

# Psychological resilience and social adaptation among college students facing stressful events: a moderated mediation model

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## Article

**Keywords:** social adaptation, psychological resilience, stressful events, intervention measures, college students

**Posted Date:** October 22nd, 2026

**DOI:** <https://doi.org/10.21203/rs.3.rs-10823584/v1>

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**Additional Declarations:** No competing interests reported.

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# Abstract

Social adaptation is important to university students' academic and interpersonal functioning, yet the pathways linking stressful events to adaptation remain insufficiently integrated. This cross-sectional study examined whether psychological resilience statistically mediated the association between stressful events and social adaptation among Chinese university students and whether a self-reported intervention-measure score moderated the modelled pathways. A survey of 910 students used the China College Student Adjustment Scale, China College Student Psychological Stress Scale, Psychological Resilience Scale, and a 10-item intervention-measure composite. Regression, 10,000-sample bootstrap mediation, and 5,000-sample conditional-effect analyses were conducted. Stressful events were negatively associated with social adaptation after covariate adjustment ( $B = -0.067$ ,  $\beta = -0.163$ ,  $p < 0.001$ ). Psychological resilience carried an indirect association of  $-0.021$  (95% bootstrap confidence interval  $[-0.043, -0.001]$ ), representing 30.32% of the total association. The interaction between stress and the intervention-measure score was positive for resilience ( $B = 0.071$ ,  $p = 0.003$ ) but negative for adaptation ( $B = -0.042$ ,  $p < 0.001$ ). The resilience-by-intervention-measure interaction was not significant ( $B = 0.032$ ,  $p = 0.057$ ). These findings indicate that resilience-related and direct adaptation pathways should be distinguished when considering potentially modifiable support and coping resources.

## Introduction

Mental health is more than the absence of mental disorder. It can be understood as a dynamic state of internal equilibrium that supports cognitive and social abilities, emotion regulation, coping, and functioning in valued roles (Chongde et al. 2003; Galderisi et al. 2015). Psychological well-being is related but distinct: it denotes positive functioning across autonomy, environmental mastery, personal growth, positive relations, purpose in life, and self-acceptance (Ryff 1989). For university students, social adaptation connects these intrapersonal capacities with effective participation in academic and interpersonal life. It is therefore a behavioural and relational expression of mental health and well-being, not a synonym for either.

Social adaptation refers to the capacity to fit into a social environment, acquire context-appropriate skills, and negotiate interpersonal and role demands (Ward and Kennedy 1999). Here, it includes interpersonal communication, learning, campus life, career planning, emotional adjustment, self-adaptation, and satisfaction (Fengyu 2023; Ke and Yuxiang 2024; Yan and Gangshun 2022; Ying et al. 2014; Zewen et al. 2021). This capacity is consequential during emerging adulthood, a period marked by identity exploration and instability in education, work, and relationships (Arnett 2000). Students must respond to changing academic expectations, diverse social values, financial uncertainty, and career decisions. Academic performance, pressure to succeed, post-graduation plans, and financial concerns are prominent correlates of student depression, anxiety, and stress (Beiter et al. 2015). Adaptation therefore requires coordinating personal resources with a changing institutional and social environment.

Stress and stressful events should be distinguished. Psychological stress is a person-environment transaction appraised as taxing or exceeding coping resources and threatening well-being (Keshan 2003; Lazarus and Folkman 1984). A stressful event is a discrete external occurrence that requires substantial readjustment and may initiate emotional, cognitive, behavioural, and biological responses (Holmes and Rahe 1967; Monroe 2008). Short-term activation can be adaptive, but repeated or prolonged activation can accumulate as allostatic load and increase vulnerability to psychological and physical problems (McEwen 1998; Slavich 2016). Psychological resilience is the capacity and dynamic process through which positive adaptation is maintained or regained under adversity (Fletcher and Sarkar 2013; Luthar et al. 2000; Masten 2001). Meta-analytic evidence links resilience positively with life satisfaction and positive affect and negatively with depression, anxiety, and negative affect (Hu et al. 2015). Resilience may therefore help explain variation in students' adaptation following stressful events.

Prior research has linked stressful events with mental-health outcomes, resilience with positive adaptation, and social support with stress buffering. However, fewer studies have examined these constructs together in relation to the multidimensional social adaptation of university students. This study therefore tests whether stressful events are associated with poorer social adaptation, whether psychological resilience statistically mediates that association, and whether a composite score reflecting perceived support and personal coping activities moderates the modelled pathways. Because the data are cross-sectional and observational, mediation and moderation refer to statistical patterns rather than established temporal or causal processes.

## **Literature review and hypotheses**

### **Stressful events and social adaptation**

Selye's experiments described a nonspecific biological response to diverse harmful agents and established a foundation for modern stress research (Selye 1936). Contemporary psychological accounts treat stress as a transaction among environmental demands, personal appraisal, and coping resources (Lazarus and Folkman 1984). Thus, students exposed to similar demands may interpret them differently and experience different levels of distress.

Stressful events disrupt usual activities or require behavioural and psychological readjustment (Holmes and Rahe 1967; Monroe 2008; Rahe et al. 1964). They include major acute events and repeated daily difficulties, whose effects vary with severity, timing, duration, controllability, and personal meaning (Monroe 2008; Slavich 2016). When demands persist or coping resources are insufficient, stress responses may develop into sustained negative affect, anxiety, or depressive symptoms (McEwen 1998; Slavich 2016). Student stressful events have accordingly been associated with depression, negative affect, nonsuicidal self-injury, and suicidal ideation (Ailou and Kuo 2024; Bjørndal 2023; Lin et al. 2019; Yang et al. 2022).

