Research Square

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The effects of hardiness personality on mental health among Chinese medical students: coping styles of Intermediation and the moderating role of the nature of the school

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Research Article

Keywords: hardiness personality, mental health, coping styles, medical students, nature of schools

Posted Date: March 31st, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9091919/v1

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Additional Declarations: No competing interests reported.

Abstract

Background

Medical students are a unique group of people whose intensive academic workload and extensive curriculum content make it challenging for them to balance academic pursuits, professional development, and personal life. Methods: In this study, a cross-sectional research method was used to investigate 1,360 medical students from different medical colleges and universities in Hefei City, Anhui Province, using the Hardiness Scale (HS), the Simplified Coping Style Questionnaire (SCSQ), and the Symptom Checklist-90 (SCL-90). In the analysis, correlation, linear regression and structural equation modeling were used to identify the mediating and moderating roles. Purpose: This study aimed to explore the effects of hardiness personality and coping styles on the mental health of medical students, and to provide theoretical references and practical bases for the mental health interventions for medical students by constructing the corresponding structural equation models to reveal the complex relationship among the three and the moderating role of the nature of the school. Conclusion: The psychological health of Chinese medical students is significantly associated with hardiness personality and positive coping style. The SCL-90 scores of medical students were significantly different from those of the national college students' norms, and the positive rate of their mental health status reached 28.8%. Coping styles fully mediated the relationship between hardiness personality and mental health among Chinese medical students, and the nature of school partially moderated the relationship between hardiness personality and positive coping styles, with no significant moderating effect on negative coping styles.

1. Introduction

Medical students are under increasing pressure in their studies, career choices and life, and long-term psychological tension not only induces various psychological problems, but also triggers physiological reactions and abnormal changes in body organ functions. Medical students' occupational characteristics are related to life, high-intensity learning pressure, high competition and high-risk career factors make medical students have higher demands on themselves, and are more prone to psychological confusion and ideological pressure[1, 2]. In addition, the long-term pressure of medical learning will have a negative impact on the mental health of medical students and lead to further burnout[3]. Therefore, the mental health problems of medical students are becoming more and more prominent. Research has shown that there are numerous complex factors that affect the mental health of college students. Mental health is often influenced by a combination of personality traits, education, family-related factors, coping styles, and other environmental factors[4]. Positive personality traits and coping styles, such as optimism, resilience, and calmness, can mitigate the negative effects of stressful situations on mental health[5].

hardiness personality is an outward and stable manifestation of an individual's tough will quality, which refers to the psychological traits of courage, perseverance, and perseverance that an individual possesses in order to achieve his or her goals.Kobasa (1979) found that individuals with resilient personalities are able to control their own development in the set direction, are able to devote themselves to their studies and work, and view changes in their lives as a challenge they are capable of overcoming. The relationship between resilience and mental health has been discussed in the following study: physiological and psychological changes in medical students are influenced by many factors, and the hardiness personality is one of the most important aspects; the higher the level of resilience in medical students, the fewer the psychological symptoms, and the higher the level of mental health they are likely to experience[6]. Studies have shown that the hardiness personality can have a positive impact on the mental health of college students and reduce the number of academic problems. Research suggests that hardiness personality can have a positive impact on the mental health of college students and reduce negative emotions such as anxiety caused by academic stress[7]. Other studies have shown that medical students who use positive coping styles have better mental health, while those who use

negative coping styles have worse mental health than those who use negative coping styles[8–10]. Therefore, Hypothesis 1 is proposed: Hardiness personality and coping styles can significantly predict the mental health status of medical students.

Coping styles, also known as coping mechanisms or coping strategies, refer to the means, methods, or strategies adopted to cope with the stress and distress generated by internal and external environments. Coping style is considered to be a cognitive-adjustment behavioral approach and strategy used by an individual in the face of a stressful event, and it is the result of the interaction between individual and situational factors[13, 14]. Andrews' study showed that if individuals lacked supportive and positive coping with the situation, they were in a highly stressful state, and their mental health was impaired to the extent of 43.3%, which is twice that of the normal population[15]. Coping styles are mainly categorized into positive coping styles and negative coping styles, which have different outcomes on mental health[16]. Positive coping styles enhance an individual's positive psychological qualities[17]. Some studies have shown that positive coping styles and negative coping styles are predictive of psychological symptoms, and that positive coping styles are significantly negatively correlated with the SCL-90 total scores and all dimensions[18]. In conclusion. hardiness personality predicts coping styles, and coping styles predict mental health, then hardiness personality may have an effect on mental health through coping styles. Although previous studies have confirmed the association between the three, the mediating mechanism of coping styles has not yet been clarified. Hypothesis 2: Coping styles mediate the effect of hardiness personality on the mental health of medical students is therefore proposed.

The different management styles and curriculum contents of public and private schools in China, as well as some differences in the quality of teachers and the focus of lectures, have a certain impact on the psychological conditions of students. Research has shown that students in private institutions in China have a poorer foundation for school enrollment, have lower self-control, and are susceptible to the influence of the external environment; in particular, medical specialties have more theoretical and practical skills, heavy study loads, frequent exams, and higher academic pressure, so the proportion of students experiencing psychological problems is slightly higher than that in the national medium ($M = 2.78 > 2.5$); compared to the public institutions, the psychological health of college students in private institutions is higher than that of the national medium ($M = 2.78 > 2.5$); and compared to the public institutions, college students in the private institutions are more vulnerable to psychological problems. Compared with public institutions, the mental health education of college students in private institutions is relatively more backward[19], and the overall degree of hardiness personality is average, with more room for improvement. The coping styles of students in private institutions are more inclined to adopt negative coping styles in the face of psychological stress than those of students in public institutions[20]. Accordingly, Hypothesis 3 is proposed: the nature of the school moderates the relationship between hardiness personality and coping styles.

Previous studies have revealed the relationship between coping styles and mental health, however, the association between hardiness personality and mental health is still fragmented, and there is a lack of research on the complex relationship between hardiness personality, coping styles, and mental health of medical students compared with that of medical students' mental health. In addition, few studies have examined the mediating role of coping styles in the relationship between hardiness personality and mental health of medical students, and there is a lack of empirical studies on medical student groups of different school natures. These groups have been reported to have more pronounced mental health problems in previous studies and require significant attention. Therefore, this study constructed a model of the mediating mechanism of hardiness personality affecting mental health through coping styles, verified the mediating role of coping styles between hardiness personality traits and mental health, and provided a basis for improving the mental health of medical students. Considering the differences between different school natures, this study focuses on whether different school natures play a moderating role in hardiness personality and

coping styles. The hypothesized model of the relationships among hardiness personality, coping styles, mental health and the moderating role of school nature is depicted in Fig. 1.

2. Methodology

2.1 Population and sample

In this survey, participants were medical students studying in different medical colleges and universities in China, mainly Anhui University of Traditional Chinese Medicine (a public university) and Anhui Medical University School of Clinical Medicine (a private university). The rationale for the two institutions is as follows: they are typical representatives of public and private medical education in Anhui Province, with clear differences in the nature of the schools, which fits the core hypothesis of the study, "the moderating effect of the nature of the school"; they both focus on medical specialties, with the same training objectives to minimize the interference of the differences in specialties on the results of the study; they are both located in Hefei City, with similar geographic, cultural, and educational resource environments; and they are also located in the city of Hefei. They are all located in Hefei City, with similar geographic cultures and educational resource environments, so that geographic confounding factors can be controlled. Inclusion criteria: majoring in medicine, born after January 1, 2000; exclusion criteria: those who answered all the questions in the questionnaire consistently, and those who were in a state of suspension or dropout.

