Competency-Based Medical Education and Student Wellness in Andhra Pradesh:A Multicentric Mixed-Methods Study

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IEC Approval: Lr. No. 1661-1680/Chairman-IEC/MIMS/Ethics Approval, dated 14/07/2025

Manuscript type: Original Research | Reporting standard: STROBE + GRAMMS

HOW TO CITE:

Kotakala CMK, Panneerselvam P, Mallika BSB, Shyamala D, Tulasi Madhuri P (2026). Competency-Based Medical Education and Student Wellness in Andhra Pradesh:A Multicentric Mixed-Methods Study. International Journal of Special Education, 41(18s), 1674-1693

ABSTRACT:

Background: India's transition to Competency-Based Medical Education (CBME) under the National Medical Commission (NMC) in 2019 represents the most sweeping reform in undergraduate medical education in decades. While CBME's pedagogical intent is to produce competent, patient-centred physicians, its structural demands — continuous assessment, reflective documentation, longitudinal tracking, and accelerated clinical integration — have raised substantive concerns about student mental health. Empirical multicentric data from Indian medical colleges examining this relationship remain scarce. (1,5,10)

Methods: We conducted a cross-sectional, multicentric, mixed-methods study across five medical colleges in Andhra Pradesh (two government, three private), enrolling 1,064 MBBS students in Phases II, III, and Compulsory Rotating Medical Internship (CRMI) between February and April 2026. Validated instruments included the Perceived Stress Scale-10 (PSS-10), Maslach Burnout Inventory–Student Survey (MBI-SS), Generalized Anxiety Disorder-7 (GAD-7), Patient Health Questionnaire-9 (PHQ-9), and an institution-specific 20-item CBME Perception Survey (Cronbach's $\alpha = 0.956$). Focus group discussions (FGDs) were conducted at all five sites ($n = 35$). Quantitative data were analysed using descriptive statistics, t-tests, ANOVA, Pearson correlation, and multiple linear regression. Qualitative data underwent six-phase reflexive thematic analysis. (16,17,18,21,22,23)

Results: The mean PSS-10 score was 19.74 (±5.52), with 80.6% of students reporting moderate-to-high perceived stress. Clinically significant anxiety (GAD-7 ≥10) was present in 39.7% and depression (PHQ-9 ≥10) in 47.8% of participants. Burnout emotional exhaustion (MBI-EE ≥15) was elevated in 44.0% of students. Female students reported significantly higher stress (PSS: 20.55 vs 18.45, $p < 0.001$), anxiety (8.87 vs 7.93, $p = 0.006$), and emotional exhaustion (14.64 vs 12.57, $p < 0.001$). Private institution students demonstrated consistently higher distress versus government counterparts (all $p < 0.001$). Third-year MBBS students (Phase III Part I) showed peak emotional exhaustion (MBI-EE: 16.11). CBME perception correlated negatively with anxiety ($r = -0.154$) and depression ($r = -0.144$), and positively with academic efficacy ($r = +0.407$; all $p < 0.01$). Five cross-cutting qualitative themes were identified: assessment overload, documentation burden, value of early clinical exposure (ECE), mentorship deficit, and appreciation for AETCOM modules.

Conclusions: CBME implementation in Andhra Pradesh is generating a substantial and measurable wellness burden, particularly at private institutions and during the third year of training. Better CBME perception correlates with lower distress, underscoring the importance of implementation quality. Structural interventions — rationalised assessment schedules, formalised mentorship, and accessible psychological support — are urgently needed to align CBME's educational promise with student well-being.

Keywords: Competency-based medical education; student wellness; burnout; anxiety; depression; CBME perception; medical education India; mixed-methods; MBBS students; Andhra Pradesh

1. Introduction

The landscape of undergraduate medical education in India underwent a fundamental transformation with the National Medical Commission's (NMC) mandatory introduction of the Competency-Based Medical Education (CBME) framework in 2019, anchored in the "Indian Medical Graduate" (IMG) competency document. (1) This reform replaced the traditional teacher-centred, examination-dominated curriculum with a framework designed to develop measurable, role-based competencies across seven IMG roles: clinician, communicator, lifelong learner, leader and member of the healthcare team, professional, advocate, and researcher. (1,2,3) While the philosophical underpinnings of CBME are widely lauded, the operational realities of implementation have created an environment that some scholars have characterised as structurally demanding to the point of adversity. (4,10,11) The CBME framework requires students to participate in frequent formative assessments, maintain detailed logbooks and reflective portfolios, fulfil Attitude, Ethics and Communication (AETCOM) module requirements, engage in early and longitudinal clinical exposure, and undergo skill laboratory training — all within a compressed academic calendar that has not been proportionally expanded. The cumulative psychosocial burden imposed by these concurrent demands on young

adults, many of whom are navigating their first extended periods of separation from family, has received limited empirical investigation in the Indian context. (11,15) Globally, the mental health of medical students has become a recognised public health concern. Systematic reviews and meta-analyses report prevalences of depression ranging from 27% to 30%, anxiety from 28% to 33%, and burnout affecting the majority of students in clinical years. (5,6,7,8) Within India, the few institution-level studies available have reported similarly alarming figures, but multicentric, multi-instrument investigations spanning government and private institutions with integrated qualitative data remain scarce. (9,14,15,39) This gap is particularly significant in the post-2019 CBME era, because the operational demands of this specific curriculum reform have not been mapped against validated wellness outcomes at scale. This study was designed to address that gap. We employed a multicentric, cross-sectional, mixed-methods design encompassing five medical colleges across Andhra Pradesh — two government and three private — to characterise the prevalence and determinants of perceived stress, anxiety, depression, and burnout among MBBS students under the CBME framework, and to integrate these quantitative findings with qualitative perspectives gathered through focus group discussions at each site. The study further examines how students' own perceptions of the CBME curriculum relate to their mental health outcomes, with the hypothesis that implementation quality, rather than CBME per se, is the proximal driver of student distress. (12,28)

1.1 Objectives

The primary objective was to assess the prevalence and severity of perceived stress, anxiety, depression, and burnout among MBBS students across five institutions in Andhra Pradesh operating under the NMC CBME framework. Secondary objectives were to:

- Identify significant sociodemographic and academic predictors of psychological distress;
- Compare wellness outcomes between government and private medical institutions;
- Examine how CBME curriculum perception relates to mental health outcomes across domains;
- Integrate quantitative findings with qualitative focus group data to develop a comprehensive, triangulated account of the CBME–wellness relationship. (22,27)

2. Methods

2.1 Study Design and Setting

This was a cross-sectional, multicentric, mixed-methods study conducted from 19 February 2026 to 29 April 2026. The quantitative and qualitative strands were conducted concurrently, with integration occurring at the interpretation phase using the convergent parallel design described by Creswell and Plano Clark. (22) Study reporting follows the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (21) and the Good Reporting of a Mixed Methods Study (GRAMMS) framework. Five NMC-recognised medical colleges in Andhra Pradesh were purposively selected to maximise institutional diversity: Andhra Medical College (AMC), Visakhapatnam (government, n = 299); Rangaraya Medical College (RMC), Kakinada (government, n = 237); Maharajah's Institute of Medical Sciences (MIMS), Nellimarla, Vizianagaram (private, n = 217); NRI Institute of Medical Sciences (NRIIMS), Visakhapatnam (private, n = 170); and GITAM Institute of Medical Sciences and Research (GIMSR), Visakhapatnam (private, n = 141). Together these institutions represent contrasting administrative structures, geographic contexts, and student intake capacities within a single state implementing a uniform NMC CBME mandate.

2.2 Participants and Eligibility

Inclusion criteria: MBBS students currently enrolled in Phase II, Phase III (Parts I and II), or CRMI at one of the five participating institutions; registered under the NMC CBME

curriculum (batch 2019 onwards); willing to provide voluntary informed consent.

Exclusion criteria: Phase I (1st year) students, who had not yet completed a full CBME assessment cycle; students absent during the survey window; students declining consent.