At the macro level, social adaptation concerns adjustment to society and the natural environment; at the micro level, it concerns the skills used to participate in social life (Greenspan and Granfield 1992; Fang 2005; Liu 2003). Here, social adaptation is defined as using personal skills and external resources to manage social roles, relationships, rules, and pressures (Cohen and Wills 1985; Gross and John 2003; Haidt and Joseph 2008). Emotion regulation has also been identified as a potential pathway linking rejection sensitivity to social adjustment in adolescents (Jiexia and Nala 2023).

It is widely acknowledged in academia that stressful events have a negative impact on individuals' social adaptation. Negative life events, as common occurrences in the lives of adolescents, adversely affect their physical and mental health and serve as strong predictors of poor social adaptability (Yibing and Hong 2011). Among these, academic pressure and interpersonal conflicts are the most prominent stressful events for students. They significantly negatively predict positive social adaptation and significantly positively predict negative social adaptation (Ying et al. 2012). Similarly, individuals who have experienced major stressful events often face challenges in social adaptation (Aldwin and Yancura 2004). Even the smallest negative life events, when continuously accumulated as persistent sources of stress, can have long-term and cumulative negative effects on an individual's social adaptability—effects that may even surpass those caused by severe stressful events (Jeronimus et al. 2013).

Hypothesis 1 (H1). Stressful events are negatively associated with college students' social adaptation.

## **The mediating role of psychological resilience**

Psychological resilience has been conceptualized as a stable trait, a positive adaptive outcome, or a dynamic process. Across these approaches, adversity and positive adaptation are central (Fletcher and Sarkar 2013). Trait models emphasize enduring capacity (Connor and Davidson 2003), outcome models emphasize successful adaptation under adversity (Masten 2001), and process models emphasize continuing person-environment interaction (Luthar et al. 2000). Because the Psychological Resilience Scale used here assesses confidence, perseverance, and coping, the study adopts a process-oriented interpretation while recognizing that the measure captures relatively stable individual differences.

Resilience may buffer stress through flexible appraisal, emotion regulation, persistence, and the mobilization of social and personal resources. More resilient students may preserve goal-directed behaviour and relationships under pressure, whereas those with fewer resources may be more vulnerable to distress and withdrawal (Yulong et al. 2024). Meta-analytic evidence links trait resilience positively with life satisfaction and positive affect and negatively with depression, anxiety, and negative affect (Hu et al. 2015). Research among university students has also linked psychological resilience with physical activity and well-being (Jing 2020). Although these associations do not establish causality, they support resilience as a plausible pathway between stressful events and social adaptation.

Stressful life events predict psychological crises among university students partly through resilience (Jing et al. 2019). Resilience also mediates associations between social support and post-traumatic

stress and is positively related to social adaptation (Chunhua et al. 2023; Jiangli et al. 2023; Li et al. 2021; Liping et al. 2013). These findings support resilience as a mechanism linking stressful events to adaptation.

Hypothesis 2 (H2). Psychological resilience mediates the association between stressful events and social adaptation.

## The moderating role of intervention measures

Stressful events may challenge both internal coping capacities and access to external resources. The present study therefore examined a self-reported intervention-measure score that combines perceived social support with personal coping activities, including exercise, leisure, communication, and self-regulation. The term intervention measure describes potentially modifiable resources; it does not indicate that participants were assigned to, or received, a standardised intervention. Social support has long been proposed as a resource that can alter the association between stress and health by providing emotional and practical assistance (Cobb 1976).

Social support and coping strategies may help explain variation in responses to stressful events, and limited support has been associated with more depressive symptoms (Fang et al. 2011; Ying 2019). Support from families, peers, and institutions has also been associated with better social adaptation and positive student development (Danying et al. 2023; Jia et al. 2019; Li et al. 2025; Libin et al. 2024; Qingyun et al. 2022; Ying and Mengrou 2016). These findings provide a rationale for testing moderation, although they do not establish that the composite score used here is itself an effective intervention.

Psychological resilience is also related to social support and positive emotion, which may help individuals maintain coping resources under adversity. Social support may contribute to self-efficacy and positive coping, both of which are theoretically relevant to resilience (Southwick et al. 2005; Zautra et al. 2008). Coping-resource models similarly suggest that external support can be associated with adaptation through personal coping capacities (Taylor and Stanton 2007).

Hypothesis 3 (H3). Higher intervention-measure scores weaken the negative association between stressful events and social adaptation.

Hypothesis 4 (H4). Higher intervention-measure scores attenuate the negative association between stressful events and psychological resilience.

Hypothesis 5 (H5). Higher intervention-measure scores strengthen the positive association between psychological resilience and social adaptation.

Figure 1 summarizes the proposed statistical model. Stressful events were expected to be associated with poorer social adaptation directly and indirectly through lower psychological resilience. The

intervention-measure score was expected to attenuate the stressful events–adaptation and stressful events–resilience associations and to strengthen the resilience–adaptation association.

*[Insert Fig. 1 near here]*

## Methods

### Participants and procedure

The data used in this study were collected from students enrolled after 2020 in the College of Chemical and Environmental Engineering at a university in Shanghai, ranging from first-year undergraduates to third-year postgraduates. The survey was administered at the class level using both paper-based questionnaires and online platforms. A total of 1,191 questionnaires were collected. After identifying variables with missing critical information and excluding invalid or incomplete responses, 281 questionnaires were removed, resulting in 910 valid responses. The effective response rate was 76.41%. The demographic statistics are shown in Table 1.

