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THE RELATIONSHIP BETWEEN ACADEMIC STRESS, RESILIENCE, SOCIALIZATION, AND BURNOUT AMONG DOCTORAL STUDENTS ACROSS ETHNIC GROUPS IN MALAYSIA

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ABSTRACT

Aim/Purpose	This study examined how academic stress is associated with impaired doctoral socialization through burnout, and whether psychological resilience buffers this process differently across ethnic groups.
Background	Research suggested that approximately one-third of doctoral students worldwide reported depression or anxiety symptoms. Yet no study has simultaneously examined burnout as a mediator and resilience as a culturally moderated buffer within a single multiethnic doctoral sample. This study addressed this gap in Malaysia.
Methodology	A cross-sectional survey with 695 doctoral students (285 Chinese, 268 Malay, 142 Indian) from Malaysian research universities was conducted. Data were analyzed using structural equation modeling and multi-group analysis.

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Contribution	This study demonstrated that burnout mediated the stress-socialization pathway, that resilience buffered this process in collectivistic groups, and that protective resource function depended on cultural context.
Findings	Academic burnout partially mediated the stress-socialization relationship, accounting for 62.2% of the total effect. Resilience moderated the stress-burnout pathway in Chinese and Malay groups but not in the Indian group. Mediation paths were culturally invariant, while moderation paths differed significantly.
Recommendations for Practitioners	The researchers recommend implementing a three-tier system: reducing structural stressors, such as publication pressure, and improving supervisory training; providing culturally tailored resilience programs; and screening for and supporting students who exhibit burnout symptoms.
Recommendations for Researchers	The researchers recommend that future studies employ longitudinal designs, develop culturally specific resilience measures, integrate physiological stress markers, and test the model's generalizability across different contexts.
Impact on Society	By revealing culturally differentiated pathways through which stress impairs doctoral socialization, this research provided an evidence base for mental health policies in multiethnic higher education systems.
Future Research	For future research, the researchers recommend conducting intervention experiments comparing culturally tailored versus standard resilience programs, incorporating physiological stress markers to complement self-report data, and adopting multilevel models examining system-level factors, such as departmental climate and supervisory practices.
Keywords	doctoral students, academic burnout, psychological resilience, doctoral socialization, cross-cultural comparison, academic stress, Job Demands-Resources theory

INTRODUCTION

Doctoral education represents a critical phase in cultivating future academic talent, yet the mental health challenges facing this population have increasingly drawn global attention. Research has consistently revealed that doctoral students experience psychological distress at rates substantially exceeding those of the general population, with depression and anxiety showing marked upward trends (Evans et al., 2018). Satinsky et al. (2021) demonstrated through large-scale surveys that approximately one-third of Ph.D. students reported depression or anxiety symptoms, a proportion that escalated further during the COVID-19 pandemic (Andrade et al., 2023). These mental health crises constitute more than isolated incidents; they stem from multiple systemic stressors embedded within academic environments, including publication pressures, funding uncertainties, supervisor-student tensions, and work-life imbalances (Levecque et al., 2017). However, the literature remains limited in systematically examining how academic stress translates into impaired academic development through specific psychological mechanisms. Moreover, few studies have considered how cultural context shapes these processes, despite growing evidence that coping resources and stress appraisals vary across collectivistic and individualistic orientations. This study addressed these gaps by integrating Job Demands-Resources theory with cross-cultural psychology to examine the stress-burnout-socialization pathway among Chinese, Malay, and Indian doctoral students in Malaysia. The following sections reviewed the relevant literature, presented the methodology and findings, and discussed implications for culturally responsive doctoral education reform.

LITERATURE REVIEW

ACADEMIC STRESS AND BURNOUT IN DOCTORAL EDUCATION

Academic burnout, characterized by an exhaustion state induced by prolonged chronic stress, has demonstrated substantial value in explaining psychological difficulties among doctoral students. The Job Demands-Resources (JD-R) theory proposed by Demerouti et al. (2001) provided a robust theoretical foundation for understanding this phenomenon. This framework posits that burnout emerges when job demands consistently exceed individual resources. Although initially developed for workplace contexts, recent studies have confirmed its applicability to student populations in higher education settings (Bakker & Mostert, 2024; Lesener et al., 2020). Academic burnout manifests not only as emotional exhaustion but also encompasses academic alienation and diminished academic efficacy (Allen et al., 2021). This psychological state potentially threatens the academic socialization process of doctoral students. Indeed, Hunter and Devine (2016) found that emotional exhaustion among doctoral students predicted intentions to leave academia, underscoring burnout's practical consequences. Nevertheless, this negative pathway mechanism has not been adequately validated empirically, particularly in non-Western doctoral contexts (Deroncele-Acosta & Norabuena-Figueroa, 2025).

DOCTORAL SOCIALIZATION AND ITS PSYCHOLOGICAL BARRIERS

Doctoral socialization refers to the complex process through which graduate students progressively acquire disciplinary knowledge, academic norms, professional values, while developing their scholarly identity (Weidman & Stein, 2003). Weidman and Stein (2003) conceptualized this process as a developmental journey wherein doctoral students integrate into academic communities, master scholarly practices, and establish academic networks. Successful socialization determines not only degree completion but also preparedness for future academic careers (Austin, 2002). Existing research has predominantly focused on facilitative factors such as mentorship support and peer interaction (Gardner, 2007, 2008), while investigations into how academic stress and burnout impede socialization remain comparatively scarce. Sverdlik et al. (2018) provided a comprehensive review indicating that stress and supervisory quality are among the most robust predictors of doctoral well-being, yet the specific mediating role of burnout remains undertested. This gap constrains the design of targeted intervention strategies.

PSYCHOLOGICAL RESILIENCE AS A BUFFERING MECHANISM

Psychological resilience, defined as the capacity to maintain adaptive functioning under adversity, may play a critical buffering role in the relationship between academic stress and burnout. The stress-buffering hypothesis advanced by S. Cohen and Wills (1985) suggested that protective resources can attenuate the negative impact of stressors on individuals. Recent studies on university students indicate that learning resources and personal resources jointly constitute the foundation of academic resilience (Emerson et al., 2023); high-resilience individuals demonstrate enhanced emotional regulation and cognitive flexibility. Several individual resources could plausibly buffer the stress-burnout relationship, including academic self-efficacy, social support, and coping styles. However, resilience is theoretically distinct in that it captures a general capacity for recovery and adaptation rather than a domain-specific belief or a single coping strategy (Connor & Davidson, 2003). Its trait-like stability makes it particularly suitable for cross-cultural comparison, whereas coping styles tend to be more situation-dependent and harder to measure equivalently. Despite this theoretical promise, empirical evidence regarding how resilience moderates the stress-burnout relationship among doctoral students remains limited. Validating this moderating mechanism is crucial for the development of resilience-based intervention programs.