2.3 Sample Size Justification

The minimum required sample was estimated using the single-proportion formula $n = Z^2 \cdot p(1-p)/d^2$, where $Z = 1.96$ (95% confidence), $p = 0.30$ (estimated prevalence of depression among Indian medical students (7)), and $d = 0.05$ (margin of error), yielding $n = 323$. Applying a design effect of 1.5 for the multicentric cluster structure and a 15% non-response correction, the adjusted minimum was $n = 559$ across all sites. Targeting 200 per institution ($n = 1,000$) provided additional power for subgroup analyses. The final analytical sample of 1,064 exceeded all projections.

2.4 Data Collection Instruments

The survey battery comprised five instruments administered in fixed sequence to minimise order effects: (1) demographic questionnaire; (2) PSS-10; (3) MBI-SS; (4) GAD-7; (5) PHQ-9; and (6) CBME Perception Survey. Survey completion was facilitated outside scheduled teaching hours and not in the presence of faculty. Completed surveys were collected via Google Forms; email addresses captured by the platform were deleted prior to analysis.

2.4.1 Perceived Stress Scale-10 (PSS-10)

A 10-item, 5-point Likert scale (0 = Never to 4 = Very Often) developed by Cohen, Kamarck, and Mermelstein (16) to assess perceived stress over the past month. Items 4, 5, 7, and 8 are reverse-scored. Total scores range 0–40; established cutoffs: 0–13 (low), 14–26 (moderate), 27–40 (high). The PSS-10 demonstrates excellent reliability (Cronbach's $\alpha = 0.78$–0.91) and has been validated in Indian student populations. (16,15)

2.4.2 Maslach Burnout Inventory–Student Survey (MBI-SS)

A 15-item, 7-point frequency scale (0 = Never to 6 = Every Day) developed by Schaufeli et al. (17) assessing three burnout dimensions: Emotional Exhaustion (EE, 5 items), Cynicism (CY, 4 items), and Academic Efficacy (AE, 6 items). Higher EE and CY with lower AE indicate greater burnout. Subscale scores are interpreted independently, consistent with the instrument's theoretical framework. (17,20)

2.4.3 Generalized Anxiety Disorder-7 (GAD-7)

A 7-item, 4-point screener (0 = Not at all to 3 = Nearly every day) developed by Spitzer et al. (18) assessing anxiety over the past two weeks. Severity categories: minimal (0–4), mild (5–9), moderate (10–14), severe (15–21). A threshold of ≥10 has a sensitivity of 89% and specificity of 82% for generalised anxiety disorder. (18)

2.4.4 Patient Health Questionnaire-9 (PHQ-9)

A 9-item, 4-point screener (0–3) assessing depressive symptoms over the past two weeks, with scores ranging 0–27. (19) Severity categories: minimal (0–4), mild (5–9), moderate (10–14), moderately severe (15–19), severe (20–27). PHQ-9 item 9 screens for passive suicidal ideation or self-harm thoughts; endorsement at any frequency (≥1) triggered display of crisis referral information to the participant within the survey itself. (19)

2.4.5 CBME Perception Survey — Development and Psychometric Validation

A 20-item instrument was developed de novo using a three-stage process following DeVellis (30) and Streiner and Norman. (33)

Stage 1 — Item Generation

An initial pool of 32 candidate items was generated through systematic review of the NMC curriculum document (1), AAMC Medical Education Milestones, and the CanMEDS 2015 framework, supplemented by published qualitative studies of CBME student perceptions in South Asian contexts. (10,11) Items covered

the full spectrum of CBME student experience across seven a priori domains.

Stage 2 — Content Validity

The 32-item pool was submitted to a five-member expert panel (three medical education faculty, one community medicine faculty, one medical education fellow). Experts rated each item on a 4-point scale (1 = Not relevant to 4 = Highly relevant). Items with a Content Validity Index (CVI) of ≥0.78 — the threshold recommended by Polit and Beck (29) — were retained; 12 items were removed and two merged, yielding a 20-item draft. The draft was piloted with 25 MBBS students (not included in the main sample) for cognitive readability and comprehension.

Stage 3 — Psychometric Validation (Main Study Sample, N = 1,064)

All items used a 5-point Likert response scale (1 = Strongly Disagree to 5 = Strongly Agree) organised across seven domains: (1) Curriculum Design and Integration (3 items); (2) Teaching–Learning Methods (3 items); (3) Assessment Strategies (3 items); (4) Faculty Support and Mentorship (3 items); (5) Student Engagement and Well-being (3 items); (6) Professional Development (3 items); and (7) Overall Satisfaction (2 items). Total scores were converted to a 0–100 scale for analysis. Psychometric results are summarised in Table 3 and Figure 11.

Internal consistency: Full-scale Cronbach's $\alpha = 0.956$ (excellent (32)). Domain-level α ranged from 0.848 (Teaching–Learning Methods) to 0.924 (Assessment Strategies), all exceeding the accepted threshold of 0.70. (32) Split-half reliability corrected by Spearman-Brown formula: $r = 0.814$, SB = 0.897. Alpha-if-item-deleted analysis confirmed that no single item, when removed, meaningfully increased the overall alpha (maximum change: +0.0002).

Composite Reliability (CR) and Average Variance Extracted (AVE): CR ranged from 0.759 to 0.883 (all ≥0.70). AVE ranged from 0.513 to 0.716 (all ≥0.50), confirming adequate convergent validity at the domain level following the Fornell-Larcker criterion. (31)

Item-total correlations: All 20 corrected item-total correlations exceeded 0.60 (range: 0.640–0.790), well above the recommended minimum of 0.30. (33)

Factor structure: Principal Component Analysis (N = 816 complete cases) identified four components with eigenvalue $\lambda > 1.0$ (Kaiser criterion): Factor 1 ($\lambda = 10.962$, 54.8% variance), Factor 2 ($\lambda = 1.417$, 7.1%), Factor 3 ($\lambda = 1.260$, 6.3%), Factor 4 ($\lambda = 1.005$, 5.0%); cumulative variance 73.2%. The dominant first factor supports a superordinate "overall CBME perception" construct.

Convergent validity: All CBME domains correlated negatively with at least two of three distress measures (PSS-10, GAD-7, PHQ-9), most $p < 0.05$. The Student Well-being domain showed the strongest inverse associations ($r = -0.193$ with PSS-10, −0.237 with GAD-7, −0.216 with PHQ-9). Floor effects were highest for well-being items (extracurricular time: 16.3%; stress management resources: 11.8%), consistent with the lowest domain mean scores observed (2.82–3.07/5).

Table 3. CBME Perception Survey — Psychometric Summary by Domain (N = 1,064)

Domain	Items	Cronbach's α	CR	AVE	ITC range	Domain mean ±SD (/5)	Floor/Ceiling
Curriculum Design	3	0.901	0.846	0.647	0.726–0.734	3.34 ± 0.87	4.2%/11.8%
Teaching-Learning	3	0.848	0.759	0.513	0.676–0.702	3.39 ± 0.83	4.2%/15.6%

Assessment Strategies	3	0.924	0.883	0.716	0.734–0.752	3.29 ± 0.91	4.8%/9.6%
Faculty Support	3	0.909	0.859	0.671	0.670–0.689	3.49 ± 0.78	0.0%/14.6%
Student Well-being	3	0.908	0.857	0.667	0.640–0.742	2.94 ± 0.92	10.7%/6.8%
Professional Development	3	0.909	0.859	0.670	0.741–0.760	3.27 ± 0.84	5.2%/9.5%
Overall Satisfaction	2	0.903	0.809	0.679	0.751–0.790	3.23 ± 0.85	5.0%/8.8%
Full scale (20 items)	20	**0.956**	0.846*	0.665*	0.640–0.790	64.07 ± 15.97 (/100)	SB = 0.897

CR = composite reliability; AVE = average variance extracted; ITC = corrected item-total correlation; SB = Spearman-Brown split-half coefficient. *Domain-average values. All α and CR values exceed the 0.70 threshold; all AVE values exceed the 0.50 threshold for convergent validity. (31,32,33)