## Measures

### Social adaptation

Social adaptation was measured using the 60-item China College Student Adjustment Scale (CCSAS) developed by Fang Xiaoyi and colleagues. The seven domains are interpersonal relationships, academic adaptation, campus life, career adaptation, emotional adaptation, self-adaptation, and satisfaction. Items are rated from 1 to 5, and the item mean was used in the analyses, with higher scores indicating better adaptation. After range validation, Cronbach's  $\alpha$  was 0.900.

### Stressful events

Stressful events were assessed with the 85-item China College Student Psychological Stress Scale (CCSPSS) developed by Liang Baoyong and Hao Zhihong. The measure covers academic, developmental, social-interaction, daily-life, and family stressors. Each item is rated from 1 (never occurred or extremely little impact) to 7 (extremely significant impact). The item mean was used, with higher scores indicating greater stress. Cronbach's  $\alpha$  was 0.974.

### Psychological resilience

Psychological resilience was measured with the 25-item Resilience Scale developed by Wagnild and Young (1993) and translated and revised by Chao Fenfang. Items are rated from 1 to 7; the theoretical

sum ranges from 25 to 175. The item mean was used in the analyses, with higher scores indicating greater resilience. Cronbach's  $\alpha$  was 0.781.

## Intervention measures

The moderating variable was a 10-item intervention-measure score adapted from the Social Support Rating Scale developed by Xiao Shuiyuan. Items assess perceived family and social support together with exercise, leisure, hobbies, communication, and self-regulation. Items are rated from 1 to 5, and higher mean scores indicate greater reported access to or use of these resources. The composite describes potentially modifiable resources rather than assignment to a standardised intervention. After range validation, Cronbach's  $\alpha$  was 0.699.

## Control variables

Covariates were coded as follows: male = 1 and female = 0; rural household registration = 1 and urban = 0; position holder = 1 and nonholder = 0; only child = 1 and not an only child = 0. Academic year (1–7), class-rank category (1 = top 25%, 2 = middle 50%, 3 = bottom group), and household-income category (1–5) were entered as ordered variables.

## Data preparation and statistical analysis

Item responses were checked against their stated Likert ranges. Twelve CCSAS cells and 14 intervention-measure cells were out of range or noninteger and were treated as missing; no invalid CCSPSS or resilience responses were detected. Scale means were computed when at least 80% of the relevant items were valid. This yielded complete scale scores for 910 participants for adaptation, stress, and resilience and for 906 participants for the intervention-measure score.

Ordinary least-squares models were used for the adjusted, subgroup, mediation, and moderation analyses. The mediation indirect association was evaluated with 10,000 percentile-bootstrap resamples. Continuous predictors were mean-centred before interaction terms were created. The moderated-mediation models included both main effects and the relevant interaction terms; conditional slopes and indirect effects were estimated at the moderator mean and one standard deviation below and above the mean, with 5,000 bootstrap resamples for conditional effects. Ordinary least-squares regression was selected because the hypotheses concerned linear associations among continuous scale scores. All tests were two-tailed with an alpha level of 0.05. Exact p values are reported when p was at least 0.001; smaller values are reported as  $p < 0.001$ .

The verified scale-score means (and standard deviations) were 3.219 (0.442) for social adaptation, 3.452 (1.082) for stressful events, 4.395 (0.628) for psychological resilience, and 3.235 (0.598) for the

intervention-measure score. Reliability estimates after range validation were  $\alpha = 0.900, 0.974, 0.781$ , and  $0.699$ , respectively.

## Results

### Correlations among stressful-event dimensions

Pearson correlations were calculated between the total stressful-event score and the five prespecified item groups: academic (Items 1–18), developmental (Items 19–30), social-interaction (Items 31–58), daily-life (Items 59–73), and family stress (Items 74–85). All dimensions were positively correlated with the total score (all  $p$  values  $< 0.001$ ), with coefficients from  $0.80$  to  $0.95$  (Table 2).

Social-interaction stress had the largest correlation with total stressful events ( $r = 0.95$ ), followed by daily-life ( $r = 0.87$ ), family ( $r = 0.86$ ), developmental ( $r = 0.84$ ), and academic stress ( $r = 0.80$ ). Correlations among dimensions ranged from  $0.54$  to  $0.78$ , indicating substantial shared variance together with dimension-specific variation.

These results confirm that each prespecified dimension contributed to the overall stressful-event score. Subsequent models used the total item mean.

### Direct association between stressful events and social adaptation

Table 3 presents the covariate-adjusted regression model. Stressful events were negatively associated with social adaptation ( $B = -0.067$ ,  $SE = 0.013$ ,  $\beta = -0.163$ ,  $t = -5.023$ ,  $p < 0.001$ ), supporting H1. The full model explained  $7.0\%$  of the variance,  $F(8, 901) = 8.455$ ,  $p < 0.001$ .

Class-rank category ( $B = -0.053$ ,  $p = 0.009$ ), position-holder status ( $B = 0.086$ ,  $p = 0.003$ ), and household-income category ( $B = 0.044$ ,  $p < 0.001$ ) were significant. Movement toward a poorer class-rank category was associated with lower adaptation; position holders reported higher adaptation than nonholders after adjustment; and higher household-income categories were associated with higher adaptation. Gender, household registration, academic year, and only-child status were not significant.