This is a study conducted by researchers from December 2023 to February 2025 in Hefei, China. All questionnaires in this study were answered offline, and the questionnaire consisted of four parts with a total of 147 questions, and it took subjects an average of 6 minutes to complete the questionnaire. A total of 2,400 questionnaires were distributed, 2,300 were returned, and 2,180 valid questionnaires were obtained after excluding invalid questionnaires, from which 680 questionnaires from public universities and 680 questionnaires from private universities, totaling 1,360 questionnaires, were randomly selected for inclusion in the statistical analysis of this study.

In this study, a general information questionnaire, Hardiness Scale (HS), Symptom Checklist-90 Score (SCL-90) and Simplified Coping Style Questionnaire (SCSQ) were used to analyze medical students. "), Symptom Checklist-90 Score ("SCL-90") and Simplified Coping Style Questionnaire ("SCSQ") were analyzed for medical students. The aim of this study is to better understand the coping style, hardiness personality, mental health status and its related influencing factors of this group through structural equation modeling (SEM), and to reveal their intrinsic connections, so as to provide theoretical references for the prevention and intervention of mental health problems among medical students. In the process of receiving the data, the consent of the subjects was obtained and the confidentiality of personal data and results was maintained.

Interviewers were master's students from Anhui University of Traditional Chinese Medicine, and school experts conducted a two-day interviewer training. The role of the interviewers was to reduce errors and use interviewing techniques including standardized questions, questionnaire format and conventions, clarification, feedback, recording answers and other protocols.

2.2 Evaluation

The general demographic questionnaire was self-administered by the researcher to investigate the demographic characteristics and basic living conditions of the subjects. The items asked about the nature of their school, whether they were student leaders, whether they were only children, whether they were single parents, whether they were from poor families, and their upbringing.

Toughness Personality Scale: The Toughness Personality Scale (HS) compiled by Chinese scholars Lu Guohua and Prof. Liang Baoyong was used to measure[24]. The scale is based on foreign toughness personality theories, combined with

Chinese understanding of toughness, and researched and compiled with domestic college students as subjects, finally determining the structure of Chinese toughness personality. The scale contains four dimensions: resilience, control, commitment, and challenge, with a total of 27 entries. A four-point scale was used, i.e., 4 points for "fully compliant", 3 points for "compliant", 2 points for "somewhat compliant", and 1 point for "not at all compliant". "The score is 1. The resilience dimension consists of 6 items, 1, 5, 12, 13, 19, and 23, mainly reflecting the individual's firmness and persistence in pursuing goals, optimism and aggressiveness in the face of difficulties, and perseverance. The control dimension consists of 8, 14, 15, 20, 21, 22, 26, and 27 items, mainly reflecting the individual's characteristics of actively controlling and influencing the events experienced. The Commitment dimension consists of 6, 7, 9, 11, 16, and 17 items that reflect the personality traits of individuals who are committed or focused on the activities they are involved in, and who are willing to accept and take responsibility. The challenge dimension consists of a total of 7 items, 2, 3, 4, 10, 18, 24, and 25, and mainly reflects the individual's characteristic of being able to see change as a challenge and draw strength for growth from it[25]. In terms of reliability, the internal consistency coefficients of the four dimensions of the scale, namely, resilience, control, commitment, and challenge, were .91, .91, .89, and .92, respectively, and the total scale Cronbach 's α was 0.962.

Symptom Self-Control Scale (SCL-90) This scale was developed by Derogatis (1975) and translated by Wang Zhengyu of Shanghai Mental Health Center, which has good reliability and validity. The scale accurately reflects the multidimensional mental health status of the subjects and has been widely used by researchers around the world[26, 27] and has a Chinese norm. The scale consists of 90 items, including 9 factors of somatization, obsessive-compulsive, interpersonal sensitivity, depression, anxiety, hostility, phobia, paranoia, and psychoticism, and is scored on a 5-point scale (0 = never, 1 = mild, 2 = moderate, 3 = severe, 4 = severe). The total score is the sum of all 90 item scores, and the dimension score = (sum of subscale scores for this dimension)/(number of items for this dimension). A dimension score of more than 2 indicates that the dimension is positive.SCL-90 positivity is determined by a total score of ≥ 160, or by a number of positive items of ≥ 43, or by a score of ≥ 2 on any dimension. A positive result indicates that the subject may have a mental health problem in one of the dimensions.The Cronbach's α for the SCL-90 was 0.987, the KMO value was 0.970, and the significance of the Bartlett's test of sphericity was ≤ 0.001.

Simple Coping Styles Questionnaire (SCSQ): Developed by a Chinese scholar, Prof. Xie Yaning, based on cognitive theories of coping styles from home and abroad, and taking into account the characteristics of the Chinese population, it is a general self-rating scale for assessing coping styles. The questionnaire has shown high reliability and validity in other studies and has constructed a two-dimensional model encompassing both positive and negative coping styles.The SCSQ questionnaire consists of 20 items, and the combination of positive coping dimensions (items 1–12) and negative coping dimensions (items 13–20) reflects the characteristics of different coping styles and their relationship with mental health[27]. The scale is multilevel rated, with each coping style item is followed by four options (corresponding to scores of 0, 1, 2, and 3): never, occasionally, sometimes, and often. Subjects chose the appropriate option according to their situation, and the results obtained were the mean scores of the positive and negative coping dimensions. The difference between the positive and negative coping scores is the coping tendency score; if the coping tendency score is > 0, the higher the score, the more the individual tends to adopt positive coping; if the coping tendency score is < 0, the lower the score, the more the individual tends to adopt negative coping. Because of its convenience and practicality, this scale has been widely used and has been shown to have good reliability and validity. The scale had good internal consistency in this study, with a Cronbach's α of 0.807, a KMO value of 0.901, and a significance of ≤ 0.001[28] for the Bartlett's test of sphericity.

2.3 Statistical analysis

SPSS 27.0, Amos 26.0 and PROCESS 4.1 software were used to organize the data, transform variables and analyze statistically, and construct structural equation models. Measurement data were expressed as mean and standard

deviation or median and interquartile deviation, and count data were expressed as frequency and constitutive ratio (%). Independent samples t-test was used to compare the differences in SCL-90 scores between the medical students in this study and the national college student norm. Pearson correlation analysis was used to measure the strength and direction of the linear relationship between the two variables for binary normally distributed data with continuous independent variables; analysis of variance and mediation effect analysis were used to explore the relationship between each variable and the total SCL-90 score. Finally, structural equation modeling was constructed using Amos. $P < 0.05$ was considered statistically significant.

In conducting the mediation effect test, this study used Baron and Kenny's (1986) three-step method and combined it with Re-Sampling-Based Bootstrapping (using the PROCESS program) to estimate the confidence intervals for the mediation effect. According to Baron and Kenny's guidelines for testing mediation effects, the following conditions need to be met for mediation effects to be established: (1) the independent variable (hardiness personality) is significantly correlated with the dependent variable (mental health); (2) the independent variable (hardiness personality) is significantly correlated with the mediator variable (coping styles); and (3) the mediator (coping styles) is significantly correlated with the dependent variable (mental health), and with the addition of mediator (coping styles) to the model, the independent variable (coping styles) is significantly correlated with the dependent variable (mental health). manner) is added to the model, the effect of the independent variable (hardiness personality) on the dependent variable (mental health) shrinks (partial mediation) or becomes statistically insignificant (full mediation). All continuous variables were standardized to avoid multicollinearity[27] in regression analyses.