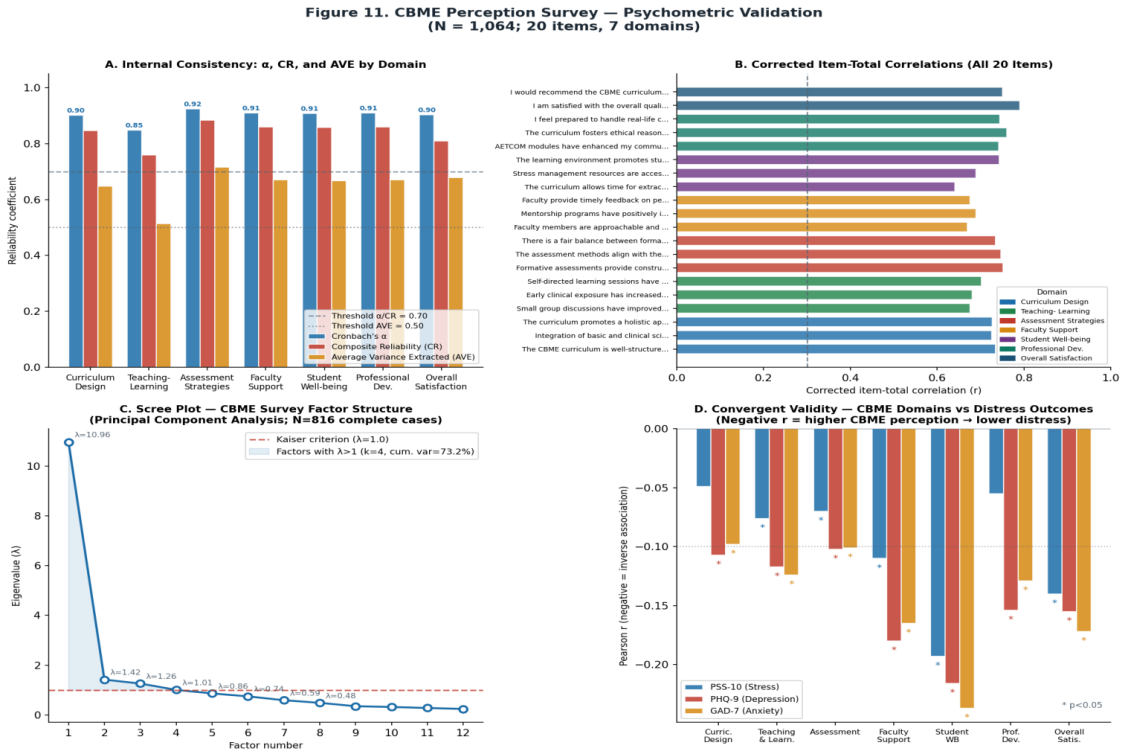

Figure 11. CBME Perception Survey psychometric validation panel. (A) Cronbach's α, composite reliability (CR), and average variance extracted (AVE) by domain. (B) Corrected item-total correlations (all 20 items, colour-coded by domain). (C) Scree plot from principal component analysis (N = 816 complete cases). (D) Convergent validity: CBME domain scores vs PSS-10, PHQ-9, and GAD-7 (* $p < 0.05$).

2.5 Qualitative Component: Focus Group Discussions

Focus Group Discussions (FGDs) were employed as the qualitative data collection method, consistent with their established utility in medical education research for eliciting group-level perceptions and contextual explanations of quantitative patterns. (26,34,35) One FGD was conducted at each of the five participating institutions, with purposive sampling to ensure representation across

training phases. Group sizes ranged from six to eight participants (total n = 35; see Table 4). Each FGD was audio-recorded with prior written consent, moderated by the site co-investigator, and conducted in a private room outside teaching hours.

Transcripts were produced verbatim within five days of each FGD and reviewed for accuracy against the audio recording. All participant identifiers were removed or replaced with generic descriptors at the transcription stage. Analysis followed the six-phase reflexive thematic analysis framework of Braun and Clarke. (23,24) Coding was performed using NVivo (QSR International, v14). Independent dual-coding of 20% of coded segments yielded an inter-coder agreement rate of 82%. Rigour was further ensured through prolonged engagement with transcripts, thick description of institutional context, and maintenance of an audit trail comprising a reflexive journal, codebook, and documentation of all analytical decisions. (25) Qualitative findings were integrated with quantitative results using the joint display method of Fetters, Curry, and Creswell. (27)

Table 4. Focus Group Discussion Characteristics by Site

Institution	Type	n	Phases	Duration	Date	Institutional wellness profile (quantitative)
MIMS, Nellimarla	Private	7	II, III-I, CRMI	48 min	Mar 2026	PSS 19.76; GAD-7 9.12; MBI-EE 13.93
AMC, Visakhapatnam	Government	8	II, III-II, CRMI	52 min	Mar 2026	PSS 18.78; GAD-7 7.83; MBI-EE 11.19 — lowest burden
GIMSR, Visakhapatnam	Private	6	II, III-I, III-II	44 min	Mar–Apr 2026	PSS 21.04; GAD-7 10.19; MBI-EE 17.79
RMC, Kakinada	Government	7	II, III-I, CRMI	50 min	Mar 2026	PSS 19.00; GAD-7 6.99; PHQ-9 8.49 — best wellness
NRIIMS, Visakhapatnam	Private	7	II, III-II, CRMI	46 min	Mar–Apr 2026	PSS 21.37; MBI-EE 16.04; PHQ-9 11.84 — highest burden
Total	—	**35**	All phases	44–52 min	Feb–Apr 2026	5 FGDs; 2 government / 3 private institutions

2.6 Statistical Analysis

All analyses were performed in Python 3.12 using pandas, scipy, numpy, and scikit-learn libraries; visualisation used matplotlib and seaborn. Continuous variables are reported as mean ± SD and median (IQR). Parametric tests were used given the large sample size and the robustness of ANOVA and t-tests to non-normality by the central limit theorem. Independent samples t-tests (reporting Cohen's d effect size) compared gender and institution type. One-way ANOVA was used for year-of-study and institution comparisons. Pearson correlation coefficients were computed between all outcome variables. Multiple linear regression (ordinary least squares) identified independent predictors of PSS-10, with R^2 and adjusted R^2 reported. Logistic regression provided odds ratios (95% CI) for the forest plot analysis of predictors of moderate-to-high stress. Statistical significance was set at $\alpha = 0.05$, two-tailed.

2.7 Ethical Considerations

The study was approved by the Institutional Ethics Committee of Maharajah's Institute of Medical Sciences, Nellimarla (Lr. No. 1661-1680/Chairman-IEC/MIMS/Ethics Approval, dated 14 July 2025). The approval covered the full multicentric scope. Departmental permissions were additionally obtained from co-investigator Heads of Department at each non-MIMS institution. Informed consent was obtained electronically from all participants. Students endorsing PHQ-9 item 9 at any frequency were provided crisis referral information for NIMHANS Helpline (1661-16800007) and iCall (9152987821) within the survey. All data are stored anonymised on a password-protected institutional research drive; email addresses captured by Google Forms were deleted prior to analysis.

3. Results

3.1 Participant Characteristics

Of 1,141 survey responses received, 1,064 participants (93.2%) provided informed consent and were included in the final analysis (77 students declined consent and were excluded). The participant flow is depicted in Figure 1. The sample comprised 651 (61.2%) female students and 407 (38.3%) male students, with a mean age of 20.6 ± 1.7 years. The largest proportion of participants were from Phase II (2nd MBBS; n = 541, 50.8%), followed by Phase III Part II (4th MBBS; n = 280, 26.3%), Phase III Part I (3rd MBBS; n = 210, 19.7%), and CRMI internship (n = 33, 3.1%). AMC contributed the largest institutional sample (n = 299, 28.1%), followed by RMC (n = 237, 22.3%), MIMS (n = 217, 20.4%), NRIIMS (n = 170, 16.0%), and GIMSR (n = 141, 13.3%). Participant backgrounds were predominantly urban (n = 653, 61.4%), with 258 (24.2%) rural and 153 (14.4%) semi-urban. Detailed characteristics are presented in Table 1.