These results show a negative adjusted association between stressful events and social adaptation in this sample. The cross-sectional design does not establish that stressful events caused subsequent changes in adaptation.

### Heterogeneity analysis

Table 4 reports separate regressions by class-rank group. The stress–adaptation association was negative for students in the top  $25\%$  ( $B = -0.105$ ,  $p < 0.001$ ) and middle  $50\%$  ( $B = -0.079$ ,  $p < 0.001$ ), but

was positive and nonsignificant in the bottom group ( $B = 0.047$ ,  $p = 0.174$ ).

Separate regressions by position status showed negative associations for both position holders ( $B = -0.090$ ,  $p < 0.001$ ) and nonholders ( $B = -0.046$ ,  $p = 0.015$ ). The coefficient was descriptively larger among position holders.

The subgroup models describe different coefficient patterns by class rank and position status. Because these regressions were estimated separately, the table does not constitute a formal cross-group interaction test.

## Robustness tests

Two sensitivity models were estimated from the verified data (Table 5). When parental education was added, the stressful-event coefficient remained negative and significant ( $B = -0.068$ ,  $SE = 0.013$ ,  $\beta = -0.165$ ,  $p < 0.001$ ). Maternal education was positively associated with adaptation ( $B = 0.034$ ,  $p = 0.016$ ), whereas paternal education was not significant.

An expanded model that included the baseline covariates, major-choice status, and both parental education variables produced a similar stressful-event coefficient ( $B = -0.065$ ,  $SE = 0.013$ ,  $\beta = -0.159$ ,  $p < 0.001$ ) and explained 7.5% of the variance.

The magnitude, direction, and statistical significance of the stressful-event association were therefore stable across the baseline and expanded covariate specifications.

## Mediation analysis

The mediation analysis tested whether psychological resilience statistically accounted for part of the stress–adaptation association. The component paths and bootstrap indirect association were estimated from the verified scale scores.

Stressful events were negatively associated with resilience ( $B = -0.048$ ,  $SE = 0.019$ ,  $p = 0.012$ ). In the joint outcome model, stressful events retained a negative association with adaptation ( $B = -0.049$ ,  $SE = 0.010$ ,  $p < 0.001$ ), whereas resilience was positively associated with adaptation ( $B = 0.439$ ,  $SE = 0.018$ ,  $p < 0.001$ ; Table 6).

The 10,000-sample bootstrap estimates are presented in Table 7. The total association was  $-0.070$  (95% bootstrap CI  $[-0.103, -0.038]$ ), the direct association was  $-0.049$  (95% bootstrap CI  $[-0.075, -0.024]$ ), and the indirect association through resilience was  $-0.021$  (95% bootstrap CI  $[-0.043, -0.001]$ ). The indirect association represented 30.32% of the total, supporting H2 statistically.

Psychological resilience therefore accounted for a statistically significant portion of the negative association between stressful events and social adaptation.

# Moderation analysis

Table 8 presents the moderated mediation regression models. Predictors were mean-centred before the interaction terms were formed. In the social-adaptation outcome model, the stress  $\times$  intervention-measure interaction was negative and significant ( $B = -0.042$ ,  $SE = 0.010$ ,  $p < 0.001$ ; 95% CI  $[-0.062, -0.022]$ ). The conditional direct association was nonsignificant at low resource scores ( $B = -0.003$ ,  $p = 0.759$ ) but negative at the mean ( $B = -0.029$ ,  $p < 0.001$ ) and at high scores ( $B = -0.054$ ,  $p < 0.001$ ). The interaction was opposite to the buffering direction proposed in H3; therefore, H3 was not supported.

For psychological resilience, the stress  $\times$  intervention-measure interaction was positive and significant ( $B = 0.071$ ,  $SE = 0.024$ ,  $p = 0.003$ ; 95% CI  $[0.024, 0.118]$ ). The stress–resilience slope was negative at low ( $B = -0.084$ ,  $p = 0.001$ ) and mean resource scores ( $B = -0.042$ ,  $p = 0.018$ ), but approximately zero at high scores ( $B = 0.001$ ,  $p = 0.974$ ). This pattern supports H4.

The resilience  $\times$  intervention-measure interaction was positive but did not reach the 0.05 level ( $B = 0.032$ ,  $SE = 0.017$ ,  $p = 0.057$ ; 95% CI  $[-0.001, 0.065]$ ); H5 was not supported. The resilience–adaptation association nevertheless remained positive at low, mean, and high resource scores ( $B$ s = 0.191, 0.210, and 0.229, respectively; all  $p$  values  $< 0.001$ ).

Conditional indirect effects through resilience were negative at low resource scores ( $-0.016$ , 95% bootstrap CI  $[-0.028, -0.005]$ ) and at the mean ( $-0.009$ , 95% bootstrap CI  $[-0.017, -0.001]$ ), but not at high scores ( $0.000$ , 95% bootstrap CI  $[-0.012, 0.011]$ ). Thus, higher resource scores attenuated the resilience-related indirect pathway while the direct stress–adaptation association became more negative.

