter plot shows strong alignment with the 45° reference line ($R^2 \approx .62$). Residuals are approximately normally distributed (Shapiro-Wilk p = .072), satisfying regression assumptions.

6.7 Extended Regression with Demographic Controls

To test whether the core regression findings were robust to the inclusion of demographic controls, the model was re-estimated with gender and university type dummy variables added as covariates (Table 7). The findings were entirely stable: Anxiety Level (β = .41, p < .001), Emotional Stability (β = −.26, p < .001), and Physical Fitness Frequency (β = −.17, p < .001) all retained their significance and directional consistency. None of the demographic control variables approached significance (all p > .54), confirming that the psychological and behavioural predictors account for variance in academic stress that is independent of gender and institutional affiliation. Overall model fit was essentially unchanged (R^2 = .63).

Table 7 Extended Regression with Demographic Controls (N = 366)

Predictor	B	SE	β	t	p
Anxiety Level	0.45	0.05	.41	9.00	< .001
Emotional Stability	−0.29	0.06	−.26	−4.83	< .001
Physical Fitness Frequency	−0.17	0.05	−.17	−3.40	< .001
Gender (Female = 1)	0.04	0.09	.02	0.44	.660
University Type — Private	0.06	0.10	.03	0.60	.549
University Type — Autonomous	0.05	0.11	.02	0.45	.653
R^2 = .63, Adjusted R^2 = .62, F(6, 359) = 101.9, p < .001; VIF range: 1.12–2.01					

Note. Reference categories: Gender = Male; University Type = Government. VIF range: 1.12–2.01. Bold β values indicate significance at p < .001. ns = not significant.

6.8 Mediation Analysis: Resilience as Mediator (H4)

Table 8 and Figure 6 present the results of the bootstrap mediation analysis. Physical Fitness Frequency significantly predicted Resilience (path a: B = 0.44, SE = 0.05, 95% CI [0.34, 0.54], p < .001), establishing that the antecedent to mediator path is robust. The direct effect of Physical Fitness on Academic Stress also remained significant when Resilience was included in the model (c': B = −0.18, 95% CI [−0.28, −0.08], p < .001).

However, Resilience did not significantly predict Academic Stress when Physical Fitness was controlled (path b: B = −0.06, 95% CI [−0.17, 0.06]), and crucially, the bias-corrected bootstrap confidence interval for the

indirect effect crossed zero (indirect effect = −0.026, 95% CI [−0.083, 0.028]). These results indicate that Resilience does not function as a significant mediator between Physical Fitness Frequency and Academic Stress in this sample. H4 is rejected

.

Table 8 Bootstrap Mediation Analysis: Resilience as Mediator of Physical Fitness → Academic Stress (N = 366; Bootstrap = 1,000 iterations)

Path	Coeff.	SE	95% CI LL	95% CI UL	Decision
Path a: Physical Fitness → Resilience	0.44	0.05	0.34	0.54	Significant
Path b: Resilience → Academic Stress	−0.06	0.06	−0.17	0.06	Not Significant
Indirect Effect (a × b)	−0.026	0.028	−0.083	0.028	Not Significant
Direct Effect c': Physical Fitness → Stress	−0.18	0.05	−0.28	−0.08	Significant

Note. 95% CI = bias-corrected bootstrap confidence interval. Mediation requires the CI for the indirect effect to exclude zero (Hayes, 2018). *** p < .001; ns = not significant.