Table 1. Participant Characteristics (N = 1,064)

Characteristic	Category	n	% (of N = 1,064)
Gender	Female	651	61.2
	Male	407	38.3
	Prefer not to say	6	0.6
Year of Study	Phase II (2nd MBBS)	541	50.8
	Phase III Pt I (3rd MBBS)	210	19.7
	Phase III Pt II (4th MBBS)	280	26.3
	Internship (CRMI)	33	3.1
Institution	AMC, Visakhapatnam	299	28.1
	RMC, Kakinada	237	22.3
	MIMS, Vizianagaram	217	20.4
	NRIIMS, Visakhapatnam	170	16.0
	GIMSR, Visakhapatnam	141	13.3
Institution Type	Government (AMC + RMC)	536	50.4
	Private (MIMS + NRIIMS + GIMSR)	528	49.6

Participant Background	Urban	653	61.4
	Rural	258	24.2
	Semi-urban	153	14.4

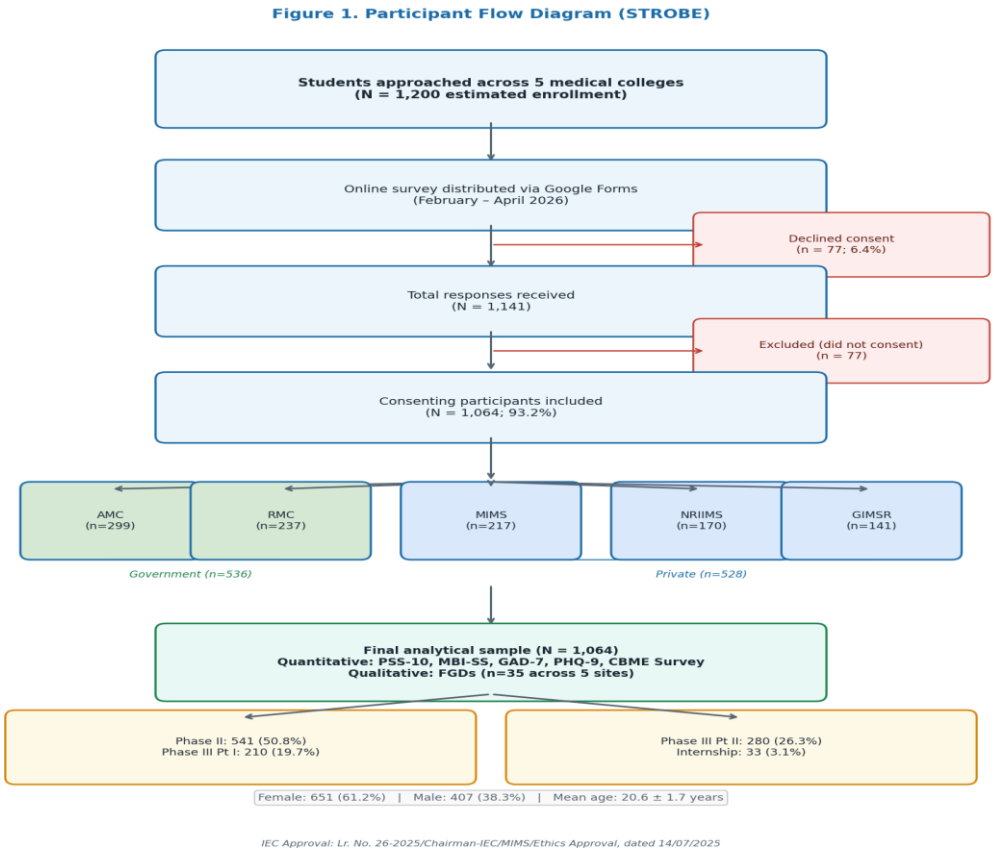

Figure 1. Participant flow diagram (STROBE). Of 1,141 survey responses received, 1,064 consenting participants were included in the final analysis. Dashed lines indicate exclusion pathways.

3.2 Prevalence of Mental Health Outcomes

Table 2 summarises descriptive statistics for all primary outcome measures. The cohort mean PSS-10 score was 19.74 ± 5.52 (median: 20, IQR: 17–22). The overwhelming majority (80.6%) fell in the moderate stress category, with 9.9% in the high stress range. For anxiety, the mean GAD-7 score was 8.50 ± 5.42; 39.7% of participants met the clinical threshold of ≥10 for likely generalised anxiety disorder, and 12.8% scored in the severe range (≥15). Collectively, 76.6% of students reported at least mild anxiety symptoms. (18)

Depression burden was substantial. The mean PHQ-9 score was 10.30 ± 6.55; 47.8% scored ≥10 (moderate or above) and 9.4% in the severe range (≥20). Only 20.3% of students reported minimal depressive symptoms. (19) A critical finding was that 53.2% of participants endorsed PHQ-9 item 9 at least at the "several days" level (score ≥1), indicating some frequency of passive suicidal ideation or thoughts of self-harm. The breakdown was: "several days" (28.0%, n = 292), "more than half the days" (16.7%, n = 174), and "nearly every day" (8.5%, n = 88). This finding must be interpreted within the context of PHQ-9's screening function; it does not constitute a clinical diagnosis but signals an urgent need for institutional mental health infrastructure. All students endorsing this item received crisis referral information in the survey.

Regarding burnout, elevated emotional exhaustion (MBI-EE ≥15) was present in 44.0% of participants. High cynicism (MBI-CY ≥9) was noted in 35.2%, and reduced academic efficacy (MBI-AE < 18) in 47.8%. A composite burnout profile (high EE and CY with low AE simultaneously) characterised 112 students (10.5%). (17,20)

Table 2. Descriptive Statistics for Primary Outcome Measures (N = 1,064)

Outcome	Mean	SD	Median	IQR	Range	Clinically significant (%)
PSS-10 (Stress)	19.74	5.52	20.0	17–22	0–40	90.5% ≥14
GAD-7 (Anxiety)	8.50	5.42	8.0	5–12	0–21	39.7% ≥10
PHQ-9 (Depression)	10.30	6.55	9.0	5–15	0–27	47.8% ≥10
MBI-EE (Exhaustion)	13.86	8.11	13.0	7–20	0–30	44.0% ≥15
MBI-CY (Cynicism)	7.84	6.22	6.0	3–11	0–24	35.2% ≥9
MBI-AE (Efficacy)	18.26	9.40	18.0	11–26	0–36	47.8% <18
CBME Perception (/100)	64.07	15.97	63.0	57–76	0–100	71.1% ≥50

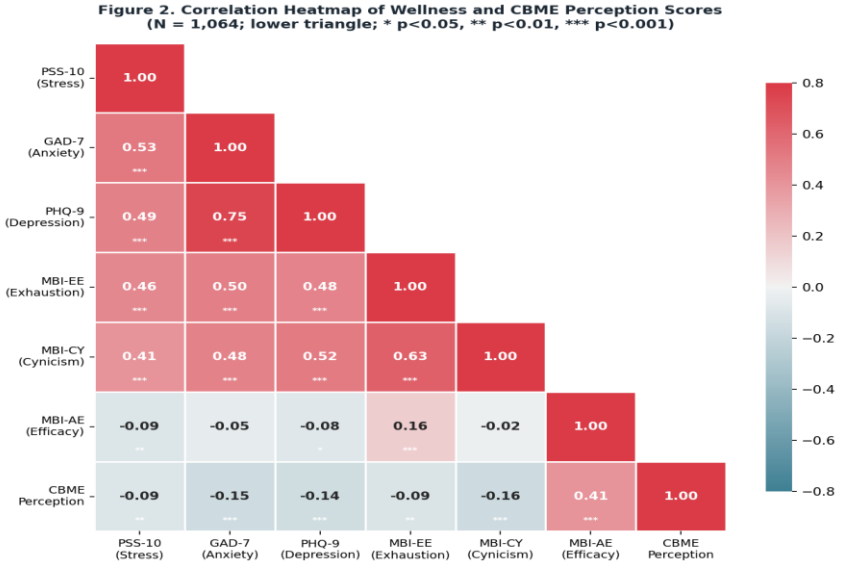

Figure 2. Correlation heatmap of all outcome variables (lower triangle; Pearson r; N = 1,064). Significance: *** p < 0.001, ** p < 0.01, * p < 0.05.