The resilience equation explained 26.9% of the variance,  $F(3, 902) = 110.698$ ,  $p < 0.001$ , and the social-adaptation equation explained 73.1%,  $F(5, 900) = 488.451$ ,  $p < 0.001$ . The intervention-measure main effect was positive in both equations ( $B = 0.540$  for resilience and  $B = 0.469$  for adaptation, both  $p$ s  $< 0.001$ ). The high explained variance in the adaptation equation was therefore reproduced directly from the raw responses and was driven primarily by the positive main effects of resilience and the intervention-measure score, together with the negative interaction between stress and the intervention-measure score.

## Discussion

The verified analyses support three main conclusions. Greater exposure to stressful events was associated with poorer social adaptation, psychological resilience accounted for 30.32% of the total association, and the intervention-measure score moderated the resilience-related and direct pathways in opposite directions.

The conditional results clarify this mixed pattern. At high resource scores, stressful events were no longer associated with lower resilience, and the indirect association through resilience included zero. At

the same time, the direct stress–adaptation association was strongest at high resource scores. The composite therefore functioned as a buffer for resilience but not for the direct adaptation pathway.

These conditional pathways describe two distinct statistical processes. The positive stress × resource interaction in the resilience equation means that higher resource scores offset the negative association between stress and resilience. By contrast, the negative stress × resource interaction in the adaptation equation means that, after resilience and the resource main effect are held constant, the remaining stress coefficient becomes more negative as resource scores rise. Because both interactions were estimated simultaneously in the outcome model, the direct-path result cannot be attributed to omission of the resilience pathway. It indicates that the resource composite is associated with better average adaptation but does not neutralize the residual association between stress and adaptation.

A person-in-context perspective remains useful for interpreting these findings because resilience can reflect both personal coping capacities and access to supportive relationships. However, the present study directly measured neither ecological systems nor exposure to institutional programmes. Family, peer, university, and community initiatives discussed below should therefore be understood as practice implications informed by the broader literature, not as interventions tested by this survey.

The adjusted negative association between stressful events and adaptation is consistent with transactional accounts in which demands are experienced in relation to appraisal and coping resources (Lazarus and Folkman 1984). Social adaptation requires students to maintain academic participation, relationships, daily routines, and role functioning while responding to those demands. Accumulated stress may compete for attention and self-regulatory capacity, but the reverse direction is also plausible: students experiencing adaptation difficulties may perceive more events as stressful or may encounter additional interpersonal and academic problems. The present results identify covariation between the constructs; they do not resolve these competing temporal accounts.

## **Implications for university mental health services**

The five stressful-event dimensions—academic, developmental, interpersonal, daily-life, and family stress—were all strongly related to the total score. This pattern suggests that campus mental-health services should avoid focusing on a single source of difficulty and should instead offer multiple routes to support. Because the sample came from one engineering college, the relative importance of these stressors should not be generalized to all university students.

Universities may combine universal mental-health education with accessible counselling and clearly defined referral procedures. Such services should be evaluated rather than assumed to be effective. Evaluation could include uptake, acceptability, symptom change, academic functioning, and social adaptation while protecting students' privacy and avoiding stigmatizing labels.

## **Mental health records and periodic screening**

If universities use periodic screening, participation, access, data retention, and referral procedures should be governed by informed consent, confidentiality, and clear clinical responsibility. Screening results should not be incorporated into academic or disciplinary records. Particular attention may be appropriate during transition periods such as entry, examinations, and graduation, but the present data did not directly compare those periods.

Validated instruments may be used to identify students who could benefit from further assessment, but screening scores are not diagnoses. Any combination of anxiety, social-distress, resilience, or adaptation measures should be selected on the basis of reliability, validity, and local referral capacity. Repeated assessment would be needed to establish whether changes in stress precede changes in resilience or adaptation.

## **Mental health education and counselling**

The strong positive association between psychological resilience and social adaptation suggests that skills related to coping, emotion regulation, persistence, and help seeking may be appropriate targets for future programmes. The present study did not test a curriculum, so the effectiveness of any specific educational approach remains an empirical question.

Potential programme components include stress-management education, emotion-regulation practice, self-awareness exercises, peer discussion, and career-planning support; positive-psychology approaches have also been proposed for university mental-health education (Zhongqin 2019). Group counselling, interactive activities, and educational media may increase accessibility, but controlled evaluation is needed to determine whether they improve resilience or adaptation beyond usual services.

Universities should also maintain access to professional services, including individual counselling, group-based support, and crisis response. Students identified as being at immediate risk require assessment and referral by qualified professionals rather than reliance on questionnaire scores alone.

## **Experiential mental health education**

Extracurricular organizations and peer-led activities may provide opportunities to practice communication, conflict resolution, and help seeking. These activities should complement, rather than replace, professional support and should include appropriate training and supervision when students are asked to assist peers experiencing distress.

Community and volunteer activities may also broaden social networks and provide meaningful roles. Future studies could test whether participation predicts subsequent changes in belonging, resilience, and adaptation while accounting for self-selection into these activities.

## **Multilevel social support**

The positive interaction for resilience showed that the negative stress–resilience association weakened as the intervention-measure score increased. At one standard deviation above the mean, the conditional

slope was essentially zero. Perceived support and coping activities may therefore help preserve resilience under stress, even though the same composite did not buffer the direct association with adaptation.

The indirect association through resilience adds specificity to this pattern. Students reporting more stressful events also reported slightly lower resilience, and resilience was strongly related to adaptation after stressful events were included in the model. This combination produced a statistically significant, but comparatively modest, indirect estimate. The result is compatible with process definitions of resilience that emphasize maintaining or regaining adaptive functioning under adversity (Fletcher and Sarkar 2013; Luthar et al. 2000). Nevertheless, the cross-sectional model cannot determine whether stressful events preceded lower resilience, whether adaptation difficulties undermined resilience, or whether an unmeasured factor influenced all three variables.