3. Results

3.1 Descriptive statistics and sample characteristics

A total of 1,360 medical students were included in this study, 680 (50% each) from public and private universities; 643 (47.3%) from student leaders, 136 (10%) from single-parent families, 328 (24.1%) from only-children, and 680 (50%) from families in poverty; and 462 (34%) from those growing up in an urban setting and 898 (66%) in a rural setting.

Seventy-five percent of medical students in public colleges and universities had good mental health, with 59.71% positive coping styles and 40.29% negative coping styles. In private colleges and universities, 66.9% of medical students had good mental health, 48.53% had positive coping styles and 51.47% had negative coping styles. 70.14% of student leaders had good mental health, 58.16% had positive coping styles and 41.84% had negative coping styles. Among non-student cadres, 71.69% of medical students had good mental health, 50.49% had positive coping styles, and 49.51% had negative coping styles; 74.09% of one-child medical students had good mental health, 52.13% had positive coping styles, and 47.89% had negative coping styles, while 69.96% of non-only children had good mental health. with 54.75% positive coping styles and 45.25% negative coping styles, while 69.96% of medical students who were not only children had good mental health.Table 1 presents the detailed descriptive statistics of SCL-90 positive rate and coping styles among medical students by demographic characteristics.

Table 1 Descriptive Statistics of SCL-90 Positive Rate and Coping Styles Among Medical Students by Demographic Characteristics (N=1360)

Variable	Group	Numbers	Proportion/%	Categories	Proportions/%	Categories	Proportions/%
School Nature	Public	680	50	SCL-90≥160	25.00	PCS	59.71
				SCL-90<160	75.00	NCS	40.29
	Private	680	50	SCL-90≥160	33.09	PCS	48.53
				SCL-90<160	66.91	NCS	51.47
Student Leader	Yes	643	47.3	SCL-90≥160	29.86	PCS	58.16
				SCL-90<160	70.14	NCS	41.84
	No	717	52.7	SCL-90≥160	28.31	PCS	50.49
				SCL-90<160	71.69	NCS	49.51
The Only Child	Yes	328	24.1	SCL-90≥160	25.91	PCS	52.13
				SCL-90<160	74.09	NCS	47.87
	No	1032	75.9	SCL-90≥160	30.04	PCS	54.75
				SCL-90<160	69.96	NCS	45.25
Single Parent Family	Yes	136	10	SCL-90≥160	26.47	PCS	46.32
				SCL-90<160	73.53	NCS	53.68
	No	1224	90	SCL-90≥160	29.33	PCS	54.98
				SCL-90<160	70.67	NCS	45.02
Growth Environment	Urban	462	34	SCL-90≥160	29.65	PCS	50.87
				SCL-90<160	70.35	NCS	49.13
	Rural	898	66	SCL-90≥160	28.73	PCS	55.79
				SCL-90<160	71.27	NCS	44.21
Students From Poor Families	Yes	680	50	SCL-90≥160	30.59	PCS	54.41

				SCL-90<160	69.41	NCS	45.59
	No	680	50	SCL-90≥160	27.50	PCS	53.82
				SCL-90<160	72.50	NCS	46.18

Abbreviations: PCS, positive coping style; NCS, negative coping style; SCL-90, Symptom Checklist-90 Score.

3.2 Comparative table of differences in demographic variables

The mean scores of the 9 factors of SCL-90 in all dimensions except interpersonal sensitivity were slightly higher than the national norm[29], and the difference between the scores of somatization, obsessive-compulsive symptoms, interpersonal sensitivity, depression, anxiety, horror, paranoia, and psychoticism dimensions was statistically significant when compared with the national norm (P<0.05),and the difference between the scores of hostility dimensions was not statistically significant when compared with the national norm (P>0.05). See Table 2.

Table 2 Comparison of SCL-90 factor means of medical students with national norms

Factor	Medical College Students（n=1360）	National Norm（n=1388）	t
Somatization	1.42±0.54	1.37±0.48	3.624***
Obsessive-compulsive Symptoms	1.90±0.70	1.62±0.58	14.652***
Interpersonal Sensitivity	1.66±0.66	1.71±0.61	-2.8**
Depression	1.61±0.63	1.50±0.59	6.39***
Anxiety	1.55±0.59	1,39±0.43	9.902***
Hostility	1.49±0.57	1.46±0.55	1.868
Phobic Anxiety	1.47±0.57	1.23±0.41	15.713***
Paranoia	1.48±0.55	1.43±0.57	3.159**
Psychosis	1.49±0.54	1.29±0.42	13.694***

Notes: *P<0.05; **P<0.01; ***P<0.001.

SCL-90 scores of students in public colleges and universities were significantly lower than the scores of private colleges and universities (t=-2.73, P<0.01), and the scores of positive coping styles were significantly higher than those of private colleges and universities (t=3.20, P<0.001); the scores of student cadres' perseverance, control, commitment, challenge, and positive coping styles were significantly higher than those of non-student cadres; the scores of only children's perseverance, commitment, and negative coping style scores were significantly higher than those of non-only children; family-poor students' engagement scores were significantly lower than those of non-family-poor students (t=-2.05, P<0.05), and SCL-90 scores were significantly higher than those of non-family-poor students (t=2.05, P<0.05), the specific results are shown in Table 3.

Table 3 Comparison of differences in hardiness personality, mental health and coping styles among medical students

Variables	Resilience	Control	Commitment	Challenge	SCL-90	PCS	NCS
Public	2.59±0.53	2.60±0.55	2.60±0.56	2.61±0.53	137.75±46.20	3.86±9.47	1.79±5.96
Private	2.60±0.57	2.60±0.58	2.61±0.62	2.59±0.58	144.84±49.69	2.25±9.18	1.73±6.24
t	-0.25	0.05	-0.21	0.45	-2.73**	3.20***	0.16
Student Leader	2.66±0.57	2.66±0.57	2.68±0.61	2.68±0.57	141.3±47.7	4.12±10.07	2.07±6.25
Non-student Leader	2.53±0.53	2.54±0.56	2.54±0.56	2.53±0.53	141.29±48.47	2.1±8.56	1.48±5.95
t	4.28***	3.90***	4.39***	4.75***	0.003	3.996***	1.808
Only Child	2.65±0.56	2.64±0.58	2.66±0.59	2.65±0.56	139.13±47.55	2.82±9.85	2.41±6.55
Non-only Child	2.58±0.55	2.59±0.56	2.58±0.58	2.58±0.55	141.98±48.26	3.13±9.2	1.55±5.94
t	2.10*	1.54	2.09*	1.86	-0.94	-0.51	2.23*
Single Parent	2.59±0.57	2.57±0.59	2.61±0.59	2.61±0.57	142.3±44.77	2.9±10.53	3±6.61
Non-single Parent	2.60±0.55	2.60±0.56	2.60±0.59	2.60±0.55	141.18±48.46	3.07±9.22	1.62±6.03
t	-0.07	-0.66	0.25	0.11	0.26	-0.20	2.51*
Urban	2.64±0.54	2.62±0.58	2.64±0.59	2.63±0.56	141.57±48.86	2.88±9.58	2.28±6.27
Rural	2.57±0.55	2.59±0.55	2.58±0.59	2.59±0.55	141.15±47.71	3.14±9.24	1.49±5.99
t	2.34*	1.06	1.76	1.20	0.15	-0.50	2.26*
Poor Family	2.58±0.55	2.59±0.56	2.57±0.59	2.58±0.56	143.97±48.57	3.42±9.37	1.84±6.09
Non-poor Family	2.61±0.56	2.61±0.57	2.63±0.58	2.62±0.55	138.62±47.49	2.69±9.34	1.68±6.11
t	-0.92	-0.78	-2.05*	-1.62	2.05*	1.44	0.49

Notes: *P<0.05; **P<0.01; ***P<0.001.