3.3 Gender Differences in Wellness Outcomes

Female students reported significantly higher perceived stress (PSS-10: 20.55 ± 5.78 vs 18.45 ± 4.82; t = 6.10, p < 0.001; Cohen's d = 0.39), anxiety (GAD-7: 8.87 ± 5.54 vs 7.93 ± 5.19; t = 2.74, p = 0.006; d = 0.17), emotional exhaustion (MBI-EE: 14.64 ± 8.13 vs 12.57 ± 7.90; t = 4.07, p < 0.001; d = 0.26), and academic efficacy (MBI-AE: 19.07 ± 8.95 vs 16.96 ± 9.97; t = 3.56, p < 0.001; d = 0.22) compared to male students. Female students also reported higher CBME perception scores (65.70 ± 14.03 vs 61.63 ± 18.32; t = 4.07,

$p < 0.001$). Depression (PHQ-9: $p = 0.197$) and cynicism (MBI-CY: $p = 0.052$) did not reach statistical significance between genders. These findings are consistent with the broader medical education literature. (5,6,37)

3.4 Year of Study Comparisons

One-way ANOVA revealed significant differences across training phases for all primary outcome variables. Third-year MBBS students (Phase III Part I) reported the highest perceived stress (PSS: 20.69, $F = 3.91$, $p = 0.009$), anxiety (GAD-7: 9.71, $F = 5.16$, $p = 0.002$), depression (PHQ-9: 11.15, $F = 2.70$, $p = 0.044$), emotional exhaustion (MBI-EE: 16.11, $F = 16.71$, $p < 0.001$), and cynicism (MBI-CY: 9.03, $F = 5.23$, $p = 0.001$). Fourth-year students (Phase III Part II) showed partial recovery (MBI-EE: 11.22; GAD-7: 7.80). Internship students demonstrated intermediate values with notably reduced academic efficacy (MBI-AE: 15.76, $F = 9.39$, $p < 0.001$), possibly reflecting transitional role uncertainty. (6,36) Distributions are illustrated in Figures 3 and 7.

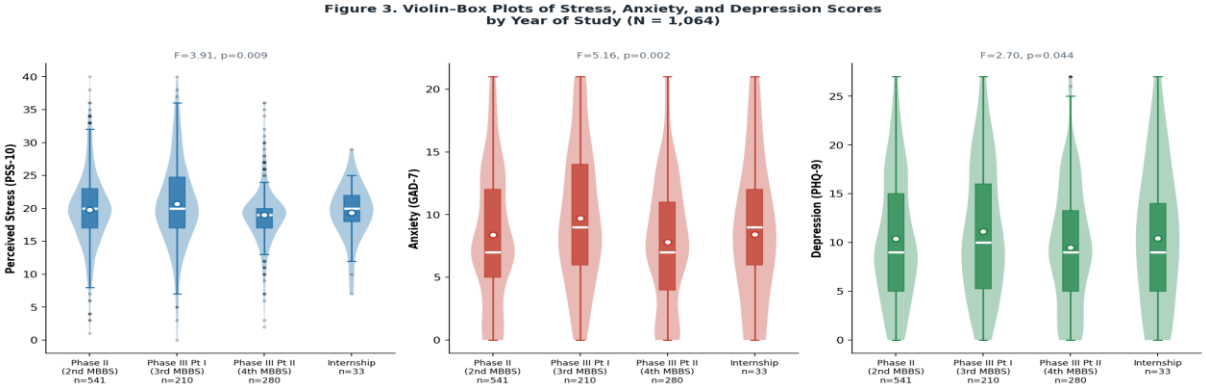

Figure 3. Violin–box plots of PSS-10, GAD-7, and PHQ-9 scores by year of study (N = 1,064). White dots indicate group means. ANOVA F-statistics and p-values shown above each panel.

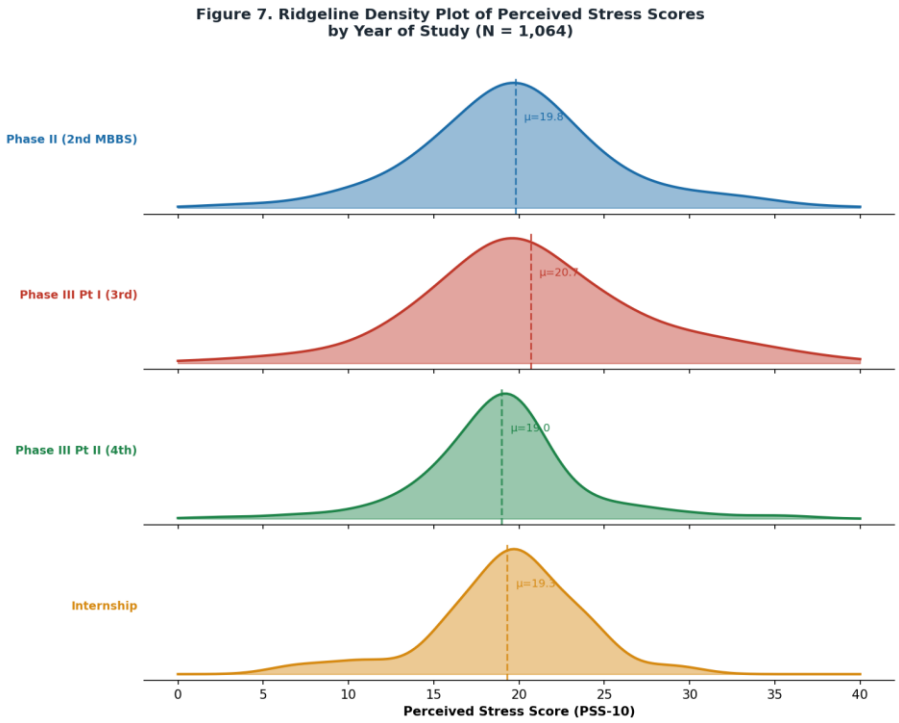

Figure 7. Ridgeline density plot of PSS-10 scores by year of study. Dashed lines indicate group means. Density peak shifts rightward at Phase III Part I (3rd year MBBS), consistent with peak stress burden at that training stage.

3.5 Government vs Private Institution Comparison

Students enrolled in private medical institutions consistently demonstrated higher psychological distress than government college counterparts. Private institution students had significantly higher PSS-10 (20.62 ± 5.85 vs 18.88 ± 5.04; $t = -5.20$, $p < 0.001$), GAD-7 (9.55 ± 5.61 vs 7.46 ± 5.03; $t = -6.40$, $p < 0.001$), PHQ-9 (11.24 ± 6.89 vs 9.38 ± 6.07; $t = -4.66$, $p < 0.001$), MBI-EE (15.64 ± 8.29 vs 12.12 ± 7.54; $t = -7.25$, $p < 0.001$), and MBI-CY (8.83 ± 6.76 vs 6.87 ± 5.46; $t = -5.23$, $p < 0.001$). Notably, CBME perception scores did not differ significantly between institution types ($p = 0.227$), indicating that the distress differential reflects structural environmental factors rather than differential curriculum perception.