## **Supportive social networks**

Universities may create opportunities for students to build supportive relationships through clubs, peer groups, mentoring, and team-based projects. The conditional results indicate that such resources may be particularly relevant to maintaining resilience, but improving resilience alone may not eliminate stress-related adaptation difficulties.

Position holders reported higher adaptation than nonholders after covariate adjustment. However, the separate subgroup regressions showed a descriptively stronger negative stress–adaptation coefficient among position holders. Leadership roles may provide social connection and skills while also increasing workload and responsibility; both features should be considered when designing support.

The opposing interactions suggest that the composite contains resources operating through different mechanisms. Social support, exercise, leisure, hobbies, disclosure, and self-regulation may help maintain resilience, while high resource use may also be mobilized in response to substantial adaptation difficulties. The conditional estimates show that the unexpected direct-path interaction is not a sign error: the fitted negative stress–adaptation association increased from approximately zero at low resource scores to -0.054 at high scores.

The conditional indirect estimates further show where the resource composite operated. At low and mean resource levels, stressful events were associated with lower resilience and the indirect confidence intervals excluded zero. At high resource levels, the stress–resilience slope was effectively zero and the indirect confidence interval included zero. Thus, the moderated portion of the mediation model was concentrated in the first-stage resilience pathway. The nonsignificant resilience × resource interaction indicates that resources did not materially change the positive association between resilience and adaptation.

## **An integrated campus support network**

A coordinated campus support network may improve access to assistance, but the present survey did not evaluate such a system. Any network should define responsibilities across university counselling services, academic departments, peer programmes, and external providers.

At the institutional level, policies should specify how students obtain routine and urgent support, how confidentiality is protected, and how staff are trained to respond. Programme outcomes should be reviewed periodically to determine whether services reach students with different academic, economic, and social circumstances.

At the peer level, trained and supervised mutual-aid or mentoring groups may provide opportunities for connection and early help seeking. Peer supporters should have clear boundaries and referral pathways and should not be expected to provide clinical assessment.

At the residential level, inclusive dormitory practices and accessible conflict-resolution resources may support belonging. Their contribution to resilience and adaptation should be assessed prospectively.

## **Family and community support**

The intervention-measure score included family support, but the analysis did not isolate a separate family-support interaction. It is therefore not possible to conclude from these data that family support alone moderated the stressful events–adaptation association. Family-focused recommendations should be treated as proposals for future evaluation rather than demonstrated effects.

Universities may nevertheless offer families optional information about common transitions, communication, and routes to professional support, while respecting adult students' autonomy and confidentiality. Future research should distinguish emotional, practical, and financial support and test their associations separately.

Partnerships with community mental-health services may expand referral options when campus capacity is limited. The feasibility and effectiveness of such partnerships will depend on local resources and should be evaluated directly.

Internships and career-development activities may help students clarify occupational goals, but they can also introduce additional demands. Studies should examine both potential benefits and role strain rather than treating participation as inherently protective.

Similarly, volunteering may provide meaning and social connection, yet students with more time or better initial adjustment may be more likely to participate. Longitudinal or experimental designs are needed to separate programme effects from selection.

Overall, the results support multilevel resilience-building strategies while showing that the intervention-measure composite did not protect every pathway. Programmes should therefore evaluate resilience and

social adaptation as distinct outcomes rather than assuming that improvement in one necessarily removes stress-related differences in the other.

The subgroup findings provide a related practical caution. Position holders may gain belonging, skills, and access to peers, yet they may also carry extra organizational responsibilities. Similarly, top-ranked students may face stronger performance expectations. The observed coefficients cannot identify these mechanisms, and the absence of formal coefficient-comparison tests prevents a definitive claim that subgroup slopes differ. Still, the pattern suggests that visible achievement or leadership should not be used as a proxy for low support needs. Universal services may need to be paired with confidential routes through which high-performing and highly involved students can seek assistance.

## **Limitations and future directions**

Several limitations qualify the findings. First, convenience sampling from one engineering college at one Shanghai university limits generalizability. Second, the cross-sectional design cannot establish temporal ordering or causal mediation. Third, all variables were self-reported, creating potential common-method and social-desirability bias. Fourth, the intervention-measure score combined perceived support with several personal activities, had modest internal consistency ( $\alpha = 0.699$ ), and did not represent a standardised intervention. Fifth, subgroup regressions were descriptive rather than formal coefficient-comparison tests. Finally, four cases lacked enough valid moderator items for the moderated models, yielding  $N = 906$  for those analyses.

For practice, the findings favour a stepped and evaluated approach rather than a single broad intervention. Universal education can provide information about stress, coping, and help seeking; selective programmes can address students facing concentrated academic, financial, interpersonal, or family demands; and indicated services can provide professional assessment for students with substantial distress or impairment. Each component should have a defined target, delivery protocol, and outcome. This distinction is important because the survey's intervention-measure score was not a treatment and cannot show that increasing any particular component will improve adaptation.

Future research should recruit students from multiple institutions, disciplines, and regions and use probability-based or stratified sampling where feasible. Repeated assessments would clarify whether stressful events precede changes in resilience and adaptation, while interviews or observational data could illuminate how students interpret and respond to stressful experiences.