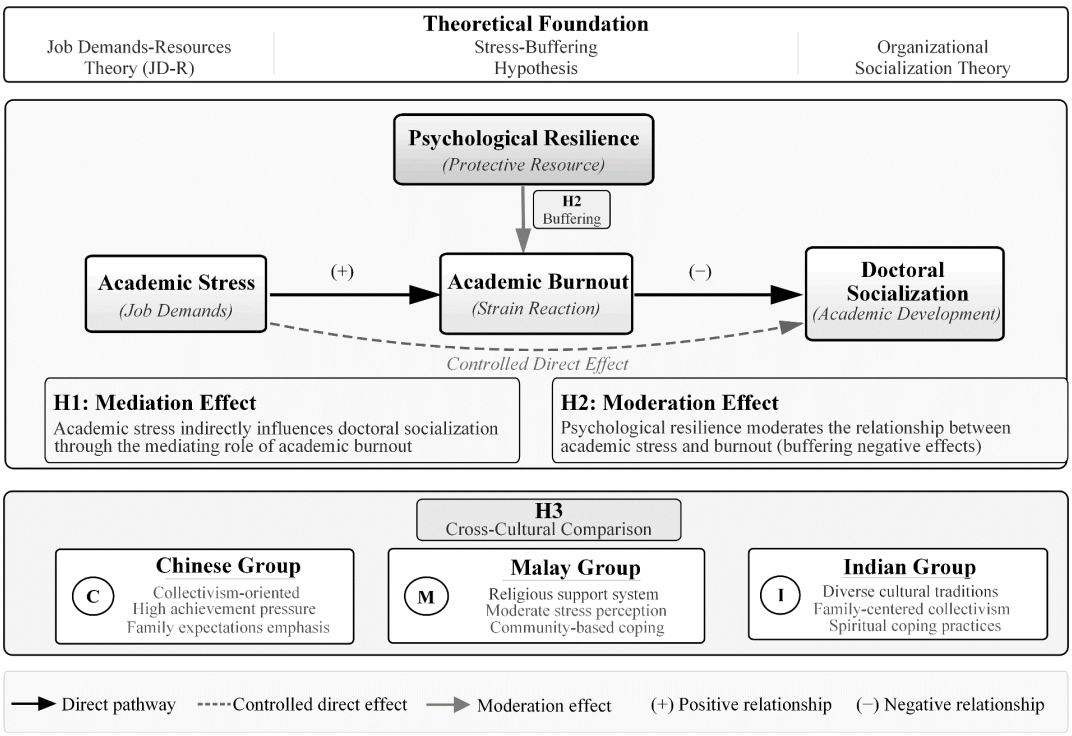
The Malaysian Multiethnic Context

Cultural contexts shape individuals' cognitive appraisals of academic stress, coping strategies, and socialization experiences (Boer et al., 2018). Collectivistic cultures emphasize group harmony, familial responsibilities, and hierarchical respect, potentially intensifying academic performance pressures while simultaneously providing cohesive social support networks; individualistic cultures highlight personal achievement and autonomy, influencing stress coping pathways. However, existing cross-cultural research has predominantly employed Western samples or simplistic East-West dichotomies, neglecting the rich variations within multicultural societies (Bakker & Demerouti, 2007, 2017). Malaysia, as a distinctive multiethnic nation where Malay, Chinese, and Indian communities, the three largest ethnic groups in Malaysia, coexist with distinct cultural value systems, offers an ideal research context for examining cultural influences on doctoral students' psychological processes. Malay culture, shaped by Islamic values, emphasizes communal obligation and religious coping; Chinese Malaysian culture retains Confucian emphases on filial piety, academic achievement, and family honor; and the Indian Malaysian community, predominantly Tamil Hindu, balances family-centered collectivism with spiritual practices such as yoga and meditation. Although India's national individualism score of 48 on Hofstede's scale suggests moderate collectivism, applying national scores to the Malaysian Indian diaspora requires caution, given the community's distinct migration history. Recent qualitative evidence suggested that supervisory support and institutional stressors interact differently across national contexts (García et al., 2025), yet Malaysian multiethnic settings remain underexplored.

This study aimed to address these research gaps by developing an integrative framework grounded in JD-R theory, the stress-buffering hypothesis, and socialization theory (illustrated in Figure 1). Through structural equation modeling, this research systematically examined how academic stress influenced doctoral socialization via the mediating role of academic burnout, validated the moderating effect of psychological resilience on the stress-burnout relationship, and compared these psychological mechanisms across Malaysia's three major ethnic groups. The study focused on negative developmental pathways to address the literature's overemphasis on positive mechanisms; an integrated examination of both mediating and moderating effects that transcends single-mechanism explanatory models; and, most importantly, advanced beyond traditional East-West dichotomous research paradigms through Malaysian multiethnic comparisons. Three hypotheses were proposed:

- **H1:** Academic burnout mediates the negative relationship between academic stress and doctoral socialization.
- **H2:** Psychological resilience moderates the stress-burnout pathway, such that higher resilience attenuates the positive association between stress and burnout.
- **H3:** The mediation and moderation pathways vary significantly across Chinese, Malay, and Indian ethnic groups.

As illustrated in Figure 1, the theoretical model posits a central mediation chain in which academic stress increases academic burnout, which in turn reduces doctoral socialization (H1). Psychological resilience enters the model as a moderator of the stress-to-burnout path, buffering the detrimental association (H2). The outer layer of the framework represents cross-cultural comparison: all paths are estimated simultaneously across the Chinese, Malay, and Indian groups to test whether their strength varies by cultural context (H3).



Note: The model integrates JD-R theory with stress-buffering hypothesis to examine negative pathways in doctoral development across cultural contexts

Figure 1. Theoretical framework and hypothesized research model

METHODOLOGY

RESEARCH DESIGN

This study employed a cross-sectional quantitative design. A survey design enables simultaneous measurement of multiple variables and establishes their covariance relationships, providing the data structure for structural equation modeling (Byrne, 2013). The incorporation of a cross-cultural comparative framework stems from theoretical expectations: collectivistic and individualistic cultures exhibit systematic differences in stress cognition, coping strategies, and social support patterns (Boer et al., 2018). These cultural variables were hypothesized to moderate the psychological mechanisms proposed in this study. Consequently, multi-group analysis became the logical choice for testing H3, while measurement invariance testing served as a prerequisite for ensuring the validity of cross-cultural comparisons (Putnick & Bornstein, 2016).

PARTICIPANTS AND SAMPLING STRATEGY

Participants were 695 doctoral students from five Malaysian public research universities (UKM, UM, UPM, USM, UTM), comprising 285 Chinese, 268 Malay, and 142 Indian participants. The smallest subgroup (Indian, n = 142) exceeded recommended minimums for multi-group SEM (Byrne, 2013). Doctoral programs in Malaysia typically span three to five years; most follow a research-only model, although some include coursework during the first year.

The sampling strategy employed stratified convenience sampling, with stratification based on disciplinary distribution (approximately 40% STEM, 30% social sciences, 20% humanities, 10% others), quotas that approximate the national distribution of doctoral enrollment across Malaysian public universities, to control for potential confounding effects of disciplinary cultures. The inclusion criterion of "completion of the first year" was established based on socialization theory: doctoral students require an initial adaptation period before developing stable patterns of stress perception and burnout

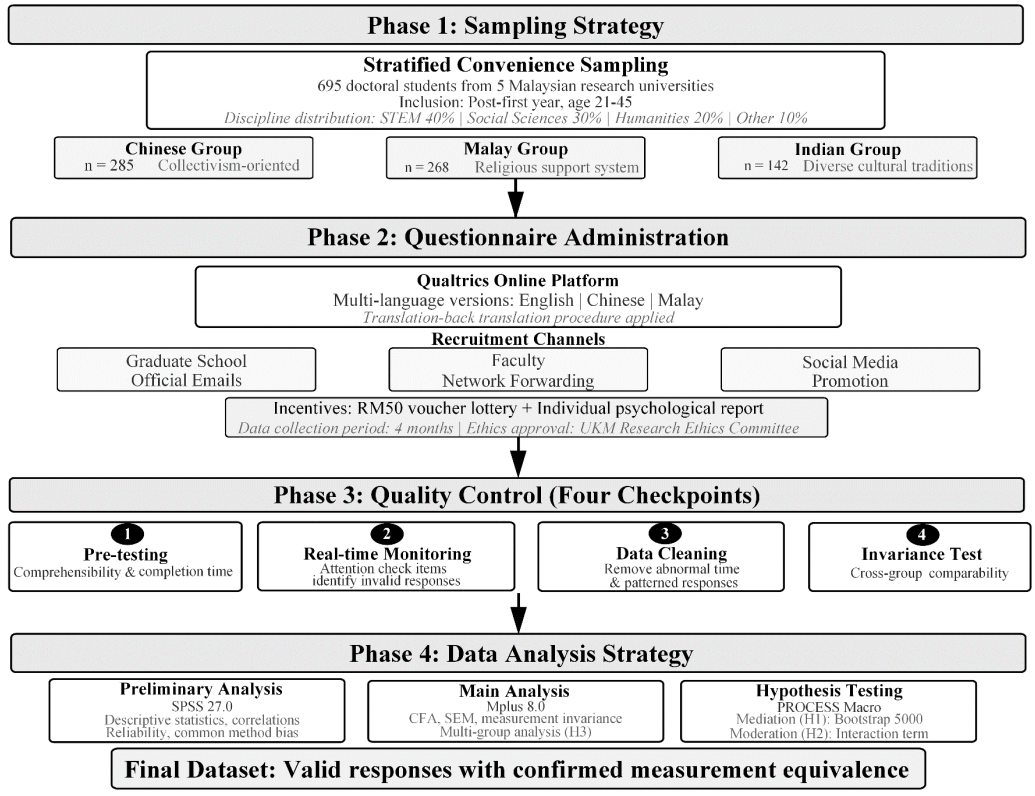
responses (Bakker & Mostert, 2024). Premature measurement might capture unstable transitional states.

Ethical Recruitment Criteria

The study received ethical approval from the Research Ethics Committee of Universiti Kebangsaan Malaysia (UKM) (UKM-PPI/111/8/JEP-2024-103). All participants met the inclusion criteria: (a) enrolled doctoral students in Malaysian research universities, (b) completed at least one year of study, (c) aged between 21 and 45 years, and (d) able to provide informed consent in English, Chinese, or Malay. Participants were recruited via official email invitations through graduate school offices and doctoral student social media groups (WeChat, WhatsApp, Facebook). Because recruitment included open channels, a traditional response rate cannot be calculated.

Data Collection Procedures

The primary challenge in data collection lay in achieving cross-cultural measurement equivalence. The questionnaire was administered via the Qualtrics platform in three language versions: English, Chinese, and Malay. Each version underwent translation-back-translation procedures and cultural adaptation testing to minimize systematic errors introduced by language differences (Boer et al., 2018). As illustrated in Figure 2, the data collection process incorporated four quality control checkpoints: (1) the pilot testing phase evaluated questionnaire comprehensibility and completion time; (2) attention check items embedded in the formal administration identified invalid responses; (3) the data cleaning stage eliminated responses with abnormal completion times and patterned responses; (4) measurement invariance testing confirmed cross-group comparability (Putnick & Bornstein, 2016).



Note: The flowchart illustrates the systematic process from sampling to analysis, with four quality control checkpoints ensuring data validity

Figure 2. Research design and data collection flowchart

The incentive mechanism (RM50 gift voucher lottery with 10% draw rate plus personalized psychological reports for all participants) was designed following previous research to enhance response rates while maintaining ethical standards. This compensation structure was reviewed and approved by the ethics committee as appropriate and non-coercive for the doctoral student population.