3.6 Institution-Level Analysis

Significant inter-institutional differences were identified across all primary outcomes (all ANOVA $p < 0.001$). NRIIMS students had the highest mean PSS-10 (21.37) and MBI-EE (16.04), while RMC students had the lowest anxiety (GAD-7: 6.99) and depression (PHQ-9: 8.49). CBME perception was highest at RMC (67.44) and lowest at AMC (60.35). The radar chart (Figure 5) displays comparative CBME domain profiles across all five institutions. The Student Well-being domain scored lowest universally (overall mean 2.94/5), while Faculty Support scored highest (3.49/5). The two lowest-rated individual items were "the curriculum allows time for extracurricular activities" (mean 2.82/5) and "stress management resources are accessible and effective" (2.93/5). Institution-level stress versus depression is displayed in Figure 6.

Figure 5. Radar Chart of CBME Domain Scores by Institution (5-point Likert scale; N = 1,064)

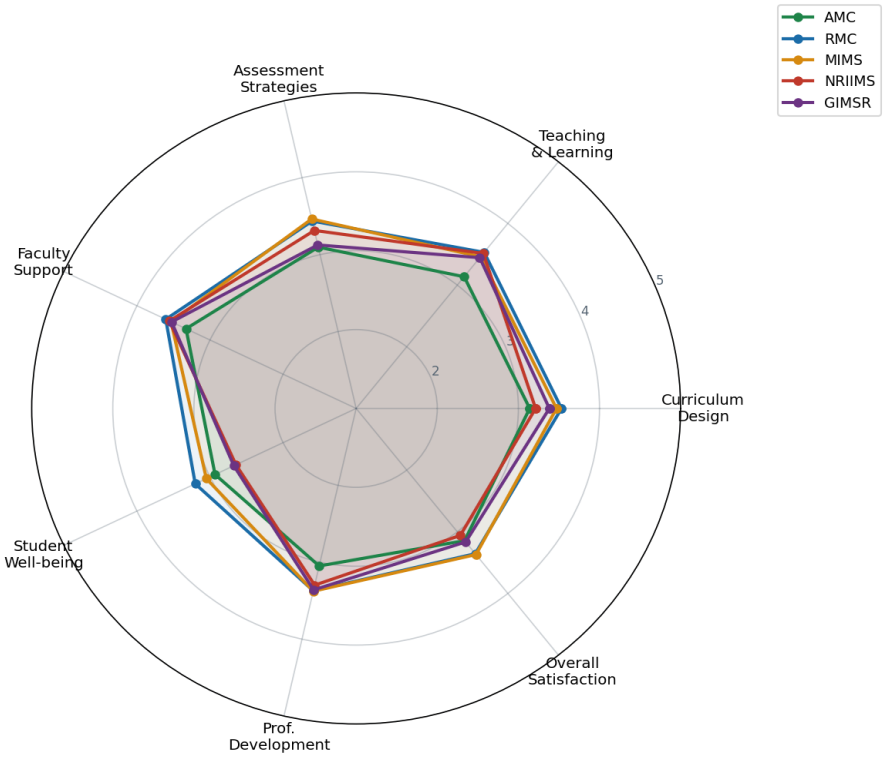

Figure 5. Radar (spider) chart of mean CBME domain perception scores by institution (5-point Likert scale; N = 1,064). The Student Well-being domain was universally the lowest-rated domain across all five sites. RMC scored highest overall; NRIIMS scored lowest on the well-being domain.

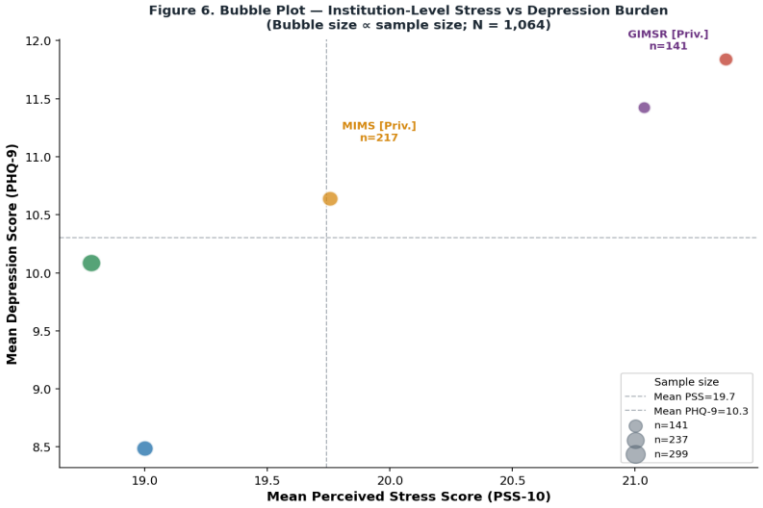

Figure 6. Bubble plot of institution-level mean perceived stress (PSS-10, x-axis) versus depression score (PHQ-9, y-axis). Bubble size is proportional to institutional sample size (n). Dashed lines indicate overall sample means. Government institutions (AMC, RMC) cluster in the lower-left quadrant.

3.7 Correlation Analysis

Pearson correlation analysis (Figure 2; Figure 9) revealed a strong positive relationship between GAD-7 and PHQ-9 ($r = 0.750$, $p < 0.001$), indicating high co-occurrence of anxiety and depressive symptoms. PSS-10 correlated significantly with GAD-7 ($r = 0.530$), PHQ-9 ($r = 0.493$), MBI-EE ($r = 0.461$), and MBI-CY ($r = 0.408$), all $p < 0.001$. MBI-EE and MBI-CY were substantially intercorrelated ($r = 0.634$). Academic efficacy (MBI-AE) showed weak negative correlations with distress indicators and a moderate positive correlation with CBME total perception ($r = +0.407$, $p < 0.001$). CBME total perception correlated negatively with anxiety ($r = -0.154$, $p < 0.001$) and depression ($r = -0.144$, $p < 0.001$).

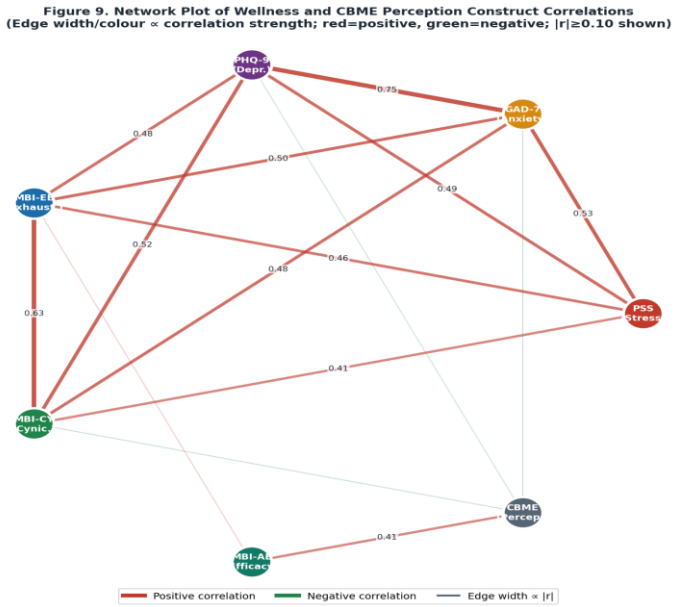

Figure 9. Network plot of correlations among wellness and CBME perception constructs. Edge colour indicates direction (red = positive, green = negative); edge width is proportional to correlation magnitude. Labels include absolute r values for $|r| \geq 0.40$.

3.8 Multiple Regression: Predictors of Perceived Stress

Multivariate linear regression identified independent predictors of PSS-10 score ($R^2 = 0.377$, adjusted $R^2 = 0.372$; N = 1,064): anxiety severity (GAD-7: β = +0.274), depression severity (PHQ-9: β = +0.117), emotional exhaustion (MBI-EE: β = +0.157), female sex (β = +1.469), and private institution enrolment (β = +0.366). Academic efficacy (MBI-AE: β = −0.083) was a significant negative predictor, confirming its protective role. CBME total perception did not independently predict PSS-10 after adjustment (β = +0.015), suggesting its effect is partially mediated through burnout and mood variables. Forest plot odds ratios for predictors of moderate-to-high stress are presented in Figure 4.