The moderator should be refined by measuring family, peer, and institutional support, exercise, leisure, disclosure, and self-regulation as distinguishable constructs. Future studies can use preregistered conditional-effect and Johnson–Neyman analyses to identify which specific resources alter each pathway.

Experimental studies could evaluate clearly specified programmes with comparison groups, treatment fidelity checks, and pre- and post-intervention assessments. Personality traits, prior mental-health status,

academic workload, and role responsibilities may be included as prespecified covariates or moderators because they could influence both stress exposure and adaptation.

Future moderated-mediation studies should report full regression equations, coding decisions, centering, changes in explained variance, and conditional direct and indirect effects. Sharing analysis syntax and deidentified data where ethically permissible would facilitate independent reproduction of the bootstrap estimates and interaction models.

These improvements would permit stronger tests of when resilience and specific social or behavioural resources are beneficial, for whom they are beneficial, and whether observed associations translate into practically meaningful changes in social adaptation.

## **Declarations**

## **Competing interests**

The authors declare no competing interests.

## **Author Contribution**

Tingting Qian: Conceptualization; Methodology; Supervision. Hui Zhu: Formal analysis; Visualization; Writing - original draft; Writing - review and editing. Binyan Jia: Investigation; Data curation; Validation. Jingfangzhou Li: Investigation; Resources. Luoyi Zeng: Translation; Writing - review and editing.

## **Data Availability**

The de-identified item-level survey data supporting the findings of this study are available in Supplementary Data , which includes 910 participant records, a README sheet, and a complete codebook. The full survey questionnaire and response options are provided in the Supplementary Information.

## **Ethics Declarations**

The informed-consent and confidentiality procedures used in this study were consistent with Standards 8.02 (Informed Consent to Research) and 4.01 (Maintaining Confidentiality) of the American Psychological Association's Ethical Principles of Psychologists and Code of Conduct (2017). All participants provided informed consent before participation. Institutional ethics approval was obtained

from the Academic Ethics and Science and Technology Ethics Committee of Shanghai Institute of Technology after completion of data collection (approval no. SIT-2026-LL69).

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## Tables

Table 1. Distribution of participants (N = 910)

| Variable     | Category                          | n   | %     | Variable                      | Category                      | n   | %     |
|--------------|-----------------------------------|-----|-------|-------------------------------|-------------------------------|-----|-------|
| Gender       | male                              | 477 | 52.4% | Ranking of grades             | The top 25%                   | 347 | 38.1% |
| Gender       | female                            | 433 | 47.6% | Ranking of grades             | The middle 50%                | 409 | 44.9% |
| Native place | Rural area                        | 390 | 42.9% | Ranking of grades             | The last 25%                  | 154 | 16.9% |
| Native place | City                              | 520 | 57.1% | Position                      | Yes                           | 464 | 51.0% |
| Grade        | Freshman Year                     | 356 | 39.1% | Position                      | No                            | 446 | 49.0% |
| Grade        | Sophomore year                    | 227 | 24.9% | Annual total household income | Less than 80,000              | 265 | 29.1% |
| Grade        | Junior year                       | 95  | 10.4% | Annual total household income | 80,000 to 150,000             | 256 | 28.1% |
| Grade        | Senior year                       | 53  | 5.8%  | Annual total household income | Between 150,000 and 300,000   | 225 | 24.7% |
| Grade        | Postgraduate Year One             | 94  | 10.3% | Annual total household income | Between 300,000 and 1,000,000 | 123 | 13.5% |
| Grade        | Second Year of Postgraduate Study | 80  | 8.8%  | Annual total household income | One million and above         | 41  | 4.5%  |
| Grade        | Postgraduate Year 3               | 5   | 0.5%  |                               |                               |     |       |

Table 2. Correlations among stressful-event dimensions and the total score

|   | 1      | 2      | 3      | 4      | 5      | 6 |
|---|--------|--------|--------|--------|--------|---|
| 1 | —      |        |        |        |        |   |
| 2 | 0.80** | —      |        |        |        |   |
| 3 | 0.84** | 0.74** | —      |        |        |   |
| 4 | 0.95** | 0.66** | 0.74** | —      |        |   |
| 5 | 0.87** | 0.62** | 0.65** | 0.78** | —      |   |
| 6 | 0.86** | 0.54** | 0.62** | 0.78** | 0.73** | — |

Note. \*\* $p < 0.01$ . Variables are numbered as follows: 1 = total stressful-event score; 2 = academic; 3 = developmental; 4 = social-interaction; 5 = daily-life; 6 = family stress.

Table 3. Covariate-adjusted association between stressful events and social adaptation

| Outcome           | Predictor          | B      | SE    | $\beta$ | t      | p      |
|-------------------|--------------------|--------|-------|---------|--------|--------|
| Social adaptation | Stressful events   | -0.067 | 0.013 | -0.163  | -5.023 | <0.001 |
| Social adaptation | Gender             | -0.036 | 0.029 | -0.041  | -1.266 | 0.206  |
| Social adaptation | Native place       | -0.004 | 0.031 | -0.004  | -0.123 | 0.902  |
| Social adaptation | Academic year      | -0.012 | 0.008 | -0.048  | -1.489 | 0.137  |
| Social adaptation | Learning ranking   | -0.053 | 0.020 | -0.086  | -2.603 | 0.009  |
| Social adaptation | Holding a position | 0.086  | 0.029 | 0.097   | 2.957  | 0.003  |
| Social adaptation | Household income   | 0.044  | 0.013 | 0.116   | 3.518  | <0.001 |
| Social adaptation | Only child         | 0.010  | 0.031 | 0.011   | 0.318  | 0.751  |

Note. Male, rural household registration, position holder, and only child were coded 1; their reference categories were coded 0. B = unstandardized coefficient;  $\beta$  = standardised coefficient. Model  $R^2 = 0.070$ ,  $F(8, 901) = 8.455$ ,  $p < 0.001$ .