Abbreviations: SCL-90, Symptom Checklist-90 Score; PCS, positive coping style; NCS, negative coping style.

3.3 Correlation matrix between hardiness personality, mental health and coping styles among medical students

Table 4 shows the mean, standard deviation and bivariate correlations between the main variables. The analysis of this study shows that there is a significant positive correlation between all dimensions of hardiness personality and positive coping styles (P<0.01), and there is a significant positive correlation between all dimensions of hardiness personality and negative coping styles, except for the dimension of challenge (P<0.01).The total score of the SCL-90 reflects the individual's overall level of mental health, and the results of the present study show that there is a significant negative correlation between each of the dimensions of hardiness personality and the total SCL- 90 total score were all significantly negatively correlated (P<0.01), and there was a significant negative correlation between mental health scores and positive coping styles (P<0.01) and a significant positive correlation with negative coping styles (P<0.01), which is in line with the expected theory of this study.

Table 4 Correlation between hardiness personality, mental health and coping styles

	Mean	SD	Resilience	Control	Commitment	Challenge	SCL-90	PCS	NCS
Resilience	2.595	0.552	1						
Control	2.598	0.566	.828**	1					
Commitment	2.602	0.586	.821**	.789**	1				
Challenge	2.600	0.555	.829**	.805**	.820**	1			
SCL-90	141.293	48.090	-.091**	-.110**	-.151**	-.175**	1		
PCS	3.054	9.357	.395**	.404**	.408**	.424**	-.193**	1	
NCS	1.759	6.098	.078**	.092**	.058*	0.044	.099**	.438**	1

Notes: *P<0.05; **P<0.01; ***P<0.001.

Abbreviations: PCS, positive coping style; NCS, negative coping style; SCL-90, Symptom Checklist-90 Score.

3.4 Regression Analysis of hardiness personality, Mental Health and Coping Styles of Medical Students

3.4.1 Hypothesis testing

Table 5 Stratified regression analysis of mediation effects

	PCS		NCS		SCL-90		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
(Constant)	8.585	-13.558	7.458	5.235	139.693**	176.784**	148.351*
School Nature	-1.647**	-1.591***	-0.093	-0.088	7.193	7.099	4.997
Student Leader	-2.089***	-1.108**	-0.503	-0.404	-0.037	-1.679	-2.541
Only Child	0.17	0.541	-0.531	-0.494	3.28	2.658	4.294
Single Parent	0.373	0.238	-1.175*	-1.189*	-1.999	-1.772	0.655
Environment	0.138	0.281	-0.672	-0.658	-1.915	-2.153	-0.599
Poor Families	-0.74	-0.95*	-0.339	-0.36	-5.283	-4.931	-5.645*
HS		7.79***		0.782*		-13.049***	-3.374
PCS							-1.418***
NCS							1.758***
R^2	0.021	0.208	0.012	0.016	0.009	0.028	0.089
$\triangle R^2$	0.017	0.204	0.007	0.011	0.007	0.026	0.085
F	4.941***	50.746***	2.691*	3.184**	2.159*	5.832***	14.595***
$\triangle F$	4.941***	318.618***	2.691*	6.082*	2.159*	27.615***	43.97***

Notes: Notes: *P<0.05; **P<0.01; ***P<0.001. the regression coefficients in the table are all standardized regression coefficients.

To make the coefficients of the regression equations more explanatory, the study centered on the independent and moderator variables before testing the product term, and tested the research hypotheses mainly through multilevel regression analysis. In the mediating effect test section, the study drew on the four-step mediating variable test proposed by Baron and Kenny to examine whether coping styles had a mediating effect between hardiness personality and mental health[30]. First, it tested whether there was a significant effect of hardiness personality on coping styles; second, it examined whether there was a significant effect of hardiness personality on mental health; third, it tested whether there was a significant effect of coping styles on mental health, and if the first three steps are verified, then it will continue to test whether toughness personality and coping style have a significant effect on mental health. If the predictive effect of toughness personality on mental health is weakened or no longer significant after adding the mediator variable, then the mediating effect of coping style is established, and the specific empirical research results are shown in Table 5.

Model 1 in Table 5 shows that among all the control variables, school nature (β=-1.647,P<0.01) and student cadre (β=-2.089,P<0.001) were able to significantly influence the positive coping styles of the medical students, and Model 2 shows the results indicating that the hardiness personality had a significant positive effect on positive coping styles (β=7.79,P<0.001); Model 3 showed that among all the control variables, single-parent family (β=-1.175,P<0.05) had a significant effect on the negative coping styles of medical students; Model 4 showed that hardiness personality had a significant effect on negative coping styles (β=0.782,P<0.05); and after controlling for the effects of the other variables, Model 6 showed that hardiness personality and mental health scores had a significant negative correlation (β=-13.049,P<0.001), and the results of our further examination of the relationship between hardiness personality and coping styles and mental health showed that, as model 7 showed, positive coping styles (β=-1.418,P<0.001) negative coping styles (β=1.758,P<0.001) had a certain mediating role. Finally, in order to make the test results more credible, the mediating role of coping styles was tested in this study using the PROCESS program in SPSS, and hypothesis 2 was supported and confirmed.

3.4.2 Structural Equation Modeling

Coping styles as a mediating variable in the impact of hardiness personality on mental health. The proposed hypothesized model paths were estimated and tested through the software. The path estimation and testing of the hypothesized model resulted in a more than satisfactory fit between the model and the research data.

Table 6 Evaluation indicators for the model

Standard	χ^2/df	RMSEA	NFI	CFI	IFI	RFI	RMR	GFI	AGFI
Rescult	5	0.1	0.9	0.9	0.9	0.9	0.1	0.9	0.9
	4.943	0.054	0.961	0.969	0.969	0.955	0.023	0.938	0.921

Indicators assessed the fit of the model to the data: chi-square test (x^2), chi-square test of goodness of fit (χ^2/df), root mean square of approximation error (RMSEA), goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normative fit index (NFI), and root mean square residuals (RMR). Throughout the study, it was generally accepted that a χ^2/df of less than 2 was considered a good model fit; a χ^2/df between 2 and 5 was an acceptable model; and an RMSEA of less than 0.1 was generally considered to indicate a good fit; and less than 0.05 was considered to indicate a very good fit. The relative fit indices are NFI, CFI, IFI, and RFI, and it is generally believed that the closer these indices are to 1, the better the fit, and greater than 0.90 indicates a better model fit. Currently, most scholars believe that GFI ≥ 0.90, AGFI

≥ 0.80,suggests a better model fit; RMR < 0.1, the model is considered to be well-fitted. The fit indexes of the structural equation model constructed in this study are: χ^2/df=4.942; RMSEA=0.054; NFI=0.961; RMR=0.023; GFI=0.938; AGFI=0.921. the model fit is high.