Measurement Instruments

The selection of measurement instruments followed dual standards of theoretical alignment and psychometric properties. The Academic Stress Scale (Appendix A) was developed based on doctoral student-specific stressors (Evans et al., 2018; Levecque et al., 2017), offering superior capture of unique demands within academic contexts compared to general stress scales. The survey was administered in three languages (English, Chinese, and Malay) via the Qualtrics platform. All scales underwent translation-back-translation procedures and cultural adaptation testing to ensure cross-cultural equivalence. Chinese and Malay versions are available from the corresponding author upon request. The Academic Burnout Scale (Appendix B) was adapted from the Maslach Burnout Inventory-General Survey (MBI-GS) (Maslach et al., 1996), whose three-dimensional structure (emotional exhaustion, depersonalization, reduced personal accomplishment) has been validated across multinational samples and demonstrates cross-cultural applicability.

The Doctoral Socialization Scale (Appendix C) was constructed based on Weidman and Stein's (2003) socialization framework and Gardner's (2007, 2008) empirical work, measuring core dimensions including academic identity formation and academic network integration. Psychological resilience was assessed using the Connor-Davidson Resilience Scale 10-item version (Appendix D) (CD-RISC-10) (Campbell-Sills & Stein, 2007; Connor & Davidson, 2003), which demonstrates sound reliability and validity across Chinese, Malay, and Indian cultures. The CD-RISC-10 is copyrighted; permission information is available at www.connordavidson-resiliencescale.com . The 10-item version maintained measurement precision while reducing respondent burden. The questionnaire comprised 57 items in total: 49 core measurement items (Academic Stress 12, Academic Burnout 15, Doctoral Socialization 12, Psychological Resilience 10) and 8 demographic items (Appendix E).

A pilot study was conducted with 38 doctoral students from UKM (14 Chinese, 13 Malay, 11 Indian) prior to the main data collection. The pilot evaluated the clarity of translated items and estimated completion time. Three items on the Socialization Scale were revised for cultural appropriateness based on participant feedback. Preliminary Cronbach's alpha values were 0.84 for Academic Stress, 0.87 for Academic Burnout, 0.86 for Doctoral Socialization, and 0.85 for Psychological Resilience. Mean completion time was 18.4 minutes (SD = 3.2).

Data Analysis Strategy

All analyses were conducted using SPSS 27.0 (descriptive statistics, correlations), Mplus 8.0 (CFA, SEM, multi-group invariance), and PROCESS Macro 4.0 (mediation and moderation bootstrapping). The analytical strategy corresponded directly to the hypothesis testing logic. Descriptive statistics and correlation analysis provided preliminary evidence for variable relationships. Common method bias was examined using Harman's single-factor test (Podsakoff et al., 2003) to ensure the validity of self-report data. Confirmatory factor analysis verified the measurement model's fit indices and discriminant validity. Acceptable model fit was defined as CFI and TLI ≥ 0.90, RMSEA ≤ 0.08, and SRMR ≤ 0.08; good fit as CFI and TLI ≥ 0.95, RMSEA ≤ 0.06, and SRMR ≤ 0.05 (Byrne, 2013). Measurement invariance testing progressed through three hierarchical levels (configural invariance, metric invariance, scalar invariance); only upon establishing scalar invariance could cross-group mean comparisons be conducted.

Structural equation modeling tested the mediating effect of H1, with path decomposition quantifying the relative contributions of direct and indirect effects. The Bootstrap procedure in the PROCESS Macro generated 5,000 resampled datasets to construct 95% confidence intervals for indirect effects;

the exclusion of zero values supports the mediation hypothesis. The moderating effect of H2 was examined by incorporating interaction terms in the SEM, with simple slope analysis revealing variations in the stress-burnout relationship strength across different resilience levels. Multi-group analysis compared path coefficients across the three ethnic groups, with chi-square difference tests determining the significance of between-group differences, thereby validating H3.

RESULTS

DATA SCREENING

The study collected data over 4 months, yielding 812 completed questionnaires. Data screening followed rigorous quality control procedures. Initially, 37 questionnaires with abnormal completion times were excluded: responses completed in less than 8 minutes, indicating rushed participation, and those exceeding 60 minutes, suggesting abnormal delays. Eighteen questionnaires exhibiting patterned responses were removed (10 or more consecutive identical responses). Because the Academic Burnout Scale contains five reverse-scored items (11-15), uniform responses produced contradictory scores. Independent-samples t-tests comparing deleted and retained cases on demographic variables and scale means revealed no significant differences (all $p > 0.10$). An additional 25 questionnaires with failing attention check items were eliminated. Missing value analysis of the remaining questionnaires identified 12 cases where key variables exceeded the acceptable 20% threshold for missingness, which were consequently deleted. Following these stringent screening procedures, 720 valid responses were retained, yielding a completion rate of 88.7% of returned questionnaires. Because recruitment included open social media channels, the total number of individuals exposed to the invitation is unknown; a traditional response rate cannot be reported.

Regarding sample composition, the dataset comprised 285 Chinese participants, 268 Malay participants, 142 Indian participants, and 25 participants from other ethnic groups. Given the limited sample size and high cultural heterogeneity of the other ethnic category, subsequent multi-group analyses included only the three major ethnic groups, yielding a final analytical sample of 695 participants. Within this sample, Chinese participants constituted 41.0%, Malay participants 38.6%, and Indian participants 20.4%.

Multivariate outlier detection employed the Mahalanobis distance method with a criterion of $p < 0.001$. This procedure identified eight extreme cases significantly deviating from the distribution center. Upon verification, these cases represented authentic data rather than entry errors and were therefore retained. Normality tests revealed that absolute skewness values for all major variables ranged from 0.12 to 0.87, while absolute kurtosis values ranged from 0.08 to 1.24, all falling within acceptable ranges for parametric statistical analysis and providing adequate justification for subsequent structural equation modeling. As a sensitivity check, all structural models were re-estimated with the eight outlier cases excluded; results remained unchanged.

Common method bias was evaluated using Harman's single-factor test (Podsakoff et al., 2003). Unrotated exploratory factor analysis showed that the first factor explained 34.3% of the total variance, substantially below the critical 50% threshold. Additionally, when a common latent factor was incorporated into the confirmatory factor analysis, model fit improvement proved non-significant ($\Delta\chi^2 = 18.34$, $\Delta df = 15$, $p = 0.243$). This convergent evidence indicated that common method bias did not pose a serious threat to the validity of the study's conclusions.

Table 1 results demonstrated that the three ethnic groups showed no significant differences across all demographic variables, including gender distribution, age, disciplinary distribution, study duration, funding status, marital status, and supervisory arrangement type, with all p-values exceeding 0.05.

This finding ensured balanced baseline characteristics across groups, suggesting that subsequently observed ethnic differences are more likely attributable to cultural factors rather than confounding effects of demographic characteristics, thereby providing important support for the validity of multi-group comparative analyses.

Table 1. Demographic characteristics and group comparisons

Variable	Total sample (n = 695)	Chinese (n = 285)	Malay (n = 268)	Indian (n = 142)	Test statistic	p
Gender, n (%)					$\chi^2 = 4.83$	0.305
Male	318 (45.8%)	125 (43.9%)	128 (47.8%)	65 (45.8%)		
Female	377 (54.2%)	160 (56.1%)	140 (52.2%)	77 (54.2%)		
Age (years)					F = 2.14	0.118
M (SD)	29.4 (4.2)	29.8 (4.1)	29.2 (4.3)	28.9 (4.5)		
Range	21-45	22-45	21-44	23-43		
Discipline, n (%)					$\chi^2 = 11.26$	0.081
STEM	278 (40.0%)	121 (42.5%)	105 (39.2%)	52 (36.6%)		
Social Sciences	208 (29.9%)	83 (29.1%)	78 (29.1%)	47 (33.1%)		
Humanities	139 (20.0%)	52 (18.2%)	58 (21.6%)	29 (20.4%)		
Other	70 (10.1%)	29 (10.2%)	27 (10.1%)	14 (9.9%)		
Study Duration					F = 1.67	0.189
M (SD)	3.1 (1.3)	3.2 (1.4)	3.0 (1.3)	3.0 (1.2)		
Range	2-7	2-7	2-6	2-6		
Funding Status, n (%)					$\chi^2 = 7.92$	0.095
Full Funding	492 (70.8%)	209 (73.3%)	195 (72.8%)	88 (62.0%)		
Partial Funding	143 (20.6%)	54 (18.9%)	53 (19.8%)	36 (25.4%)		
Self-funded	60 (8.6%)	22 (7.7%)	20 (7.5%)	18 (12.7%)		
Marital Status, n (%)					$\chi^2 = 8.45$	0.076
Single	397 (57.1%)	158 (55.4%)	147 (54.9%)	92 (64.8%)		
Married/Partnered	298 (42.9%)	127 (44.6%)	121 (45.1%)	50 (35.2%)		
Supervision Type, n (%)					$\chi^2 = 3.17$	0.530
Single Supervisor	285 (41.0%)	112 (39.3%)	115 (42.9%)	58 (40.8%)		
Joint Supervision	410 (59.0%)	173 (60.7%)	153 (57.1%)	84 (59.2%)		

Note. The three ethnic groups showed no significant differences across demographic variables (all $p > 0.05$), ensuring baseline comparability for multi-group analyses.