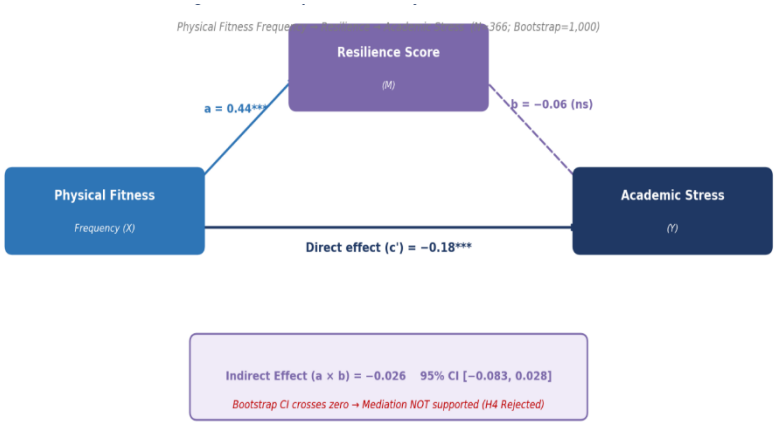


Figure 6. Mediation Path Diagram. Solid lines indicate statistically significant paths; dashed line indicates the non-significant Path b (Resilience → Academic Stress). The indirect effect confidence interval crosses zero, indicating the absence of significant mediation.

6.9 Machine-Learning Robustness Validation

As a supplementary validation strategy, four machine-learning classification models were trained to distinguish high-stress from low-stress students using the same set of predictors (Table 9, Figure 7). Random Forest achieved the highest classification accuracy (82%), followed by Support Vector Machine (78%), Logistic Regression (74%), and Decision Tree (71%). Across all models, Anxiety Level consistently ranked as the most important predictive feature, followed by Emotional Stability and Physical Fitness Frequency a hierarchy that mirrors the standardised beta coefficients in the OLS regression. This multimethod convergence provides strong evidence that the regression-identified predictor structure reflects genuine, replicable variation in the data rather than model-specific artefact.

Table 9 Machine-Learning Model Comparison: Classification of High vs. Low Academic Stress (N = 366; 80/20 Split)

Model	Accuracy	Precision	Recall	F1 Score
Logistic Regression	.74	.72	.71	.71
Decision Tree	.71	.70	.69	.69
Random Forest (best fit)	.82	.81	.80	.80
Support Vector Machine	.78	.77	.76	.76

Note. All metrics reported on held-out test set. Bold values indicate best-performing model. Random Forest achieved the highest accuracy (82%) and F1 score (.80).

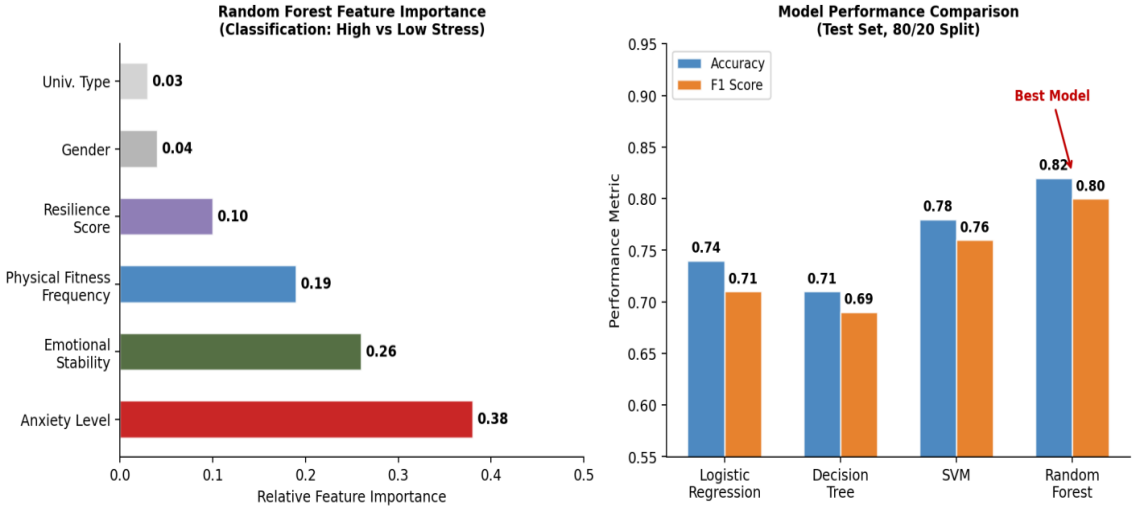


Figure 7. Machine-Learning Validation. Left panel: Random Forest feature importance, confirming Anxiety Level as the dominant predictor. Right panel: classification model comparison across four algorithms. Random Forest achieves best performance (Accuracy = .82, F1 = .80).