Based on the correlations among hardiness personality, mental health and coping styles, mental health was taken as the endogenous latent variable, hardiness personality and coping styles as the exogenous latent variables, the 8 factor scores of SCL-90 as the observed indicators of the latent variable mental health, the 4 factor scores of PCS as the observed variables of the latent variable positive coping style, the 4 factor scores of NCS as the latent variable Negative coping styles as observational variables, and 4 factor scores of HS as observational indicators of the latent variable hardiness personality, structural equations of hardiness personality, coping styles and mental health were constructed and analyzed. The results showed that each fitting index of the equation was good, and all of them were within the acceptable range, so the model was reasonable; from the model diagram, it can be seen that there are five paths affecting mental health: HS→SCL-90; PCS→SCL-90; NCS→SCL-90; HS→PCS→SCL-90; and HS→NCS→SCL-90. the model diagram is shown in Figure 2, and the data of the model fitting are shown in Table 6 .

Abbreviations: HS, hardiness scale; PCS, positive coping style; NCS, negative coping style; SCL-90, Symptom Checklist-90 Score.

Table 7 Structural equation modeling path analysis results

AMOS	Unstandardized Estimates	Standardized Estimates	Estimate	S.E.	C.R.	*P*
HS→PCS	0.66	0.64	0.662	0.036	18.369	***
HS→NCS	0.12	0.10	0.119	0.039	3.066	***
HS→SCL-90	-0.08	-0.06	-0.075	0.047	-1.583	0.113
PCS→SCL-90	-0.18	-0.16	-0.182	0.051	-3.597	***
NCS→SCL-90	0.21	0.22	0.212	0.030	7.026	***

Abbreviations: HS, hardiness scale; PCS, positive coping style; NCS, negative coping style; SCL-90, Symptom Checklist-90 Score.

Path analysis results of the structural equation model for the hypothesized relationships are presented in Table 7. As shown in the above table, the absolute value of Critical Ratio (C.R.) for hardiness personality → Positive Coping Styles, hardiness personality → Negative Coping Styles, Positive Coping Styles → Mental Health, and Negative Coping Styles → Mental Health is greater than the reference value, which indicates that the path coefficient has reached the level of significance (P<0.001). The critical ratio (C.R.) for hardiness personality → mental health is less than the reference value, indicating that the path coefficient did not reach the level of significance (P>0.001).

In the hypothesized model, the standardized path coefficient of hardiness personality → mental health was -0.06, which did not reach the level of significance (P>0.001); the path coefficient of positive coping styles → mental health was -0.16, and the path coefficient of negative coping styles → mental health was 0.22, which reached the level of significance (P<0.001), which indicates that the direct impact of hardiness personality on mental health effect is smaller than the direct effect of coping styles on mental health.

Conclusions: hardiness personality had a significant positive effect on coping styles, and hardiness personality had a non-significant effect on mental health scores; positive coping styles had a significant positive predictive effect on

mental health levels, and negative coping styles had a significant negative predictive effect; hardiness personality affects mental health through the mediating effect of coping styles.

3.4.3 The moderating role of the nature of the school

Table 8 Test results of the moderated mediation model

Variable	M1	M2	M3
	PCS	NCS	SCL-90
	B(t)	B(t)	B(t)
HS	4.836（3.426***）	-2.000（-1.951）	-3.539(-1.315)
PCS			-1.406(-8.408***)
NCS			1.747(7.564***)
School Nature	-6.682(-2.900**）	-4.863(-2.909**）	
HS*School Nature	1.951(2.245*)	1.852(2.935**)	
R^2	0.204	0.012	0.041
F	115.65***	5.394**	29.336(***)

Notes: *P<0.05; **P<0.01; ***P<0.001.

Abbreviations: PCS, positive coping style; NCS, negative coping style; SCL-90, Symptom Checklist-90 Score.

From the analysis in Table 8, it can be seen that the nature of school plays a moderating role between hardiness personality and positive coping styles, where the 95% confidence interval is [-11.202,-2.162], and the interval does not contain 0, so the moderating effect is significant. The moderating effect of school nature is significant and there is a mediating effect of moderation present. The interaction of school nature and hardiness personality played a positive moderating effect (B > 0), i.e., the interaction of school nature and hardiness personality positively predicted positive coping styles, negatively predicted negative coping styles, and indirectly affected the level of mental health of medical students through the mediating effect of coping styles.

The moderating effect of the nature of the school was further explained by a simple slope analysis to plot the moderating effect. Figure 3 illustrates that among medical students in public institutions, positive coping styles increased with increasing levels of toughness; among medical students in private institutions, positive coping styles increased with increasing levels of toughness. However, among medical students in public institutions, negative coping styles showed a decreasing trend with increasing levels of toughness personality; among medical students in private institutions, negative coping styles showed a significant increasing trend with increasing levels of toughness personality. The moderating effect of school nature on the relationship between hardiness personality and negative coping styles is visually illustrated in Figure 4.

4. Discussion

Mental health is an important factor in the careers of medical students. Many medical students are unable to successfully complete their studies or interrupt their medical careers due to mental health problems that occur before they formally become physicians. Therefore, mental health management and intervention for medical students is significant and important.

4.1 Relationship between hardiness personality and demographic variables among medical students

In terms of differences in the nature of schools, medical students in public colleges and universities have a higher percentage of mental health numbers and a higher percentage of adopting positive coping styles than those in private colleges and universities, and students in public colleges and universities have SCL-90 scores that are significantly lower than the scores of private colleges and universities, and scores of positive coping styles that are significantly higher than the scores of private colleges and universities. The tuition fee of students in private colleges and universities is much higher than that of ordinary college students, which not only increases the financial burden of their families, but also makes them bear more pressure from their families, which will have a certain impact on the psychological condition of the students[31]. Some private colleges and universities attach great importance to the learning of knowledge and skills of the students, and the work of mental health education is relatively weak, which objectively creates a blind zone of the education of the psychological growth of the students[32].

In terms of the differences in student cadres, the number of non-student cadre medical students with good mental health is slightly higher than that of student cadres, probably because student cadres need to take on more affairs, deal with more complex interpersonal relationships, and then bear higher psychological pressure, which will bring great pressure to student cadres and make them prone to psychological problems[33]. However, in terms of adopting positive coping methods, student cadres adopt positive coping methods more often than non-student cadres. However, in terms of adopting positive coping methods, student leaders are more likely to adopt positive coping methods than non-student leaders. The work of student leaders provides students with an opportunity to exercise their quality and belief in order to accomplish their tasks, and their ability to grasp and control things actively in the process of being a student leader. Students with experience as student leaders showed significantly greater mental toughness than ordinary students on all dimensions and total scores of the hardiness personality. Student leaders play the role of a bridge between teachers and students, have honed strong resilience in constant communication, are able to control their thoughts and behaviors in various occasions, need to invest more in terms of time and energy, and are constantly faced with challenges that may arise, and these experiences greatly contribute to the development of their hardiness personality[34].