Descriptive Statistics and Correlations

Descriptive statistical analyses were conducted using SPSS 27.0, calculating means, standard deviations, and internal consistency reliability coefficients for all major variables in the total sample. Correlation analyses employed Pearson correlation coefficients to examine bivariate associations among variables. All scales utilized Likert-type measurements, with academic stress, academic burnout, and doctoral socialization assessed on seven-point scales, while psychological resilience employed a five-point scale. Higher scores indicated higher levels of the respective constructs. Table 2 presents descriptive statistics, reliability coefficients, and the correlation matrix among variables.

As shown in Table 2, mean scores for academic stress (M = 4.52, SD = 1.18) and academic burnout (M = 4.28, SD = 1.34) fell at the moderate-to-high range on the seven-point scale, indicating that the sampled doctoral students faced considerable stress and burnout. Doctoral socialization (M = 4.15, SD = 1.22) and psychological resilience (M = 3.24, SD = 0.76) were at moderate levels on their respective scales.

All scales demonstrated satisfactory internal consistency reliability. Cronbach's α coefficients were 0.91 for the Academic Stress Scale, 0.93 for the Academic Burnout Scale, 0.94 for the Doctoral Socialization Scale, and 0.89 for the Psychological Resilience Scale, all exceeding the 0.70 acceptable standard. Values above 0.90 for the first three scales may partly reflect the scale length (12–15 items each); however, inter-item correlations ranged from 0.30 to 0.70, indicating that item redundancy was not a concern.

Correlation patterns aligned with theoretical expectations (Table 2). Academic stress was positively associated with burnout ($r = 0.58$, $p < 0.001$) and negatively with socialization ($r = -0.41$, $p < 0.001$); burnout was negatively associated with socialization ($r = -0.52$, $p < 0.001$). The weaker stress-socialization correlation relative to the stress-burnout and burnout-socialization correlations was consistent with a mediation pattern. Psychological resilience correlated negatively with stress ($r = -0.28$, $p < 0.001$) and burnout ($r = -0.46$, $p < 0.001$), and positively with socialization ($r = 0.39$, $p < 0.001$), supporting its theoretical role as a protective resource. Control variables showed weak associations with core variables; study duration had a small positive correlation with socialization ($r = 0.15$, $p < 0.01$).

Table 2. Descriptive statistics, reliabilities, and correlation matrix

Variable	M	SD	α	1	2	3	4	5	6
1. Academic stress	4.52	1.18	0.91	—					
2. Academic burnout	4.28	1.34	0.93	0.58***	—				
3. Doctoral socialization	4.15	1.22	0.94	-0.41***	-0.52***	—			
4. Psychological resilience	3.24	0.76	0.89	-0.28***	-0.46***	0.39***	—		
5. Age	29.4	4.2	—	-0.06	-0.09*	0.08*	0.11**	—	
6. Study year	3.1	1.3	—	0.04	0.07	0.15**	0.03	0.52***	—

Note. N = 695. M = mean; SD = standard deviation; α = Cronbach's alpha. Academic stress, burnout, and socialization: 7-point scales; resilience: 5-point scale. *p < 0.05. **p < 0.01. ***p < 0.001.

The coefficient directions and magnitudes in the correlation matrix provided preliminary support for subsequent mediation and moderation effect testing. The strong positive correlation between academic stress and burnout, along with the strong negative correlation between burnout and socialization, fulfils prerequisite conditions for mediation effects. The negative correlations between psychological resilience and both stress and burnout provided preliminary evidence for its moderating role. Notably, the weak correlations between control variables and core variables suggested limited confounding effects of demographic characteristics on primary relationships; nevertheless, these variables were included as covariates in subsequent structural equation modeling to ensure precision in effect estimation.

Measurement Model

The measurement model underwent confirmatory factor analysis using Mplus 8.0. Based on prior literature and theoretical frameworks, a measurement model incorporating four latent variables was constructed: academic stress, academic burnout, doctoral socialization, and psychological resilience. Model estimation employed the maximum likelihood method, with full information maximum likelihood estimation handling missing data. Model fit was evaluated using χ^2, CFI, TLI, RMSEA, and SRMR (Byrne, 2013; Cheung & Rensvold, 2002).

Confirmatory factor analysis results indicated a good fit for the four-factor measurement model. As shown in Table 3, the model chi-square value was $\chi^2 = 1847.32$, df = 712, $p < 0.001$. Although the chi-square test reached significance, this statistic demonstrated sensitivity to sample size and commonly showed significance in large samples. Other fit indices all met acceptable standards: CFI = 0.95, TLI = 0.94, RMSEA = 0.049 with a 90% confidence interval of [0.046, 0.052], and SRMR = 0.042. All factor loadings proved significant with standardized coefficients ranging from 0.68 to 0.92, yielding an average factor loading of 0.81, indicating strong indicator representation of latent variables.

Table 3. Model fit indices for measurement and structural models

Model	χ^2	df	χ^2/df	CFI	TLI	RMSEA	90% CI	SRMR
Measurement model	1847.32***	712	2.59	0.95	0.94	0.049	[0.046, 0.052]	0.042
Structural model	1923.56***	715	2.69	0.94	0.93	0.051	[0.048, 0.054]	0.045

Note. N = 695. Both models controlled for age and study year. ***$p < 0.001$.

Reliability and validity assessments yielded satisfactory results. Beyond the aforementioned Cronbach's α coefficients, composite reliability was calculated as supplementary evidence. Composite reliability values for the four latent variables were: academic stress CR = 0.92, academic burnout CR = 0.94, doctoral socialization CR = 0.95, and psychological resilience CR = 0.90, all exceeding the 0.70 recommended threshold. Convergent validity was assessed through Average Variance Extracted (AVE), with the four variables demonstrating AVE values of 0.61, 0.67, 0.64, and 0.58, respectively, all surpassing the 0.50 critical standard, indicating that latent variables adequately explained variance in their indicator variables. Discriminant validity was examined using the Fornell-Larcker criterion, confirming that the square root of each latent variable's AVE exceeded its correlations with other latent variables, thereby establishing discriminant validity among variables. To further establish discriminant validity, the hypothesized four-factor model was compared against three alternative models. A single-factor model yielded substantially worse fit ($\chi^2 = 5284.67$, df = 718, CFI = 0.72, RMSEA = 0.097, SRMR = 0.109). A three-factor model combining stress and burnout into one factor also fit poorly ($\chi^2 = 3912.41$, df = 716, CFI = 0.81, RMSEA = 0.082, SRMR = 0.078). A three-factor model combining burnout and socialization produced similar results ($\chi^2 = 4156.23$, df = 716, CFI = 0.80, RMSEA = 0.084, SRMR = 0.083). All alternative models fit significantly worse than the four-factor model (all $\Delta\chi^2$ $p < 0.001$), supporting the distinctiveness of the four constructs.

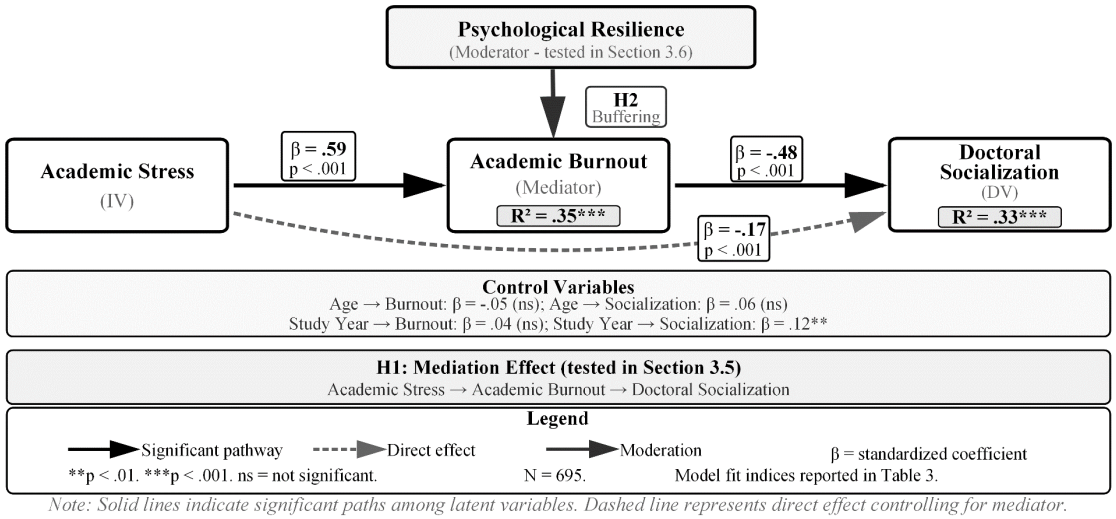
Cross-cultural measurement invariance was tested through progressively constrained models (Putnick & Bornstein, 2016). Configural invariance showed good fit ($\chi^2 = 3256.48$, df = 2136, CFI = 0.94, RMSEA = 0.048), confirming a common four-factor structure across groups. Metric invariance was supported ($\Delta\chi^2 = 42.27$, Δdf = 32, $p = 0.105$, ΔCFI = 0.000). Scalar invariance yielded $\Delta\chi^2 = 69.09$, Δdf = 32, $p = 0.001$, but ΔCFI = 0.01, within the accepted threshold (Cheung & Rensvold, 2002). Partial scalar invariance was established after freeing two intercepts on the Academic Burnout subscale for the Indian group, where these items showed differential functioning.