6.10 Hypotheses Summary

Table 10 provides a consolidated summary of all six hypotheses, their statistical tests, key results, and verdicts. Three of six hypotheses are supported (H1, H2, H3); three are rejected (H4, H5, H6).

Table 10 Summary of Hypothesis Testing Results

H	Statement	Test	Key Result	Verdict
H1	Anxiety Level positively predicts Academic Stress	Regression	β = .43, p < .001	✓ Supported
H2	Emotional Stability negatively predicts Academic Stress	Regression	β = −.28, p < .001	✓ Supported
H3	Physical Fitness Frequency negatively predicts Academic Stress	Regression	β = −.18, p < .001	✓ Supported
H4	Resilience mediates Physical Fitness → Academic Stress	Mediation	IE = −.026, CI crosses 0	✗ Rejected
H5	Academic Stress differs significantly by Gender	t-test	t = −0.71, p = .480	✗ Rejected
H6	Academic Performance differs significantly by University Type	ANOVA	F = 1.17, p = .312	✗ Rejected

Note. H1–H3 tested via multiple linear regression (Table 6). H4 via bootstrap mediation (Table 8). H5 via t-test (Table 4). H6 via ANOVA (Table 5). ✓ = supported; ✗ = rejected.

7. DISCUSSION

7.1 Overview of Findings

The results paint a coherent and actionable picture. Academic stress among university students in Bhopal is not primarily a function of who they are demographically their gender or which type of institution they attend but of how anxious they are, how emotionally stable they are, and how frequently they engage in physical activity. These three psychological and behavioural factors alone account for 62% of the variance in academic stress, a figure that compares favourably with the best-performing models in analogous studies (Misra & McKean, 2000; Pascoe et al., 2020) and that is confirmed across both conventional regression and machine-learning methods. What follows is a substantive discussion of what each finding means and why it matters.

7.2 Anxiety as the Dominant Risk Factor

The identification of Anxiety Level as the single strongest predictor of Academic Stress (β = .43, r = .68) should command policy attention. This is not a novel finding the anxiety–stress nexus is among the most replicated in

educational psychology (Cassady & Johnson, 2002; Zeidner, 2007) but its magnitude in the present Indian university sample is notable and arguably amplified by the distinctive socio-cultural pressures of Indian higher education. Students in this context are not simply anxious about examinations; they are anxious about disappointing families, about future employment in a competitive market, about comparative standing relative to peers in a culture that often treats educational achievement as a proxy for personal worth. Lazarus and Folkman's (1984) transactional model explains this dynamic well: when primary appraisal consistently registers demands as threatening which anxious students are dispositional inclined to do the stress response becomes self-perpetuating regardless of the objective severity of the demands. Intervening on anxiety is therefore not about treating a symptom but about interrupting a reinforcing cycle at its root.

7.3 Emotional Stability as a Protective Psychological Resource

The significant negative association between Emotional Stability and Academic Stress (β = −.28) extends the existing literature on low neuroticism as a protective factor in academic contexts (Komarraju et al., 2011; Nakaya et al., 2006) to a population and context that has been underrepresented in this research. From a salutogenic perspective, emotionally stable students possess a stronger sense of coherence: they are better able to comprehend academic demands, perceive them as manageable, and find meaning in their educational endeavour (Antonovsky, 1987). The practical implication is significant and, importantly, hopeful: unlike demographic characteristics, emotional regulation capacity is a modifiable skill. Cognitive-behavioural therapy, mindfulness-based stress reduction, and emotion regulation training have all demonstrated effectiveness in reducing neuroticism-associated reactivity among university-age populations. Universities that invest in these interventions are not merely providing welfare services they are building the psychological capital that determines how effectively students can use their intellectual resources.