In terms of the only-child difference, the number of only-children who are mentally healthy is slightly higher than that of non-only-children, which may be related to the fact that only-children receive more parental attention and emotional support from an early age[35]. Some findings suggest that the difference between only-child college students and non-only-child college students in terms of subjective well-being and level of depression is significant, and that the group of college students who are only-children have higher scores of subjective well-being and lower levels of depression[36].

In terms of upbringing, there was no significant difference in the mental health level of medical students from different upbringing environments, but the percentage of positive coping styles of rural college students (55.79%) was significantly higher than that of urban college students (50.87%). This result is consistent with the findings of a study on rural-oriented medical students[37]. This study found that although medical students from rural backgrounds had similar starting points, the differentiation of academic and career trajectories was directly related to individual resilient personalities and stress coping strategies, and that the long-term stress-adaptation process honed their stronger perseverance and problem-solving abilities.

In terms of single-parent family differences, medical students from single-parent families did not show any significant abnormalities in the areas of hardiness personality and mental health compared with non-single-parent students except for very few indicators, which is consistent with the results of the previous study[38], and the differences between the psychological state and personality characteristics of the single-parent population and those of the norm were not significant.

In terms of the difference between whether the family is family poor or not, the percentage of non-family poor college students who are mentally healthy is higher than that of family poor college students. Some studies show that low self-esteem, self-isolation, psychological pressure and other problems are more common among poor students from families, and the proportion of poor students from families with psychological problems is higher than that of poor students from non-families[39]. Although poor students receive certain material support, it is difficult to solve the economic difficulties fundamentally; at the same time, the identity label of "poor students" easily causes them to have problems such as frustrated self-esteem and reduced self-efficacy, which in turn affects their interpersonal interactions and behaviors, and ultimately induces psychological problems. At the same time, the identity label of "poor students" may easily cause them to suffer from self-esteem and reduced self-efficacy, which in turn affects their interpersonal interactions and behaviors, and ultimately induces psychological problems.

4.2 Relationship between hardiness personality, coping styles and mental health among medical students

A comparison of high and low resilience college students in their coping styles revealed significant differences in both positive and negative coping between the high and low resilience subgroups. The study showed that the total score and all dimensions of resilience personality were significantly positively correlated with positive coping, and that there was a significant positive correlation between all dimensions of resilience personality and negative coping styles, except for the challenge dimension. The correlation between resilience personality and SCL-90 shows that: college students' level of resilience and all dimensions are significantly negatively correlated with the SCL-90 total score; resilience personality becomes a suppressor of psychological symptoms, and has a certain predictive effect on psychological symptoms, which is conducive to the maintenance of mental health. A Japanese study showed that hardiness personality is a core positive trait for alleviating stress-related psychological problems, and the direct buffering effect of hardiness personality on short-term psychological stress response[40]. The present study verified Hypothesis 1 that hardiness personality and coping styles significantly predicted the mental health status of medical students. The mean scores of the SCL-90 of medical students in this study were higher than those of the national college student norms except for interpersonal sensitivity, indicating that the overall mental health status of medical students is not optimistic, which is similar to the results of a large number of previous studies[41]. It has been suggested in previous studies that the mental health status of medical students is significantly moderated by coping styles, through which individuals often deal with stressful events and manage the corresponding emotional states. The present study confirms that hardiness personality affects the mental health of medical students through the mediation of coping styles, which is consistent with the finding of similar studies that there are multiple pathways mediating the development of psychological problems among medical students[42]. In addition, negative coping styles are prone to form a vicious cycle with negative life stressors, which may exacerbate mental health problems, while positive coping styles are a key factor in the mental health of medical students. In addition, negative coping styles were associated with negative life stress, which exacerbated mental health problems, while positive coping styles were an important protective factor for the mental health of medical students, which was consistent with the findings of previous studies[43].

4.3 The mediating role of coping styles and the moderating role of school nature

Meanwhile, the present study found that hardiness personality affects the mental health of medical students through the fully mediated effect of coping styles, which suggests that coping styles are a more important and direct influence on the mental health of medical students compared to hardiness personality. This finding is consistent with previous research[44] and supports the validation of Hypothesis 2. Through the study of the relationship between medical students' mental health and hardiness personality, it was found that both the overall level of medical students' mental health and various symptoms were negatively correlated with hardiness personality, and that hardiness personality has an important influence on college students' mental health. The higher the level of resilience, the fewer the psychological symptoms and the higher the level of mental health, and the students with resilient personalities are able to take

measures to actively overcome difficulties and obstacles, and are more inclined to take the initiative to solve the problem[45]. It was found that positive coping is beneficial to the mental health of college students, while negative coping is detrimental to the mental health of college students, and negative coping is negatively predictive of mental health, and that different coping styles are important in the mental health of students, and that the negative coping styles have negative influence on the mental health of students. Different coping styles play different roles in mental health.

Finally, the nature of the school moderated the first half of the pathway of the mediating process "hardiness personality-coping style-mental health". This study also examined the moderating effect of school nature as a demographic variable on hardiness personality and coping styles, which has rarely been examined in previous studies. Unlike Ivy League schools in the United States, private medical colleges and universities in China have relatively low enrollment and admission scores, and their quality and social recognition are not as good as those of public medical colleges and universities[46]. Currently, although China's private colleges and universities are booming and have made great strides in various aspects, objective gaps and longstanding prejudices have led to a lack of full social recognition of private colleges and universities. Some medical students in private colleges and universities are prone to academic frustration, have low self-identity, and find it difficult to accept their own institutional identity, and the tuition fees of students in private colleges and universities are higher than those of students in public schools, so they are burdened with economic pressures in their hearts[47]. At the same time, some private colleges and universities attach great importance to the learning of knowledge and skills of students, and the work of mental health education is relatively weak, which objectively creates a blind zone in the education of the psychological growth of students[40]. Different schools and universities have different levels of mental health education, but they have different levels of psychological growth. The nature of different schools may be an important contextual factor in Chinese medical students' perceived resilient personalities and coping styles. Therefore, the present study considered school nature as a moderator in the mediation model. The results showed that the moderating effect of school nature was mainly reflected in the "hardiness personality→positive coping style" pathway, whereas the moderating effect on the "hardiness personality→negative coping style" pathway had a tendency to be significant but did not reach the level of full significance (P=0.068), indicating that Hypothesis 3 was partially tested.), indicating that Hypothesis 3 was partially tested. This result may be related to the specificity of the stressors of students in private colleges and universities: private college students are more prone to negative coping tendencies due to greater economic pressure and lower social identity, and even if they have a high level of hardiness personality, it is difficult for them to be quickly transformed into the inhibitory effect of negative coping. In addition, the relative weakness of mental health education resources in private institutions may have weakened the moderating effect of the hardiness personality on negative coping styles, which also provides a direction for subsequent targeted interventions.

5. Conclusion

This study investigated the mediators and moderators of the effects of hardiness personality on the mental health of Chinese medical students. This study confirmed that hardiness personality affects the mental health of medical students through the complete mediation of positive and negative coping styles; meanwhile, school nature plays a partial moderating role between hardiness personality and coping styles: hardiness personality of medical students in public colleges and universities has a significantly stronger positive predictive effect on positive coping styles than that of private colleges and universities, whereas negative moderating effect on negative coping styles is not fully confirmed and further exploration of boundary conditions is needed for follow-up. The results of this study provide valuable theoretical references for improving the mental health of medical students, and intervention strategies can be developed based on these findings to improve the mental health of medical students and help train mentally healthy doctors.