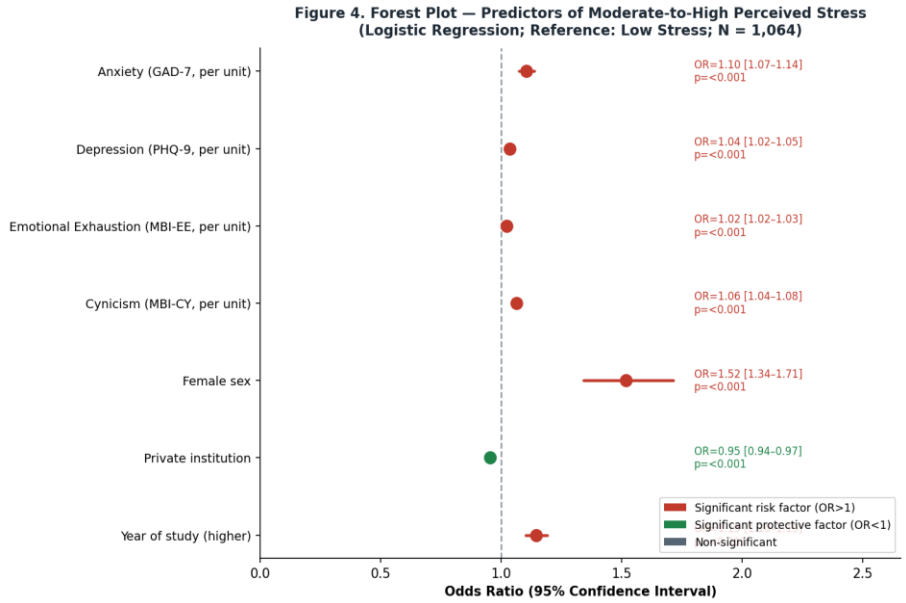

Figure 4. Forest plot of adjusted odds ratios (95% CI) for predictors of moderate-to-high perceived stress (PSS-10 ≥14) from multivariate logistic regression (N = 1,064). Red markers indicate significant risk factors (OR > 1, p < 0.05); green markers indicate significant protective factors.

3.9 CBME Perception and Mental Health Outcomes

Students with "highly positive" CBME perception reported the lowest distress across all metrics (PSS: 17.63; GAD-7: 6.32; PHQ-9: 7.88; MBI-EE: 10.73), while those with "neutral" perception — rather than active negative perception — demonstrated the highest distress (PSS: 21.46; GAD-7: 10.53; PHQ-9: 12.79; MBI-EE: 16.27). ANOVA confirmed significant differences across perception groups for MBI-EE ($F = 17.90$, $p < 0.001$), MBI-CY ($F = 19.44$, $p < 0.001$), and MBI-AE ($F = 51.67$, $p < 0.001$). The counterintuitive pattern in which neutrality predicts greater distress than active negativity is discussed in Section 4. The alluvial diagram (Figure 8) illustrates the flow between CBME perception, stress, and depression categories.

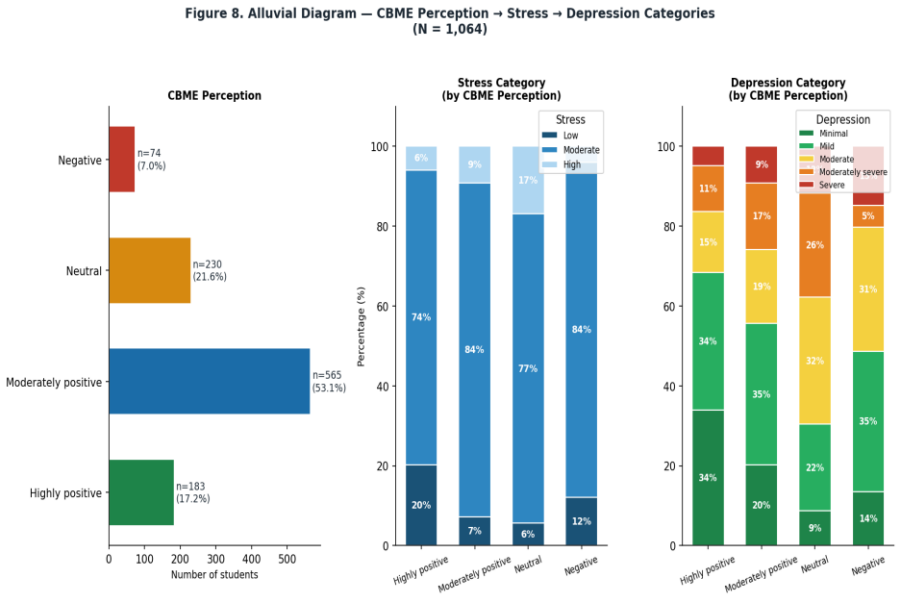

Figure 8. Alluvial diagram showing distribution of students across CBME perception categories (Panel A) and corresponding stress (Panel B) and depression (Panel C) categories. Percentages indicate proportion within each CBME perception group.

3.10 Qualitative Findings: FGD Thematic Analysis

Thematic analysis of focus group data from 35 students across five institutions identified five superordinate themes with near-universal cross-site convergence. (23,24,27) Qualitative and quantitative data are jointly displayed in Figure 10.

Theme 1: Assessment overload as a primary stressor

Students across all phases and institutions cited the frequency and simultaneity of formative assessments as the dominant driver of academic stress. The concern was not about the principle of formative assessment, but about its operationalisation: multiple departmental assessments occurring concurrently, without inter-departmental coordination. This theme corroborates the 80.6% moderate-to-high stress prevalence and the peak distress observed in Phase III Part I, when assessment density is maximal across multiple clinical disciplines simultaneously. (4,12)

Theme 2: Documentation burden divorced from learning

Logbooks and reflective portfolios were characterised as compliance activities rather than learning tools, primarily because faculty engagement with submitted material was inconsistent or absent. At NRIIMS, students described fear of academic consequences as the primary driver of logbook completion, consistent with that institution's highest MBI-EE score (16.04). At RMC, internship students offered a retrospective endorsement of documentation — the only site where longitudinal benefit was acknowledged — consistent with RMC's significantly lower distress profile.

Theme 3: Early Clinical Exposure as a motivational anchor

Early Clinical Exposure (ECE) was unanimously identified as the most positively valued element of CBME. Students described it as motivation-sustaining, context-setting, and confidence-building. Quantitatively, the ECE item ("early clinical exposure has increased my confidence in clinical settings") was the second-highest rated item in the CBME perception survey (mean 3.55/5), and academic efficacy correlated most strongly with CBME total perception ($r = +0.407$), suggesting a mechanistic pathway from ECE engagement to protective academic self-efficacy. (1,3,28)

Theme 4: Structural mentorship deficit

No institution reported a formalised, universally accessible faculty mentorship system. Mentorship was informal and relationship-dependent, creating an inequitable environment in which student access to support was determined by proximity to individual faculty rather than institutional design. The CBME item "mentorship programmes have positively impacted my academic growth" rated a mean of 3.44/5 and masked considerable site-level variance. (12)

Theme 5: AETCOM as the curriculum's humanising core

AETCOM modules were consistently credited with producing tangible changes in professional behaviour, particularly in clinical communication, patient interaction, and ethical reasoning. The most nuanced observation, emerging from NRIIMS, was that AETCOM's cultivation of empathy was being partially eroded by the surrounding institutional environment of high pressure and low support. This finding has significant implications for curriculum implementation theory: curricular interventions cannot operate independently of the institutional culture in which they are embedded. (1,11)

Figure 10. Joint display integrating quantitative prevalence data, CBME perception–stress scatter, qualitative FGD themes, government–private comparison, and a mixed-methods convergence matrix. All five major themes show quantitative–qualitative convergence (confirmed). (27)

4. Discussion

This multicentric study provides the most comprehensive empirical characterisation to date of the mental health burden experienced by Indian medical students under the NMC's CBME framework. Across 1,064 students from five institutions spanning government and private sectors in Andhra Pradesh, we document alarming prevalences of moderate-to-high perceived stress (90.5%), clinically significant anxiety (39.7%), clinically meaningful depression (47.8%), and emotional exhaustion (44.0%). These figures not only corroborate but in several domains exceed the estimates reported in pre-CBME Indian studies and global systematic reviews. (5,6,7,8,9,15,39,40) This suggests that the post-2019 curriculum reform has, without commensurate investment in student support

infrastructure, compounded an already-substantial mental health challenge.