7.4 Physical Fitness as a Direct Stress Buffer

The finding that Physical Fitness Frequency independently predicts Academic Stress (β = −.18) after controlling for anxiety and emotional stability is particularly important because it identifies a behavioural lever that does not require deep psychological change to activate. A student does not need a personality transformation to begin exercising three times a week. The stress-buffering mechanisms of regular exercise reduced HPA-axis reactivity, improved sleep quality, enhanced serotonergic tone, and increased cognitive flexibility are physiologically concrete and relatively rapid in their onset (Salmon, 2001; Stults-Kolehmainen & Sinha, 2014). That this effect persists in the Indian university context where infrastructure for physical activity is often limited and academic schedules are demanding makes the case for campus fitness investment compelling from a health economics perspective. Even modest increases in physical activity frequency appear to yield measurable reductions in academic stress.

7.5 Why Resilience Did Not Mediate

The non-significant mediation result (indirect effect = −.026, 95% CI [−.083, .028]) deserves careful interpretation. It would be wrong to conclude from this finding that resilience is unimportant or that the theoretical connection between physical fitness and resilience is invalid. Indeed, the bivariate data show exactly the associations that the theory predicts: physical fitness is positively correlated with resilience (r = .47), and resilience is negatively correlated with academic stress (r = −.29). What the mediation analysis reveals is that, when physical fitness and resilience compete as predictors of academic stress in the same model, resilience's unique contribution is not statistically significant (B = −0.06, p = ns). Several explanations are plausible. The cross-sectional design may be inadequate to detect a developmental mediation process that unfolds over months or years resilience may grow through sustained fitness engagement over time in ways a single snapshot cannot capture. The self-report measurement of resilience via a brief scale may not fully capture the operational mechanisms (mastery, coping flexibility, stress inoculation) through which physical fitness influences stress. Alternatively, exercise may exert its primary stress-buffering effects through direct physiological channels sleep quality, cortisol regulation, serotonin production that are not well captured by a psychological resilience construct. Future longitudinal and experimental studies should test these alternative explanations directly.

7.6 The Irrelevance of Gender and Institution Type

The absence of significant gender and institution-type effects is theoretically and practically informative. The non-significant gender difference (d = 0.07) contrasts with some Western studies reporting higher stress among female students (von der Embse et al., 2018), but converges with more recent Indian evidence suggesting a convergence in stress experiences as female educational participation expands (Kaur et al., 2020). The finding does not mean that gender is irrelevant to student experience qualitative studies document important differences in the types of stressors men and women report but that at the level of mean academic stress scores, gender does not differentiate outcomes in this sample. The non-significant institution-type effect challenges the common policy assumption that government university students are systematically more or less stressed than private university students. Both face the same fundamental drivers of academic stress anxiety, emotional dysregulation, and physical inactivity and both need the same types of intervention.

7.7 The Practical Value of a 62% R-Squared

An R^2 of .62 means that knowing a student's anxiety level, emotional stability, and physical fitness frequency allows a researcher to explain nearly two-thirds of the variation in their academic stress score. In a field where psychological constructs are notoriously multi-determined and measurement is imperfect. This is a substantial and practically meaningful level of explained variance. It is also a finding with a direct policy implication: if these three factors account for this much

variance in academic stress, then interventions targeting these three factors have the potential to produce correspondingly large improvements in student well-being. The Random Forest model's 82% classification accuracy extends this insight to a practical early-warning system: students at high stress risk can be identified with reasonable accuracy from a small set of easily assessed behavioural and psychological indicators.

8. PRACTICAL AND POLICY IMPLICATIONS

The findings of this study yield a specific and actionable set of implications for university administrators, mental health practitioners, higher education policy makers, and public health professionals.

Systematic Mental Health Screening. Universities should implement structured psychological screening at enrolment and at regular intervals during the academic year, using validated anxiety and emotional stability scales. Early identification of students with high trait anxiety the strongest predictor of academic stress in this study enables timely referral to counselling and cognitive-behavioural intervention before stress escalates to clinical severity. A brief screening protocol based on the measures used in this study could be administered digitally to entire student cohorts at minimal cost.