Limitations and future research

The current study has several limitations. First, this study is a cross-sectional survey, which only reveals the correlation between variables and cannot infer causality; in the future, longitudinal tracking or experimental design can be used to verify the causal mechanism between variables in depth. Second, this study only focused on medical students, and the generalizability of the findings is limited. In the future, the sample can be expanded to include college students from other majors to compare and validate the mediation and moderation model of this study. Third, the samples in this study were only from medical colleges and universities in Hefei City, Anhui Province, which is geographically limited, and multi-center and cross-regional studies can be conducted in the future to further validate the generalizability of the study's conclusions. Fourth, this study only verified the moderating effect of school nature on the first half of the mediation pathway of "hardiness personality → coping style", and we can further explore whether school nature moderates the second half of the mediation pathway or the moderating effect of other demographic variables in the future.

Declarations

Consent to Participate

All human participants in this study provided their written informed consent prior to the survey implementation. Each participant was fully informed of the study’s purpose, procedures, data usage and confidentiality measures, and voluntarily agreed to participate in the research.

Ethics Statement

This study involving human participants was reviewed and approved by the Institutional Review Board (IRB) of Anhui University of Traditional Chinese Medicine (Hefei, China). The study was conducted in accordance with the Declaration of Helsinki (2013 revision) and local institutional research regulations. Written informed consent was obtained from all individual participants for the collection and publication of the study data (excluding personally identifiable information).

Clinical Trial Number

Not applicable.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Funding

Declaration

Funding for this research was provided by the Anhui Provincial Department of Education 2024 Comprehensive Education and Ideological-Political Capacity Enhancement Project: "Ying Shan Hong" Counselor Master Teacher Studio (Project Number: sztsjh-2024-8-11); Anhui Provincial Department of Education 2025 Key Humanities and Social Sciences Project for Higher Education Institutions: Coupling Mechanisms and Optimization Pathways for Cultivating a Sense of Community for the Chinese Nation through Cultural and Museum Research and Study under the Perspective of Cultural Embedding: An Empirical Study Based on Anhui-Xinjiang Practices (Project Number: 2025AHGXSK30457).

Author Contribution

Hao Zhang, Yating He: Data curation, investigation, methodology, software, writing - original draft, writing - review & editing. Maoqing Lu: Data curation, investigation, methodology, software, writing - original draft, writing - review & editing. Chuanwei Zhang: Formal analysis, methodology, project administration, validation, writing - review & editing. Qinghe Peng: Methodology, software, validation, writing - review & editing. Huan Liu, Jiabao Chen: Data curation, investigation, validation, writing - original draft.

Acknowledgments

We are grateful to the school administrators, teachers, and students who actively cooperated with the researchers in the collection of data, and to all the participants in this study.

Data Availability

Original results from this study are included in the article/supplementary material and further queries can be directed to the corresponding author.

References

1. Xu Shuai Z, Jiayi. Meta-analysis of the mental health of medical school students in China[J]. Practical Prev Med. 2018;25(04):463–6.
2. Su Y, Yan N, Li Q, et al. Investigation and analysis of psychological stress among medical students in higher education[J]. Psychol Monthly. 2020;15(19):77–8.
3. Backovi DV, Maksimovi M, Davidovi D, et al. Stress and mental health among medical students[J]. Srp Arh Celok Lek. 2013;141(11–12):780–4.
4. McLafferty M, Armour C, Bunting B, et al. Coping, stress, and negative childhood experiences: the link to psychopathology, self-harm, and suicidal behavior[J]. PsyCh J. 2019;8(3):293–306.
5. Fenwick-Smith A, Dahlberg EE, Thompson SC. Systematic review of resilience-enhancing, universal, primary school-based mental health promotion programs[J]. BMC Psychol. 2018;6(1):30.
6. Kobasa SC. Stressful life events, personality, and health: an inquiry into hardiness[J]. J Personal Soc Psychol. 1979;37(1):1–11.
7. Xinzhong G, Zizhe Z. Relationship between medical students' mental health and hardiness personality and coping styles[J]. Med Res Educ. 2014;31(02):60–3.
8. Banerjee Y, Akhras A, Khamis AH, et al. Investigating the Relationship Between Resilience, Stress-Coping Strategies, and Learning Approaches to Predict Academic Performance in Undergraduate Medical Students: protocol for a Proof-of-Concept Study[J]. JMIR Res protocols. 2019;8(9):e14677.
9. Guo L, Yan D, Yan J, et al. Correlation of academic emotion and hardiness personality of undergraduate nursing students[J]. BMC Nurs. 2024;23(1):134.
10. Meng Q, Jia W. Influence of psychological hardiness on academic achievement of university students: The mediating effect of academic engagement[J]. Work (Reading Mass). 2023;74(4):1515–25.
11. Abdollahi A, Abu Talib M, Carlbring P, et al. Problem-solving skills and perceived stress among undergraduate students: the moderating role of hardiness[J]. J Health Psychol. 2018;23(10):1321–31.

12. Da Silva RM, Goulart CT, Lopes LFD, et al. Hardy personality and burnout syndrome among nursing students in three Brazilian universities-an analytic study[J]. BMC Nurs. 2014;13(1):9.
13. Folkman S, Lazarus RS. If it changes it must be a process: study of emotion and coping during three stages of a college examination[J]. J Personal Soc Psychol. 1985;48(1):150–70.
14. Wang Sainan G, Ruiying. The relationship between college students' coping styles and mental health - A multilayer analysis based on collective efficacy[J]. J Xihua Univ (Philosophy Social Sci Edition). 2018;37(05):109–14.
15. Andrews G, Tennant C, Hewson DM, et al. Life event stress, social support, coping style, and risk of psychological impairment[J]. J Nerv Ment Dis. 1978;166(5):307–16.
16. Xiong W, Liu H, Gong P, et al. Relationships of coping styles and sleep quality with anxiety symptoms among Chinese adolescents: a cross-sectional study[J]. J Affect Disord. 2019;257:108–15.
17. Okechukwu FO, Ogba KTU, Nwufo JI, et al. Academic stress and suicidal ideation: moderating roles of coping style and resilience[J]. BMC Psychiatry. 2022;22(1):546.
18. Li HB, Zhang WX, Yu FJ. The relationship between bullying and depression in adolescents[J]. Psychol Dev Educ. 2012;28(01):77–82.
19. Lei J, Wu LH, Su CH, et al. Analysis of the correlation between sleep hygiene habits and mental health of medical students in higher vocational colleges[J]. Chin J Social Med. 2022;39(04):436–40.
20. Luo Xiaolu. The current situation and countermeasures of college students' mental health education[J]. Educational Res. 2018;39(01):112–8.
21. Wang W, Mehmood A, Li P, et al. Perceived Stress and Smartphone Addiction in Medical College Students: the Mediating Role of Negative Emotions and the Moderating Role of Psychological Capital[J]. Front Psychol. 2021;12:660234.
22. Lai W, Li W, Guo L, et al. Association between bullying victimization, coping style, and mental health problems among Chinese adolescents[J]. J Affect Disord. 2023;324:379–86.
23. Nadimpalli SB, Kanaya AM, McDade TW, et al. Self-reported discrimination and mental health among Asian Indians: cultural beliefs and coping style as moderators[J]. Asian Am J Psychol. 2016;7(3):185–94.
24. Dai X, Wang M, Liu. Tuo. Handbook of Commonly Used Psychological Assessment Scales, 3rd edition [M]. Beijing: Beijing Science and Technology; 2023.
25. Lu GH, Liang BY. Development of the Toughness Personality Inventory[J]. Psychol Behav Res, 2008(02):103–6.
26. Judd LL, Schettler PJ, Rush AJ. A Brief Clinical Tool to Estimate Individual Patients' Risk of Depressive Relapse Following Remission: Proof of Concept[J]. Am J Psychiatry. 2016;173(11):1140–6.
27. Grabe HJ, Frommer J, Ankerhold A, et al. Alexithymia and outcome in psychotherapy[J]. Psychother Psychosom. 2008;77(3):189–94.
28. Xie Yaning. A preliminary study of the reliability and validity of the Brief Coping Style Scale[J]. Chin J Clin Psychol, 1998(02):53–4.
29. Jinhua WU, Wenyuan ZHANG, Mingyuan. Preliminary analysis of SCL-90 ratings in normal Chinese subjects[J]. Chin J Neuropsychiatric Dis, 1986(05):260–3.
30. Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations[J]. J Personal Soc Psychol. 1986;51(6):1173–82.
31. Zhang J, Meixue H, Ji Zhenpeng. Exploring the working method of college students' mental health education–Taking the example of students' mental health education work in X private colleges and universities in Chongqing[J]. Univ Educ, 2023(12):134–6.
32. Yun JIANG, Jian ZHOU, Xin QIN. Constructing a Mental Health Education Model with Diversified Approaches in Private Colleges and Universities under the Positioning of Applied Talent Cultivation–Taking Zhangjiajie College as