Structural Equation Model

Upon confirming satisfactory measurement model fit, a structural equation model was constructed to test the hypothesized pathways. The structural model added path relationships among latent variables to the measurement model, specifically including the predictive path from academic stress to academic burnout, the path from academic burnout to doctoral socialization, and the direct path from academic stress to doctoral socialization. Age and study duration were incorporated as control variables to account for their influence on endogenous variables. The structural model employed maximum likelihood estimation and reported standardized path coefficients to facilitate cross-path comparisons.

Structural model fit indices are presented in Table 3, demonstrating overall good fit: $\chi^2 = 1923.56$, df = 715, $p < 0.001$, CFI = 0.94, TLI = 0.93, RMSEA = 0.051, 90% CI [0.048, 0.054], SRMR = 0.045. Although the structural model fit was slightly lower than the measurement model, this represents a normal consequence of adding path constraints. Nevertheless, all fit indices remained within acceptable ranges, with CFI and TLI approaching the 0.95 excellent standard and RMSEA below the 0.06 good threshold, indicating satisfactory correspondence between the theoretical model and observed data. The path coefficient analysis results are illustrated in Figure 3. The path coefficient from academic stress to academic burnout was $\beta = 0.59$, SE = 0.04, $p < 0.001$, indicating that each standard deviation increase in academic stress corresponded to a 0.59 standard deviation increase in academic burnout. This strong positive association was consistent with the core proposition of JD-R theory that demands are associated with strain responses. The path coefficient from academic burnout to doctoral socialization was $\beta = -0.48$, SE = 0.04, $p < 0.001$, indicating that each standard deviation increase in burnout corresponded to a 0.48 standard deviation decrease in socialization level. This strong negative association indicated that burnout was substantially associated with reduced academic development.

The direct effect path coefficient from academic stress to doctoral socialization was $\beta = -0.17$, SE = 0.04, $p < 0.001$. This coefficient proved significant but substantially weaker than the total correlation between stress and socialization, $r = -0.41$, suggesting that academic burnout played a substantial mediating role in their relationship. Regarding control variables, age showed non-significant effects on burnout, $\beta = -0.05$, $p = 0.183$, and on socialization, $\beta = 0.06$, $p = 0.124$. Study duration demonstrated non-significant effects on burnout, $\beta = 0.04$, $p = 0.285$, but exhibited a weak positive effect on socialization, $\beta = 0.12$, SE = 0.04, $p = 0.003$, consistent with theoretical expectations that socialization deepens progressively throughout doctoral training.



Note: Solid lines indicate significant paths among latent variables. Dashed line represents direct effect controlling for mediator.

Figure 3. Structural equation model with standardized path coefficients

Variance explained in endogenous variables revealed that academic stress and control variables jointly explained 35% of the variance in academic burnout, $R^2 = 0.35$, $p < 0.001$, indicating that academic demands constituted an important source of burnout formation, though considerable variance remains to be explained by other factors. Academic stress, academic burnout, and control variables jointly explained 33% of the variance in doctoral socialization, $R^2 = 0.33$, $p < 0.001$, demonstrating moderate predictive power. These R^2 values fell within the moderate-to-high range for social science research, indicating that the model possessed substantial explanatory value.

These results were consistent with a partial mediation model: the independent variable significantly predicted the mediator, the mediator predicted the dependent variable, and the direct effect attenuated but remained significant when the mediator was controlled. Formal mediation testing followed.

Mediation Effects

Mediation effects were tested using PROCESS Macro 4.0 Model 4 with 5,000 bootstrap resamples and 95% bias-corrected confidence intervals; indirect effects are significant when the confidence interval excludes zero. Age and study duration were included as covariates.

Bootstrap analysis results, presented in Table 4, strongly supported the mediating role of academic burnout. The total effect of academic stress on doctoral socialization was $\beta = -0.45$, SE = 0.04, 95% CI [-0.53, -0.37], significantly negative, indicating that increases in academic stress were negatively associated with doctoral socialization levels. This total effect can be decomposed into direct and indirect effect components.

Direct effect analysis revealed that after controlling for the influence of academic burnout, academic stress retained a significant negative predictive effect on doctoral socialization, $\beta = -0.17$, SE = 0.04, 95% CI [-0.25, -0.09]. This effect's confidence interval excludes zero, indicating that even in the absence of burnout, academic stress itself was directly and negatively associated with the socialization process, likely stemming from stress-induced depletion of cognitive resources and attentional distraction.

The indirect effect represents the core focus of mediation analysis. Results demonstrated that academic stress exerted a significant negative indirect effect on doctoral socialization through the mediating role of academic burnout, $\beta = -0.28$, SE = 0.03, 95% CI [-0.34, -0.22]. This confidence interval fell entirely below zero, providing strong evidence supporting the existence of mediation effects. Specifically, each standard deviation increase in academic stress corresponded to a 0.59 standard deviation elevation in burnout levels, subsequently resulting in a 0.28 standard deviation decrease in socialization levels. This indirect pathway revealed an important psychological mechanism through which stress influenced socialization: stress was first associated with burnout as a strain response; doctoral students in burnout states exhibited emotional exhaustion, alienation, and diminished efficacy, which subsequently obstructed their active participation in academic community activities, academic network building, and academic identity formation.

Effect size analysis further quantified the importance of the mediating role. The proportion of total effect attributable to indirect effects was 62.2%, calculated as the absolute value of the indirect effect divided by the absolute value of the total effect (.28/.45 = 0.622). This proportion indicated that the primary transmission pathway through which academic stress influenced socialization operated via burnout mediation, with over 60% of the effect explained by this indirect mechanism. Correspondingly, the direct effect accounted for 37.8%, indicating that stress also exerted a non-negligible direct negative association with socialization.

Table 4. Mediation effects of academic burnout (bootstrap results)

Effect type	β	SE	95% CI	% of total
Total Effect	-0.45	0.04	[-0.53, -0.37]	100.0%
Academic Stress → Doctoral Socialization				
Direct Effect	-0.17	0.04	[-0.25, -0.09]	37.8%
Academic Stress → Doctoral Socialization (controlling for Academic Burnout)				
Indirect Effect	-0.28	0.03	[-0.34, -0.22]	62.2%
Academic Stress → Academic Burnout → Doctoral Socialization				

Effect type	β	SE	95% CI	% of total
Mediation Components				
Path a: Academic Stress → Academic Burnout	0.59	0.04	[0.51, 0.67]	—
Path b: Academic Burnout → Doctoral Socialization (controlling for Academic Stress)	-0.48	0.04	[-0.56, -0.40]	—

Note. N = 695. Bootstrap iterations = 5,000. All effects controlled for age and study year.

These results supported Hypothesis 1: academic burnout partially mediated the relationship between academic stress and doctoral socialization, with both significant indirect and direct effects present.

Moderation Effects

Moderation effects were tested using hierarchical regression and PROCESS Macro 4.0 Model 1. Academic stress and psychological resilience were mean-centered before computing the interaction term. Control variables were entered in Step 1, main effects in Step 2, and the interaction term in Step 3. Simple slope analysis probed the stress-burnout association at low (M − 1SD), moderate (M), and high (M + 1SD) resilience levels.

Hierarchical regression results showed that the control variable model explained 0.6% of variance in academic burnout, $R^2 = 0.006$, $F(2, 692) = 2.08$, $p = 0.126$, with neither control variable reaching significance. Adding main effects of academic stress and psychological resilience substantially increased explanatory power to 36.8%, $\Delta R^2 = 0.362$, $F(2, 690) = 196.42$, $p < 0.001$. The main effect of academic stress proved significant, $\beta = 0.52$, $SE = 0.03$, $p < 0.001$, as did the main effect of psychological resilience, $\beta = -0.25$, $SE = 0.03$, $p < 0.001$, indicating that, controlling for stress, individuals with higher resilience levels experienced lower burnout.

The critical interaction term test supported the moderation hypothesis. The interaction between academic stress and psychological resilience proved significantly negative, $\beta = -0.12$, $SE = 0.03$, $p < 0.001$, with this interaction term further increasing model explanatory power by 1.4%, $\Delta R^2 = 0.014$, $F(1, 689) = 15.63$, $p < 0.001$. Although the incremental explained variance appeared modest, upon the foundation of main effects already explaining substantial variance, an additional 1.4% explanatory power is considered substantive moderation in psychological research. The interaction yielded $f^2 = 0.023$, a small effect by J. Cohen's (1988) conventions but consistent with typical moderation effects. The negative coefficient of the interaction term indicated that psychological resilience buffered the negative impact of academic stress on burnout, meaning that among high-resilience individuals, the strength of the positive association between stress and burnout was attenuated.