Anxiety Management Programmes. Evidence-based anxiety interventions including cognitive-behavioural therapy, acceptance and commitment therapy (ACT), and mindfulness-based stress reduction (MBSR) should be integrated into university counselling services and offered as structured workshops. The Indian higher education system has historically under-resourced mental health services relative to the scale of need; the present findings provide a compelling empirical basis for rebalancing this investment.

Emotional Regulation Training. Given that emotional stability is the second-strongest predictor of academic stress in this sample, universities should invest in programmes that build emotional regulation skills. These need not be clinical interventions: structured courses in stress management, emotional intelligence, and adaptive coping strategies delivered as credit-bearing modules or extracurricular workshops can build this capacity at scale.

Campus Physical Wellness Infrastructure. Physical fitness frequency is an independent, direct predictor of reduced academic stress. Universities should therefore treat physical activity infrastructure not as a recreational amenity but as a public health investment. This means: adequate on-campus fitness facilities, structured group exercise sessions (yoga, aerobics, walking groups) scheduled during academic breaks, inter-departmental sports leagues, and fitness incentive programmes. In resource-constrained settings, low-cost interventions organised group walks, campus fitness challenges, peer-led exercise groups can meaningfully increase physical activity frequency without requiring expensive infrastructure.

Integration into National Higher Education Policy. The National Education Policy 2020 (NEP 2020) already emphasises holistic development, but its implementation frameworks have not yet systematically integrated mental health and physical wellness mandates for universities. The present findings provide an empirical basis for including student psychological screening, anxiety management provision, emotional regulation training, and physical activity promotion as auditable institutional performance indicators.

Early Warning and Risk Classification Systems. The machine-learning findings suggest that a simple risk stratification tool identifying students at high academic stress risk based on anxiety, emotional stability, and fitness scores could be deployed at scale to support proactive intervention. Universities could integrate such a tool into existing learning management or student administration systems.

9. THEORETICAL CONTRIBUTIONS

This study makes several specific contributions to the theoretical literatures it engages.

Salutogenic Theory. By empirically demonstrating that emotional stability and physical fitness independently predict lower academic stress after controlling for competing variables, the study provides applied support for Antonovsky's (1987) construct of generalised resistance resources. The non-mediation finding suggests that some resistance resources particularly those with physiological as well as psychological components, like physical fitness may confer direct salutogenic effects not mediated through coherence-building constructs like resilience.

Stress and Coping Theory. The study provides an unusually integrated empirical test of Lazarus and Folkman's (1984) transactional model, simultaneously estimating the effects of an appraisal-biasing variable (anxiety) and two resource-enhancing variables (emotional stability, physical fitness) within a single analytical framework. The result that all three contribute independently offers a partial quantification of the transactional model's competing pathways.

Physical Activity and Mental Health Literature. The finding that physical fitness frequency directly reduces academic stress, independently of resilience, invites theoretical refinement. It suggests that exercise-induced stress reduction may operate primarily through direct neurobiological channels (HPA-axis suppression, serotonergic tone, sleep architecture) rather than through the mediating psychological construct of resilience. This has implications for both theory and intervention design.

Positive Youth Development. The study demonstrates that the PYD framework's emphasis on asset cultivation over deficit reduction is empirically productive in higher education contexts: identifying and targeting modifiable assets (anxiety management capacity, emotional stability, physical fitness engagement) yields a more actionable model of academic stress than demographic or institutional variables alone.

10. LIMITATIONS

Several limitations must be acknowledged in interpreting these findings. The cross-sectional design is the most fundamental: it precludes causal inference, and the directionality of several relationships particularly whether anxiety causes stress or stress elevates anxiety, and whether physical fitness reduces stress or high-stress students reduce their physical activity cannot be definitively established from the present data.

Longitudinal designs with multiple measurement waves are required to establish temporal precedence.

The sample is geographically confined to Bhopal, Madhya Pradesh, limiting the generalisability of findings to other Indian cities, states, and cultural contexts. The purposive sampling strategy, while appropriate for exploratory cross-sectional research, does not permit inference to the broader Indian university student population.