Table 4. Subgroup regressions of stressful events on social adaptation

| Subgroup                  | B      | SE    | $\beta$ | t      | p      | F      | R <sup>2</sup> |
|---------------------------|--------|-------|---------|--------|--------|--------|----------------|
| Top 25% (N = 347)         | -0.105 | 0.022 | -0.248  | -4.748 | <0.001 | 22.543 | 0.061          |
| Middle 50% (N = 409)      | -0.079 | 0.019 | -0.205  | -4.225 | <0.001 | 17.847 | 0.042          |
| Bottom group (N = 154)    | 0.047  | 0.034 | 0.110   | 1.367  | 0.174  | 1.868  | 0.012          |
| Position holder (N = 464) | -0.090 | 0.019 | -0.214  | -4.717 | <0.001 | 22.255 | 0.046          |
| Nonholder (N = 446)       | -0.046 | 0.019 | -0.116  | -2.451 | 0.015  | 6.009  | 0.013          |

Note. B = unstandardized coefficient;  $\beta$  = standardised coefficient. Subgroup coefficients are descriptive unless a formal cross-group interaction is tested.

Table 5. Sensitivity analyses of the stressful events-social adaptation association

| Model               | Predictor        | B      | SE    | $\beta$ | t      | p      | R <sup>2</sup> |
|---------------------|------------------|--------|-------|---------|--------|--------|----------------|
| Parental education  | Stressful events | -0.068 | 0.013 | -0.165  | -5.063 | <0.001 | 0.038          |
| Parental education  | Father education | -0.003 | 0.015 | -0.007  | -0.177 | 0.860  |                |
| Parental education  | Mother education | 0.034  | 0.014 | 0.097   | 2.420  | 0.016  |                |
| Expanded covariates | Stressful events | -0.065 | 0.013 | -0.159  | -4.893 | <0.001 | 0.075          |

Note. The parental-education model included stressful events and both parental education variables. The expanded model additionally included all baseline covariates and major-choice status.

Table 6. Regression models for the indirect association through psychological resilience

| M | Predictor                | B      | SE    | t      | p      | Model fit                           |
|---|--------------------------|--------|-------|--------|--------|-------------------------------------|
| 1 | Stressful events         | -0.048 | 0.019 | -2.526 | 0.012  | R <sup>2</sup> = 0.007; F = 6.379   |
| 2 | Stressful events         | -0.070 | 0.013 | -5.256 | <0.001 | R <sup>2</sup> = 0.030; F = 27.623  |
| 3 | Stressful events         | -0.049 | 0.010 | -4.701 | <0.001 | R <sup>2</sup> = 0.416; F = 322.968 |
|   | Psychological resilience | 0.439  | 0.018 | 24.497 | <0.001 |                                     |

Note. Model 1 predicted resilience from stressful events; Model 2 predicted adaptation from stressful events; Model 3 predicted adaptation jointly from stressful events and resilience. Model fit is reported as R<sup>2</sup> and F. B = unstandardized coefficient; SE = standard error. All models used N = 910.

Table 7. Bootstrap decomposition of the stressful events-social adaptation association

| Effect   | Estimate | Boot SE | 95% CI lower | 95% CI upper | Relative effect |
|----------|----------|---------|--------------|--------------|-----------------|
| Total    | -0.070   | 0.017   | -0.103       | -0.038       |                 |
| Direct   | -0.049   | 0.013   | -0.075       | -0.024       | 69.68%          |
| Indirect | -0.021   | 0.011   | -0.043       | -0.001       | 30.32%          |

Note. Percentile bootstrap confidence intervals are based on 10,000 resamples. Relative effects were calculated from the unrounded coefficients.

Table 8. Moderated mediation regression models

| M | Predictor                     | B      | SE    | t      | p      | Model fit                     |
|---|-------------------------------|--------|-------|--------|--------|-------------------------------|
| A | Stressful events              | -0.042 | 0.018 | -2.373 | 0.018  | $R^2 = 0.269$ ; $F = 110.698$ |
|   | Resources                     | 0.540  | 0.030 | 17.926 | <0.001 |                               |
|   | Stress $\times$ resources     | 0.071  | 0.024 | 2.949  | 0.003  |                               |
| B | Stressful events              | -0.029 | 0.008 | -3.816 | <0.001 | $R^2 = 0.731$ ; $F = 488.451$ |
|   | Psychological resilience      | 0.210  | 0.014 | 14.614 | <0.001 |                               |
|   | Resources                     | 0.469  | 0.015 | 31.160 | <0.001 |                               |
|   | Stress $\times$ resources     | -0.042 | 0.010 | -4.104 | <0.001 |                               |
|   | Resilience $\times$ resources | 0.032  | 0.017 | 1.903  | 0.057  |                               |

Note. Model A predicted resilience; Model B predicted social adaptation. Predictors were mean-centred before interaction terms were formed. Resources denotes the intervention-measure score. Model fit is reported as  $R^2$  and  $F$ . B = unstandardized coefficient. Both models used  $N = 906$ .

## Figures