Simple slope analysis further revealed the specific pattern of moderation effects, presented in Figure 4, Panel (a). In the low resilience group (mean minus one standard deviation), the simple slope of academic stress on burnout was $\beta = 0.64$, $SE = 0.04$, $t = 16.87$, $p < 0.001$, 95% CI [0.56, 0.72], indicating that the stress-burnout association was strongest. In the moderate resilience group (mean level), the simple slope decreased to $\beta = 0.52$, $SE = 0.03$, $t = 17.33$, $p < 0.001$, 95% CI [0.46, 0.58], essentially consistent with the main effect of stress on burnout in the total sample. In the high resilience group (mean plus one standard deviation), the simple slope further diminished to $\beta = 0.40$, $SE = 0.04$, $t = 10.53$, $p < 0.001$, 95% CI [0.32, 0.48]. Slopes at all three resilience levels reached significance, indicating that even among high-resilience individuals, stress was still associated with burnout, though the association strength represented only 62.5% of the low-resilience group. Slope difference testing revealed significant differences between low and high resilience groups, $\Delta\beta = 0.24$, $SE = 0.06$, $t = 4.00$, $p < 0.001$, confirming the significance of moderation effects.

Figure 4, Panel (a), visually illustrates the interaction pattern of moderation effects. The three slope lines display a fan-shaped distribution, with the low resilience group exhibiting the steepest slope and the high resilience group the most gradual. When academic stress remains at low levels, burnout level

differences among the three resilience groups are relatively minor; however, as stress levels increase, between-group differences gradually expand, with high-resilience individuals' burnout growth rates notably slower than low-resilience individuals. This interaction pattern conforms to typical buffering effect characteristics, namely that protective resources exert more pronounced effects under high-stress conditions.

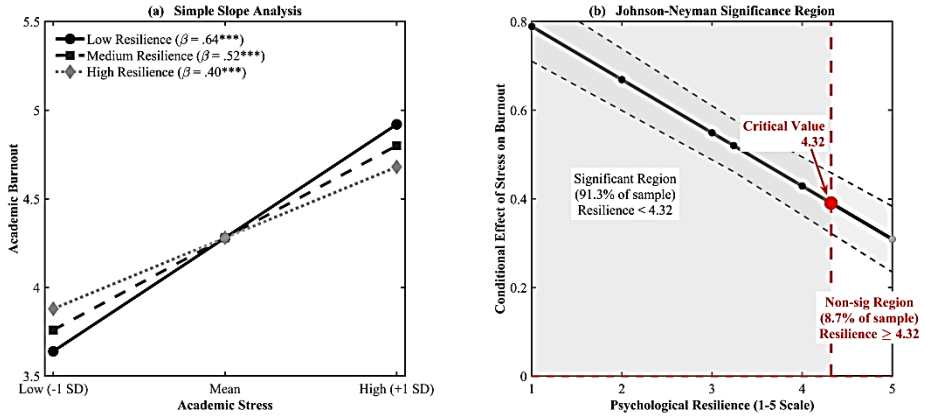


Figure 4. Moderation effects of psychological resilience on the academic stress-burnout relationship

Following Johnson and Neyman's (1936) procedure, the significance region of moderation effects was further identified, presented in Figure 4, Panel (b). This analysis calculated changes in the conditional effect of academic stress on burnout across the entire resilience continuum, precisely locating the critical point where effects transition from significant to non-significant. Results indicated that when psychological resilience scores fell below 4.32 (on the five-point scale), the positive effect of academic stress on burnout remained significant with confidence intervals excluding zero; when resilience scores reached 4.32 or above, although effects remained positive, statistical significance weakened. Figure 4, Panel (b), clearly displays the conditional effect curve and its 95% confidence interval, with the gray shaded region identifying the significance region (resilience < 4.32), encompassing 91.3% of the sample; the white region represents the non-significance region (resilience ≥ 4.32), containing only 8.7% of the sample. This indicated that high resilience could reduce stress impact to statistically unstable levels, though only a minority of individuals in this sample attained such high resilience levels, suggesting that most doctoral students' resilience levels remained insufficient to completely offset the negative effects of stress.

These results supported Hypothesis 2. Psychological resilience significantly moderated the stress-burnout relationship: high-resilience individuals showed a weaker stress-burnout association than low-resilience individuals. From low to high resilience, the predictive effect of stress on burnout decreased by 37.5% at the group level (a difference in path coefficients, not individual-level variation). Although all three slope levels remained significant, the progressive attenuation across resilience levels indicated a meaningful buffering pattern.

Cross-Cultural Comparison

To test the generalizability of the research model across doctoral student populations from different cultural backgrounds, multi-group structural equation modeling analysis was conducted. The sample was divided into three groups according to cultural background: Chinese group (n = 285, 41.0%), Malay group (n = 268, 38.6%), and Indian group (n = 142, 20.4%). Multi-group analysis followed rigorous invariance testing procedures: first establishing configural invariance, allowing parameters to be freely estimated across groups to test whether model structure applied across groups; second testing metric invariance, constraining factor loadings to equality to ensure cross-group equivalence of latent variable measurement; finally testing structural invariance, constraining path coefficients to equality

to test cross-cultural stability of relationship strength. Model comparisons employed chi-square difference tests ($\Delta\chi^2$) and CFI change (ΔCFI) as evaluation criteria, with more stringent constrained models acceptable when $\Delta CFI < 0.010$ (Cheung & Rensvold, 2002).

The configural invariance model demonstrated good fit, $\chi^2 = 3156.82$, df = 2145, CFI = 0.93, RMSEA = 0.052, indicating that the four-factor measurement structure held across all three cultural groups. Comparison of the metric invariance model with the configural model showed $\Delta\chi^2 = 38.45$, $\Delta df = 32$, $p = 0.197$, $\Delta CFI = 0.003$, supporting cross-group equivalence of factor loadings. Comparison of the structural invariance model with the metric invariance model showed $\Delta\chi^2 = 28.73$, $\Delta df = 9$, $p = 0.001$, $\Delta CFI = 0.008$; although the chi-square test reached significance, CFI change did not exceed the threshold, suggesting partial cross-group differences in path coefficients but overall stability.

Multi-group path coefficient estimates are presented in Table 5. The path from academic stress to academic burnout proved significantly positive across all three cultural groups, though with slight differences in strength: Chinese group $\beta = 0.62$, $p < 0.001$, Malay group $\beta = 0.58$, $p < 0.001$; Indian group $\beta = 0.55$, $p < 0.001$. Chi-square difference testing across the three groups reached significance, $\Delta\chi^2 = 6.89$, df = 2, $p = 0.032$. Post-hoc comparisons revealed marginally significant differences between Chinese and Indian groups ($p = 0.048$), with non-significant differences between Chinese and Malay groups and between Malay and Indian groups, indicating that stress impact on burnout proved slightly stronger in the Chinese population, though overall differences remained modest.

The negative path from academic burnout to doctoral socialization similarly proved significant across all three groups, with relatively consistent strength: Chinese group $\beta = -0.49$, $p < 0.001$, Malay group $\beta = -0.47$, $p < 0.001$, Indian group $\beta = -0.48$, $p < 0.001$. Chi-square difference testing across groups showed non-significance, $\Delta\chi^2 = 0.52$, df = 2, $p = 0.771$, supporting cross-cultural stability of this path, indicating that the negative association between burnout and socialization transcended cultural background. The direct effect path from academic stress to doctoral socialization proved significantly negative across all three groups, with coefficients of: Chinese group $\beta = -0.18$, Malay group $\beta = -0.16$, Indian group $\beta = -0.17$, with non-significant between-group differences, $\Delta\chi^2 = 0.38$, df = 2, $p = 0.827$.

The moderating role of psychological resilience exhibited pronounced cross-cultural differences. The interaction term (academic stress × psychological resilience) proved strongest in the Chinese group, $\beta = -0.15$, $p < 0.001$, $\beta = -0.12$, $p = 0.002$ in the Malay group, while weaker and not reaching traditional significance levels in the Indian group, $\beta = -0.07$, $p = 0.089$. Chi-square difference testing across the three groups reached significance, $\Delta\chi^2 = 8.94$, df = 2, $p = 0.011$. Post-hoc comparisons revealed significant differences between Chinese and Indian groups ($p = 0.008$), non-significant differences between Chinese and Malay groups ($p = 0.186$), and marginally significant differences between Malay and Indian groups ($p = 0.067$). These results indicated that the stress-buffering effect of psychological resilience proved significant in Chinese and Malay populations but did not reach significance in the Indian population. This may have reflected cultural background moderation of resilience function, as well as limitations in existing resilience scales' capture of different cultural coping mechanisms. Cultural interpretations of this pattern are presented in the Discussion section.

Table 5. Multi-group path coefficients and invariance tests

Path	Chinese (n=285)	Malay (n=268)	Indian (n=142)	$\Delta\chi^2$ (df=2)	p
Main Effects					
Academic Stress → Academic Burnout	0.62***	0.58***	0.55***	6.89	0.032
	(0.04)	(0.05)	(0.06)		

Path	Chinese (n=285)	Malay (n=268)	Indian (n=142)	$\Delta\chi^2$ (df=2)	p
Academic Burnout → Doctoral Socialization	-0.49***	-0.47***	-0.48***	0.52	0.771
	(0.05)	(0.06)	(0.06)		
Academic Stress → Doctoral Socialization (Direct Effect)	-0.18***	-0.16**	-0.17**	0.38	0.827
	(0.05)	(0.06)	(0.07)		
Moderation Effect					
Academic Stress × Psychological Resilience	-0.15***	-0.12**	-0.07	8.94	0.011
	(0.04)	(0.05)	(0.06)		
Model Fit Indices					
R^2 (Academic Burnout)	0.38	0.34	0.31	—	—
R^2 (Doctoral Socialization)	0.35	0.32	0.30	—	—

Note. Standardized path coefficients with standard errors in parentheses. **p < 0.01 ***p < 0.001.