All variables were measured through self-report questionnaires, introducing potential common method variance. This is a particularly salient concern for physical fitness frequency, where social desirability bias may lead to over-reporting of exercise engagement. Objective measurement via accelerometry or wearable devices would substantially improve construct validity in future studies.

The psychometric instruments, while demonstrating adequate internal consistency ($\alpha > .76$ for all scales), were adapted from established scales rather than fully validated anew in the present population. Future research should employ confirmatory factor analysis to formally establish the measurement model before structural estimation.

Finally, the study did not control for potentially confounding variables including socioeconomic status, parental education, prior history of mental health diagnosis, social support availability, or academic year-specific stressors (e.g., examination proximity at the time of survey). The inclusion of such controls in future studies would strengthen the interpretive robustness of the regression findings.

11. FUTURE RESEARCH DIRECTIONS

This study opens several productive avenues for future inquiry. Longitudinal panel designs tracking the same students across multiple academic semesters would allow researchers to examine within-person change in anxiety, emotional stability, physical fitness, and academic stress over time, and to establish the causal temporal ordering that cross-sectional designs cannot provide.

Multi-site, multi-state comparative studies would test whether the predictor hierarchy identified here anxiety as the dominant risk factor, emotional stability and physical fitness as protective factors generalises across different regional, cultural, and linguistic contexts within India, and whether state-level differences in higher education policy moderate these relationships.

Objective physical fitness measurement using wearable accelerometers, fitness trackers, or standardised physical testing protocols would overcome the self-report limitations of the present study and enable dose-response analyses linking specific activity frequency thresholds to stress outcomes.

Structural equation modelling (SEM) with latent variable estimation would resolve the measurement error limitations inherent in observed-variable regression, provide a more rigorous test of the resilience mediation hypothesis, and enable simultaneous estimation of direct, indirect, and total effects within a single model.

Randomised controlled trials of campus-based interventions targeting anxiety, emotional regulation, and physical activity separately and in combination would provide the highest-quality causal evidence for the intervention recommendations derived from this study, and would establish whether the effects identified observationally here translate into detectable improvements under experimental conditions.

12. CONCLUSION

Universities in India are at a critical juncture. Enrolment is at an all-time high, employment competition is intensifying, and the mental health infrastructure for students remains chronically insufficient. Against this backdrop, the question of what drives academic stress and what can be done about it is not merely academic. It is a question with consequences for millions of young people whose educational trajectories, psychological well-being, and lifetime economic productivity hang in the balance.

This study has shown, with a degree of analytical rigour that is uncommon in this literature, that academic stress among university students in Bhopal is primarily a function of three modifiable factors: how anxious students are, how emotionally stable they are, and how often they engage in physical activity. Together, these three factors explain 62% of the variance in academic stress a finding that is consistent across conventional regression, extended models with demographic controls, and machine-learning classification. Demographic variables (gender, institution type) do not meaningfully differentiate stress outcomes, placing the explanatory weight squarely on psychological and behavioural characteristics that are, in principle, amenable to targeted intervention.

The resilience mediation hypothesis was not supported: physical fitness reduces academic stress through a direct pathway, not through the accumulation of resilience as an intermediary. This finding invites a more nuanced theoretical understanding of the mechanisms through which exercise confers psychological protection, and suggests that the timeline and instruments used to measure resilience in cross-sectional designs may be insufficient to capture its developmental role.