The gender differential — with female students reporting significantly higher stress, anxiety, and burnout than male counterparts — is consistent with the broader medical education literature. Rotenstein and colleagues (5) in a meta-analysis of 195 studies, and Dyrbye et al. (6) both identified female sex as a consistent correlate of burnout and distress in medical training. In the Indian context, these differences may reflect intersecting pressures from academic demands, family expectations, and gender-based social stressors that are magnified within, though not unique to, the medical environment. (37)

The finding that third-year MBBS students (Phase III Part I) carry the greatest burden across nearly every wellness indicator is both explicable and actionable. The third year represents the convergence of the highest academic assessment load — as students simultaneously manage multiple clinical discipline internals — with early independent clinical responsibility. This dual burden, without yet the clinical confidence that accumulates through Phase III Part II and internship, creates a stress peak that institutions can anticipate and structurally address. (14,36)

The government–private institution differential is among the most practically significant findings of this study. Private institution students had higher distress across all domains except CBME perception, indicating that the disparity reflects structural environmental factors rather than differential curriculum experience. Private medical colleges in India often operate under competitive financial models with larger student-to-faculty ratios and greater pressure to optimise examination performance metrics. (8,11) The absence of formalised student counselling and well-being services, documented in the FGDs across all private institutions, likely amplifies these structural vulnerabilities.

The relationship between CBME perception and mental health outcomes is nuanced and theoretically important. Students who view the CBME curriculum positively have substantially lower distress than those who view it neutrally or negatively. Critically, the counterintuitive finding that "neutral" perception predicts greater distress than "negative" perception warrants theoretical attention. We propose that active negativity toward the curriculum implies a form of cognitive engagement — students have formed a position and can articulate their grievances — whereas neutrality may reflect motivational disengagement, curriculum incoherence, or a dissociated relationship with one's own training, which may be a more psychologically damaging state. This hypothesis is consistent with self-determination theory, in which autonomous motivation and perceived competence are central to psychological well-being. (28) The finding that academic efficacy (MBI-AE) is the strongest correlate of positive CBME perception ($r = +0.407$) further supports this mechanism.

The qualitative data not only corroborate but enrich the quantitative picture. Cross-site convergence of five themes — assessment overload, documentation burden, ECE positivity, mentorship deficit, AETCOM appreciation — across institutions of different types, locations, and quantitative profiles strengthens the validity of these concerns. (23,24,25,26) The NRIIMS-specific finding that AETCOM's cultivated empathy is being eroded by the institutional climate is particularly important: it suggests that curricular interventions cannot operate independently of the institutional culture in which they are embedded, a lesson with direct implications for the NMC's implementation oversight function.

The suicidal ideation prevalence (53.2% endorsing PHQ-9 item 9 at any frequency) demands explicit and careful attention. While PHQ-9 item 9 is a screening item and not a clinical diagnosis, the proportion of students experiencing even transient thoughts of being better off dead during the academic year reflects a community-level psychological burden that goes beyond individual pathology into institutional responsibility. (5,13,36) Medical colleges have a duty of care to their students

that extends beyond academic performance monitoring.

Taken together, the evidence supports a model in which CBME's pedagogical components — ECE, AETCOM, competency-based assessment — are genuinely valued and associated with academic efficacy when implemented well, while operational delivery mechanisms — assessment frequency, documentation volume, and the absence of support infrastructure — are the primary drivers of distress. (3,4,12) This distinction between CBME's design philosophy and its implementation reality is the central practical message of this study.

4.1 Implications for Practice and Policy

Based on the convergent quantitative and qualitative evidence, we offer the following evidence-informed recommendations:

- **Assessment rationalisation:** The NMC and individual institutions should develop coordinated inter-departmental assessment calendars to prevent concurrent assessment pile-up, particularly in Phase III Part I. Reducing the frequency of summative events while maintaining formative intent is achievable within the CBME framework. (4)
- **Mandatory mentorship systems:** All CBME-implementing institutions should establish structured, formative faculty–student mentorship systems with defined frequency, content, and accountability. Informal mentorship is inequitable by design and insufficient by evidence. (12)
- **Student well-being infrastructure:** The lowest-rated CBME domain universally was student well-being. The NMC should require, not recommend, that all affiliated colleges maintain accessible and staffed psychological counselling services. (13,36)
- **Targeted support for high-risk groups:** Female students and those in Phase III Part I require proactive outreach. Institutional mental health programmes should stratify risk by gender and training phase. (6,37)
- **Documentation reform:** Logbooks and portfolios should be redesigned as active learning tools with structured faculty feedback cycles, not compliance checklists. The RMC experience — where intern students retrospectively valued documentation — demonstrates that faculty engagement, not the tool itself, is the differentiating factor. (3)

5. Limitations

Several limitations of this study warrant acknowledgement. First, the cross-sectional design precludes causal inference; the associations documented between CBME perception and mental health outcomes may reflect bidirectional relationships or unmeasured confounders. A longitudinal cohort design tracking students through Phase II, III, and internship would provide stronger causal evidence. Second, the internship subgroup is small (n = 33, 3.1%), limiting generalisability of year-of-study comparisons for this phase. Third, all outcome data are self-reported and subject to social desirability bias, though anonymous online administration was designed to minimise this. Fourth, while the CBME Perception Survey demonstrated excellent internal consistency (Cronbach's $\alpha = 0.956$), it was developed de novo and has not yet been cross-validated in independent samples; its psychometric properties should be confirmed in future studies before its adoption as a standardised instrument. Fifth, IEC approval was obtained from MIMS as the primary site; institutional permissions were obtained from departmental heads at other sites. Sixth, the FGD component involved 35 students in total; purposive sampling may not capture the full range of student perspectives, and member checking was not conducted. Seventh, FGDs at some sites were moderated by departmental faculty, creating a potential positionality risk that was mitigated but not fully eliminated. Finally, Phase I students were excluded by design, limiting conclusions about the earliest phase of CBME exposure.

6. Conclusion

This multicentric, mixed-methods investigation of CBME and student wellness in Andhra

Pradesh reveals a medical education system in which a pedagogically sound curriculum reform is being implemented without proportionate investment in student support infrastructure. The result is a generation of medical students experiencing substantial and measurable psychological burden: four in five are stressed, nearly half are depressed, and more than half endorse passive suicidal ideation at some frequency during the academic year. These are not statistics of individual fragility — they are indicators of systemic design gaps.

CBME, as a framework, does not cause distress. Early clinical exposure is valued, AETCOM changes clinical behaviour, and positive CBME perception is associated with better mental health across every domain measured. The problem lies in how the framework is operationalised: assessment overload, documentation as bureaucracy, informal and inequitable mentorship, and near-universal absence of institutional well-being support. These are remediable. The NMC has the regulatory authority to mandate structural corrections; medical college administrations have the operational capacity to implement them; faculty have the professional responsibility to advocate for them. The evidence from this study is unambiguous: proactive, structurally embedded student well-being must become a non-negotiable feature of CBME implementation in India.

Acknowledgements

The authors gratefully acknowledge the students of AMC Visakhapatnam, RMC Kakinada, MIMS Nellimarla, NRIIMS Visakhapatnam, and GIMSR Visakhapatnam for their willing and candid participation. We thank the Institutional Ethics Committee of MIMS for their expeditious review and the department heads and administrative staff at each site for facilitating data collection. No funding was received for this study; all costs were borne by the principal investigator.

Conflict of Interest

The authors declare no conflicts of interest. The study was self-funded and conducted independently of any institutional, pharmaceutical, or commercial interest.

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