These results indicated that the negative relational chain among academic stress, academic burnout, and doctoral socialization held across all three cultural groups, demonstrating the cross-cultural applicability of this theoretical model. However, cultural differences in the moderating role of psychological resilience suggested that protective resource function was influenced by cultural context. Cross-cultural comparisons revealing differences in resilience moderation effects provided important insights for understanding the cultural contextual dependence of protective resources. Figure 5 provides an integrated display of pathway differences and cultural characteristics across the three groups. Table 6 consolidates the key findings across all three hypotheses and ethnic groups.

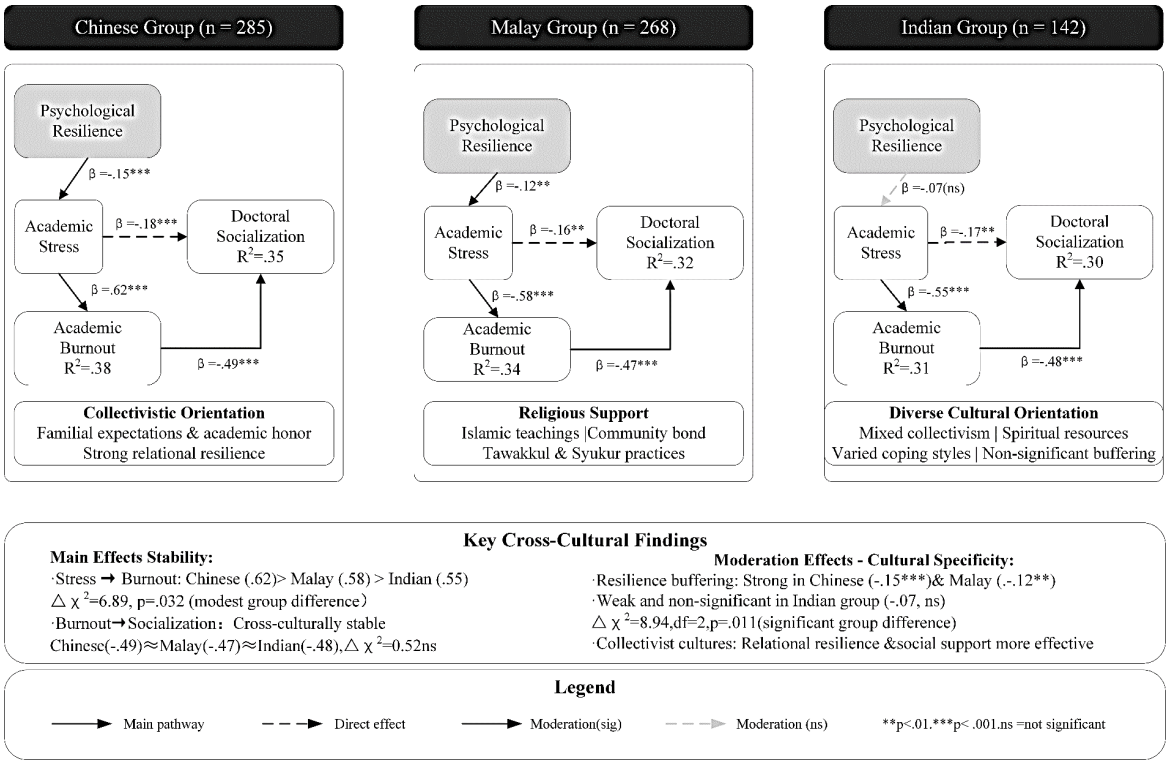


Figure 5. Multi-group comparison of path coefficients and cultural characteristics across Chinese, Malay, and Indian groups

Table 6. Summary of key findings across hypotheses and ethnic groups

Path	Total sample	Chinese (n = 285)	Malay (n = 268)	Indian (n = 142)
H1: Mediation (total sample)				
Total effect (Stress → Socialization)	–0.45 [–0.53, –0.37]	—	—	—
Indirect effect (via Burnout)	–0.28 [–0.34, –0.22]	—	—	—
Direct effect	–0.17 [–0.25, –0.09]	—	—	—
% mediated	62.2%	—	—	—
H2: Moderation				
Stress × Resilience → Burnout	–0.12***	–0.15***	–0.12**	–0.07 (ns)
f^2	0.023	—	—	—
H3: Multi-group paths				
Stress → Burnout	0.59***	0.62***	0.58***	0.55***
Burnout → Socialization	–0.48***	–0.49***	–0.47***	–0.48***
Stress → Socialization (direct)	–0.17***	–0.18***	–0.16**	–0.17**
R^2 (Burnout)	0.35	0.38	0.34	0.31
R^2 (Socialization)	0.33	0.35	0.32	0.30

Note. Bootstrap iterations = 5,000. CIs are 95% bias-corrected. Mediation tested on total sample; group-specific indirect effects not reported due to power constraints for the Indian subgroup. **p < 0.01, ***p < 0.001, ns = not significant.

DISCUSSION

This study tested whether academic burnout mediates the stress-socialization pathway, whether psychological resilience buffers the stress-burnout link, and whether these mechanisms vary across ethnic groups. The findings supported all three propositions, though the buffering role of resilience proved culturally bound. These findings illuminated the formation mechanisms of doctoral students' psychological difficulties, validated the applicability of JD-R theory in doctoral education contexts (Nagy et al., 2019), and extended the cultural boundaries of resilience theory.

The mediating chain through which academic stress was negatively associated with doctoral socialization via academic burnout clearly demonstrated the process of resource depletion. Academic demands including publication pressures, supervisory expectations (Hermana et al., 2025), and financial burdens continuously depleted individuals' cognitive and emotional resources; when these resources could not be replenished, individuals entered burnout states characterized by emotional exhaustion, academic alienation, and loss of efficacy (Emerson et al., 2023; Liu & Cao, 2022). Burnout subsequently comprehensively impeded the socialization process: exhausted individuals lacked the energy to participate in academic community activities, alienation weakened their identification with academic identity, and diminished efficacy led them to avoid challenging academic tasks, ultimately damaging core socialization elements such as academic network building, disciplinary norm internalization, and research skill development (Michael et al., 2024). Notably, stress retained a significant direct effect on socialization, suggesting that beyond operating through burnout, stress also directly depleted cognitive resources needed for socialization (Mavrogalou-Foti et al., 2024).

Psychological resilience, as a protective resource, demonstrated a significant buffering effect in the stress-burnout relationship. Simple slope analysis revealed that the stress-burnout association was substantially stronger in the low-resilience group than in the high-resilience group. This buffering

mechanism operated at three levels: at the cognitive level, high-resilience individuals reframed setbacks as growth opportunities; at the emotional level, resilience enhanced emotion regulation capacity, effectively managing anxiety (Dessauvagie et al., 2022; Michael et al., 2024); at the behavioral level, resilience promoted adaptive coping strategies such as seeking support and flexibly adjusting plans. Johnson and Neyman's (1936) analysis identified a resilience threshold above which the stress-burnout association became non-significant, yet fewer than one in ten participants reached this level, suggesting that most doctoral students' resilience reserves remained insufficient to fully offset stress effects (Ríos-Risquez et al., 2018).

The cultural difference patterns revealed through multi-group analysis (Figure 5) provided important insights for understanding the cultural contextual dependence of stress-adaptation processes. The main effect of stress on burnout proved strongest in the Chinese group, followed by the Malay group, with the Indian group relatively weaker. Although differences remained modest, they reflected how cultural scripts shaped stress perception. The collectivistic cultural orientation of the Chinese Malaysian population, characterized by familial expectations and emphasis on academic achievement as family honor, may amplify subjective stress intensity and accelerate burnout progression.

More critically, the moderation effect exhibited cultural specificity. In collectivistic cultures, resilience manifested more as relational resilience and social support mobilization, with individuals under stress turning to family, peers, and religious communities. The Islamic faith of the Malay population may provide additional resilience sources through positive reframing and meaning-making. The non-significant moderation in the Indian group may have reflected several factors: (a) the smaller sample (n = 142) limited power for detecting small interaction effects; (b) partial scalar invariance required releasing two intercepts on the Burnout subscale for this group, potentially introducing measurement noise; and (c) the Malaysian Indian diaspora likely encompasses diverse subcommunities with varying cultural orientations. Hofstede's national individualism score for India (48) suggests moderate collectivism rather than individualism; applying national scores to a diaspora population requires caution. These alternative explanations should be weighed against cultural interpretations.

The conceptual theoretical contribution of this study was threefold: (a) demonstrating burnout as a mediating pathway between academic stress and doctoral socialization, extending JD-R theory into doctoral education; (b) testing resilience as a culturally moderated buffer within a single multiethnic sample; and (c) conducting simultaneous mediation-moderation testing with invariance checks across three ethnic groups (Cornér et al., 2017; Sverdlik et al., 2018). Cross-cultural findings confirmed that protective resource functionality was shaped by cultural context.