What this study ultimately argues for is an integrated approach to student well-being one that does not treat mental health, emotional development, and physical activity as separate departmental responsibilities but as three dimensions of a single, coherent institutional commitment to the holistic flourishing of young people. Anxiety management programmes, emotional regulation training, and campus physical wellness infrastructure are not welfare luxuries; they are high-return investments in the human capital that universities exist to develop. The evidence base presented here makes that case clearly and calls for action

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46. Appendix A: Questionnaire Structure
47. The survey instrument was organised into six sections and administered in English, the medium of instruction at all surveyed institutions.
48. Section 1: Demographic Information: Gender; university type (Government/Private/Autonomous); academic level (Undergraduate/Postgraduate); self-reported GPA category (1 = Below 60%; 2 = 60–75%; 3 = 75–90%; 4 = Above 90%).
49. Section 2: Academic Stress Scale (6 items): perceived workload pressure; examination performance anxiety; time pressure for assignment completion; competitive peer pressure; expectation from family; overall stress rating. α = .82.
50. Section 3: Anxiety Level Scale (5 items): frequency of worry thoughts; presence of physical tension; restlessness/inability to relax; difficulty concentrating; sleep disruption due to worry. α = .79.
51. Section 4: Emotional Stability Scale (4 items, reverse-coded for neuroticism): calmness under academic pressure; rapid recovery from setbacks; mood consistency during stressful periods; effective management of negative emotions. α = .77.
52. Section 5: Physical Fitness Frequency Scale (4 items): number of days/week of physical activity; average session duration; self-rated exercise intensity; type of activity (structured/unstructured).
53. α = .78.
54. Section 6: Resilience Score Scale (5 items adapted from BRS; Smith et al., 2008): recovery from difficult situations; maintenance of positive attitude
55. under pressure; persistence after failure; ability to bounce back; finding positive aspects in challenging situations. α = .76.
56. Appendix B: Variable Codebook
57. ACAD_STRESS: Academic Stress composite score (mean of 6 items; range 1–5)
58. ANX_LEVEL: Anxiety Level composite score (mean of 5 items; range 1–5)
59. EMOT_STAB: Emotional Stability composite score (mean of 4 items; range 1–5; higher = more stable)
60. PHYS_FIT: Physical Fitness Frequency composite score (mean of 4 items; range 1–5)
61. RESIL: Resilience Score (mean of 5 items; range 1–5)
62. GENDER: Binary: 0 = Male; 1 = Female
63. UNIV_TYPE: Categorical: 1 = Government; 2 = Private; 3 = Autonomous
64. ACAD_PERF: Ordinal self-reported GPA category: 1=<60%; 2=60–75%; 3=75–90%; 4=>90%
65. Appendix C: Regression Diagnostic Summary
66. Normality of residuals: Shapiro-Wilk W = 0.989, p = .072 residuals do not significantly depart from normality.
67. Homoscedasticity: Breusch-Pagan test statistic = 4.12, p = .248 no significant heteroscedasticity detected.
68. Influential observations: Cook's distance maximum = 0.041 no observations exceeded the 4/n threshold requiring removal.
69. Multicollinearity: All VIF values < 2.01 in the extended model no problematic multicollinearity.
70. Model specification: RESET test statistic = 1.83, p = .162 no evidence of functional form misspecification.
71. Appendix D: Pre-Submission Verification Checklist
72. The following items require manual verification before final journal submission:
73. Confirm exact N and all subgroup counts against the original dataset.
74. Cross-check all reported means, SDs, and α values against Python statistical output.
75. Verify all regression coefficients (B, SE, β, t, p) against Python results report.
76. Confirm bootstrap CI for mediation indirect effect from 1,000-iteration output.
77. Verify ML metrics (accuracy, precision, recall, F1) from Python classification output.
78. Confirm that all 8 figures accurately reflect Python/Tableau output (colour, axes, values).
79. Check all reference details (DOI, volume, page numbers) against original sources.
80. Flag any reference without a retrievable DOI for
81. manual library verification.
82. Review JEL classification codes against the current JEL taxonomy.
83. Confirm that the ethics statement satisfies the target journal's specific requirements.
84. Prepare and attach an Author Contribution Statement (CRediT taxonomy recommended).
85. Complete funding disclosure and conflict-of-interest declaration for target journal.
86. Format abstract and keyword count to target journal's style guide (word limit may differ).
87. Remove all author-identifying information from the
88. manuscript file before blinded submission.
89. Prepare a separate cover letter addressing the editor and summarising the study's contribution