Implications for Practice and Future Research

At the practical level, this research identified a three-tier prevention system for doctoral education reform: primary prevention requires reducing stress at the source by optimizing mentorship systems, rationalizing publication requirements, and providing financial support (Mavrogalou-Foti et al., 2024); secondary prevention should enhance resilience through culturally tailored interventions. For different cultural groups, resilience cultivation programs require localized adaptation. Interventions for Chinese and Malay doctoral students can strengthen social support network building (such as peer support groups and mentor-student connections) and integrate religious/cultural resources (such as Islamic community support for Malay groups) (Liu & Cao, 2022). For Indian doctoral students, beyond providing social support, interventions should respect and integrate spiritual practice resources from their cultural traditions, such as mindfulness meditation, yoga, and breathing regulation techniques, which have been demonstrated to effectively alleviate stress and enhance psychological resilience. Simultaneously, cultivating cognitive reframing and problem-solving skills benefits all cultural groups. Importantly, intervention designers need to adopt an attitude of cultural humility, collaboratively exploring with doctoral students from different ethnic groups the coping resources they consider most effective, rather than unilaterally imposing standardized intervention programs.

Tertiary prevention requires early identification of high-risk burnout individuals and provision of psychological counseling and academic guidance.

Several limitations should be noted. First, cross-sectional design limits causal inference; longitudinal tracking is needed to validate the proposed mechanisms. Second, self-report scales carry common method bias risks and should be supplemented with physiological indicators and behavioral observations. Third, the sample was limited to Malaysia, and within-group cultural heterogeneity was inadequately explored. Fourth, the resilience measure may favor collectivistic coping scripts, and culturally specific scales should be developed. Fifth, the Academic Stress Scale and Doctoral Socialization Scale were developed for this study and lack prior published validation evidence, which should be addressed in future psychometric work. Future research should conduct intervention experiments to test causal relationships, compare the effectiveness of resilience cultivation programs across different cultural frameworks, employ multilevel modeling to incorporate system-level factors such as departmental climate and mentoring styles, and extend to other cultural contexts to test the model's cross-regional generalizability (Park et al., 2021; Peltonen et al., 2017).

In summary, H1 was supported: burnout partially mediated the stress-socialization relationship. H2 was supported overall: resilience moderated the stress-burnout path. H3 was partially supported: mediation paths were invariant across groups, but moderation paths differed, with resilience buffering significant in Chinese and Malay groups but not in the Indian group. These findings offer an evidence-based foundation for culturally sensitive doctoral student support systems.

CONCLUSION

This study demonstrated that academic burnout served as a critical mediating pathway through which academic stress was negatively associated with doctoral socialization among Malaysian doctoral students. The stress-buffering role of resilience varied across ethnic groups, operating effectively within Chinese and Malay collectivistic contexts but not reaching significance in the Indian group. These findings extended JD-R theory (Bakker & Demerouti, 2017) into doctoral education and aligned with evidence that resilience functioned differently across cultural settings (Boer et al., 2018).

Theoretically, the contribution lay in simultaneously modeling mediation and culturally moderated buffering within a single multiethnic sample, challenging the assumption that protective resources operate uniformly across cultures. The findings provided evidence for the cultural script dependence of protective resources: relational resilience and social support mobilization appeared more effective under collectivistic frameworks, while other cultural orientations may require different measurement approaches. This extended resilience theory's cultural boundaries and challenged assumptions of psychological resource universality.

Practically, these findings called for moving beyond one-size-fits-all support models toward culturally responsive interventions that address both structural stressors and group-specific resilience pathways. Two priorities stand out for future research: longitudinal and intervention designs to establish causal relationships, and development of culturally specific resilience measures that capture diverse coping resources beyond those emphasized in Western scales. Ultimately, doctoral students' professional development cannot be understood in isolation from their psychological well-being, and culturally responsive support systems are essential for successful socialization in multiethnic educational contexts.

DATA AVAILABILITY STATEMENT

In accordance with the ethical approval conditions (UKM-PPI/111/8/JEP-2024-103) and to protect participant confidentiality, the raw data supporting this study cannot be made publicly available. Ag-

gregated data and analysis scripts are available from the corresponding author upon reasonable request, subject to UKM data protection policies. All data sharing requests will be reviewed to ensure compliance with ethical and privacy requirements.

ETHICS STATEMENT

This study was conducted in accordance with the Declaration of Helsinki and approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia (Protocol: UKM-PPI/111/8/JEP-2024-103; Date: June 15, 2024). Electronic informed consent was obtained from all participants prior to their involvement in the study.

ACKNOWLEDGMENTS

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APPENDIX A. ACADEMIC STRESS SCALE

Instructions: Please indicate your level of agreement with each statement regarding your current doctoral study experience.

Response Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Agree nor Disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

Publication Pressure

1. I feel overwhelmed by the pressure to publish research papers.
2. The publication requirements create significant stress in my doctoral journey.
3. I worry constantly about meeting publication expectations for graduation.

Supervisory Relationship

4. My relationship with my supervisor(s) is a source of considerable stress.
5. I experience anxiety about meeting my supervisor's expectations.
6. Communication with my supervisor causes me stress.

Financial Concerns

7. Financial pressures negatively impact my ability to focus on research.
8. I frequently worry about my financial situation during doctoral studies.
9. Lack of adequate funding is a major source of stress for me.

Work-Life Balance

10. I struggle to maintain balance between doctoral work and personal life.
11. The doctoral program demands leave me insufficient time for personal activities.
12. I feel stressed by conflicting academic and personal responsibilities.

APPENDIX B. ACADEMIC BURNOUT SCALE

Instructions: Please indicate how frequently you experience each of the following feelings related to your doctoral studies.

Response Scale: 1 = Never, 2 = A Few Times a Year or Less, 3 = Once a Month or Less, 4 = A Few Times a Month, 5 = Once a Week, 6 = A Few Times a Week, 7 = Every Day

Emotional Exhaustion

1. I feel emotionally drained from my doctoral work.
2. I feel burned out from my doctoral studies.
3. I feel fatigued when facing another day of doctoral work.
4. Working on my doctoral research all day is really a strain for me.
5. I feel used up at the end of a day of doctoral work

Cynicism/Academic Alienation

6. I have become less enthusiastic about my doctoral studies.
7. I have become cynical about whether my research contributes meaningfully.
8. I doubt the significance of my academic work.
9. I feel disconnected from my academic field.
10. I have lost interest in my doctoral research.

Reduced Personal Accomplishment

11. I can effectively solve problems in my doctoral research. (Reverse coded)
12. I am making an effective contribution to my academic field. (Reverse coded)
13. I am good at my doctoral work. (Reverse coded)
14. I feel exhilarated when I accomplish something in my research. (Reverse coded)
15. I have accomplished many worthwhile things in my doctoral program. (Reverse coded)

APPENDIX C. DOCTORAL SOCIALIZATION SCALE

Instructions: Please indicate your level of agreement with each statement regarding your experiences as a doctoral student.

Response Scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neither Agree nor Disagree, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree

Academic Identity Formation

1. I have developed a strong sense of identity as a scholar in my field.
2. I see myself as a legitimate member of my academic discipline.
3. I identify strongly with my chosen academic field.

Academic Network Integration

4. I have established meaningful professional relationships with faculty.
5. I actively participate in academic conferences and scholarly meetings.
6. I have built a network that supports my academic development.

Disciplinary Norms Internalization

7. I understand the core theoretical frameworks in my field.
8. I am familiar with the methodological standards of my discipline.
9. I have mastered conventions for scholarly communication in my field.

Research Skills Development

10. I have developed advanced research skills for independent scholarship.
11. I am confident in designing and executing research projects.
12. I can critically evaluate research literature in my area of study.

APPENDIX D. PSYCHOLOGICAL RESILIENCE SCALE (CD-RISC-10)

Instructions: Please indicate how much you agree with the following statements as they apply to you over the past month.

Response Scale: 1 = Not True at All, 2 = Rarely True, 3 = Sometimes True, 4 = Often True, 5 = True Nearly All the Time

1. I am able to adapt when changes occur.
2. I can deal with whatever comes my way.
3. I try to see the humorous side when faced with problems.
4. Coping with stress can strengthen me.
5. I tend to bounce back after illness, injury, or hardships.
6. I can achieve my goals, even if there are obstacles.
7. Under pressure, I stay focused and think clearly.
8. I am not easily discouraged by failure.
9. I think of myself as strong when dealing with challenges.
10. I can handle unpleasant feelings like sadness, fear, and anger.

APPENDIX E. DEMOGRAPHIC AND BACKGROUND INFORMATION

Instructions: Please provide the following information about yourself.

1. Age: _____ years

2. Gender:
   [ ] Male
   [ ] Female
   [ ] Non-binary
   [ ] Prefer not to say

3. Ethnicity:
   [ ] Chinese
   [ ] Malay
   [ ] Indian
   [ ] Other (please specify): _____

4. Field of Study:
   [ ] STEM (Science, Technology, Engineering, Mathematics)
   [ ] Social Sciences
   [ ] Humanities
   [ ] Other (please specify): _____

5. Year of Doctoral Study:
   [ ] Year 1
   [ ] Year 2
   [ ] Year 3
   [ ] Year 4
   [ ] Year 5
   [ ] Year 6 or above

6. Funding Status:
   [ ] Full funding (scholarship/fellowship)
   [ ] Partial funding
   [ ] Self-funded

7. Marital Status:
   [ ] Single
   [ ] Married/Partnered
   [ ] Other

8. Type of Supervision:
   [ ] Single supervisor
   [ ] Joint supervision (co-supervisors)

AUTHORS

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