an Example[J]. Taste Classics, 2024(12):99–102.
33. Li Y. A study on the mental health of freshmen in a medical school based on the SCL-90 scale [D]. Anhui South Medical College; 2020.
34. Haiyan D, Xiaodong W. The effects of student cadre experience on college students' hardiness personality, social support and subjective well-being[J]. J Shaanxi Pre-school Teachers Coll. 2016;32(11):27–30.
35. Nadezhda Aili P, Xiangjun L, Jiaxin, et al. A survey on the psychological health status of university freshmen–taking the freshmen of class 2022 in a university in Xinjiang as an example[J]. Psychol Monthly. 2023;18(08):211–4.
36. Worksop. Research on Psychological Health and its Cultivation of College Students in the New Era under the Perspective of Healthy China [D]. Shaanxi Normal University; 2021.
37. Xiong Y, Zhang C, Han X. From similar starting point to divergent academic trajectories: Evidence from rural order-oriented medical students in China[J]. Med Teach, 2026:1–9.
38. Dongning ZHANG, Xin WANG. A survey on the mental health status of college students from single-parent families[J]. Chin Tissue Eng Res Clin Rehabilitation, 2007(30):5949–51.
39. Zhang J. Survey on the current situation of mental health of poor students in colleges and universities and research on educational countermeasures–Taking Intelligent Manufacturing College of Jiangsu Construction Vocational and Technical College as an example[J]. J Kaifeng Cult Art Vocat Coll. 2021;41(02):154–5.
40. Tomioka M, Matsunaga Y, Ota K, et al. Effects of sleep, resilience, and hardiness on the psychological stress response of Japanese university students over the previous two to three days[J]. Sleep Biol rhythms. 2025;24(1):73–9.
41. Liang Hongxia. Research on Interpersonal Expectations and Mental Health of College Students [D]. Guangxi Normal University; 2008.
42. Zhou C, Fei W, Zhong X et al. From perceived stress to social anxiety: Roles of sleep quality and affective empathy in medical students[J]. J Health Psychol, 2026:1379586589.
43. Deng Xiaohong Z, Jie L, Yang et al. The relationship between employment stress and mental health among poor college students:The mediating role of coping styles[J]. Educational Res Experimentation, 2015(01):86–91.
44. Su H, Cao J, Zhou Y, et al. The mediating effect of coping style on personality and mental health among elderly Chinese empty-nester: a cross- sectional study[J]. Arch Gerontol Geriatr. 2018;75:197–201.
45. Song L, Wang Y, Zhang Q, et al. The mediating effect of resilience on mental health literacy and positive coping style among Chinese empty nesters: a cross-sectional study[J]. Front Psychol. 2023;14:1093446.
46. Tian J, Zhang M, Zhou H, et al. College Satisfaction, Sense of Achievement, Student Happiness and Sense of Belonging of Freshmen in Chinese Private Colleges: Mediation Effect of Emotion Regulation[J]. Int J Environ Res Public Health. 2021;18(22):11736.
47. Bai LY, Li ZY, Wu WX, et al. Student-Teacher Relationship: Its Measurement and Effect on Students' Trait, Performance, and Wellbeing in Private College[J]. Front Psychol. 2022;13:793483.

Figures

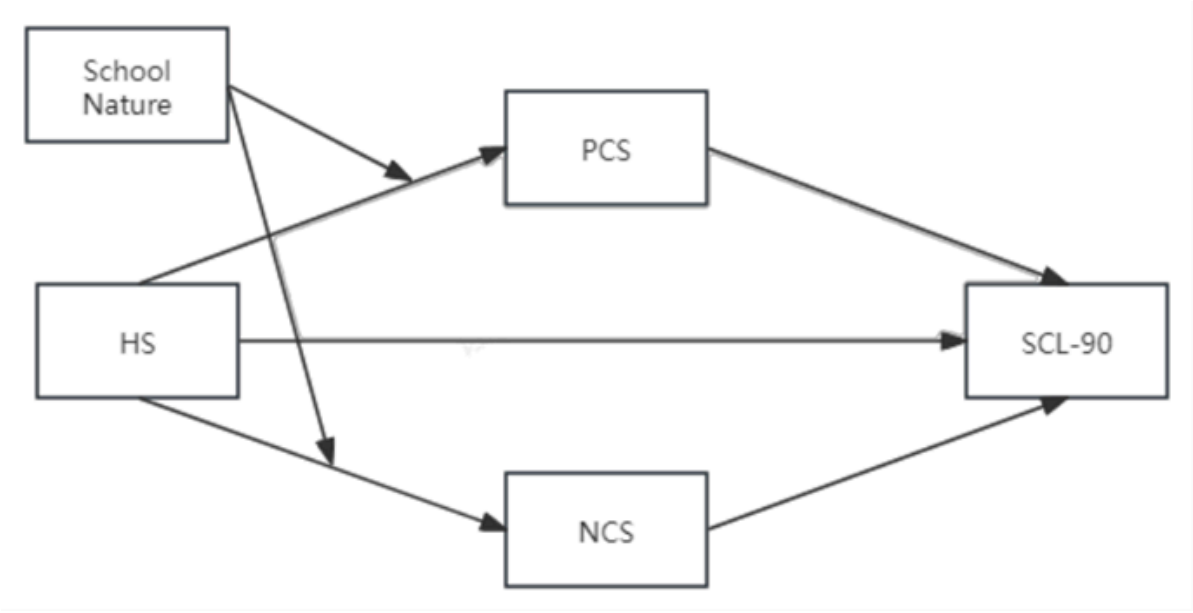


Figure 1

Hypothetical model of the relationships among HS, PCS, NCS, SCL-90 and the moderating role of school nature

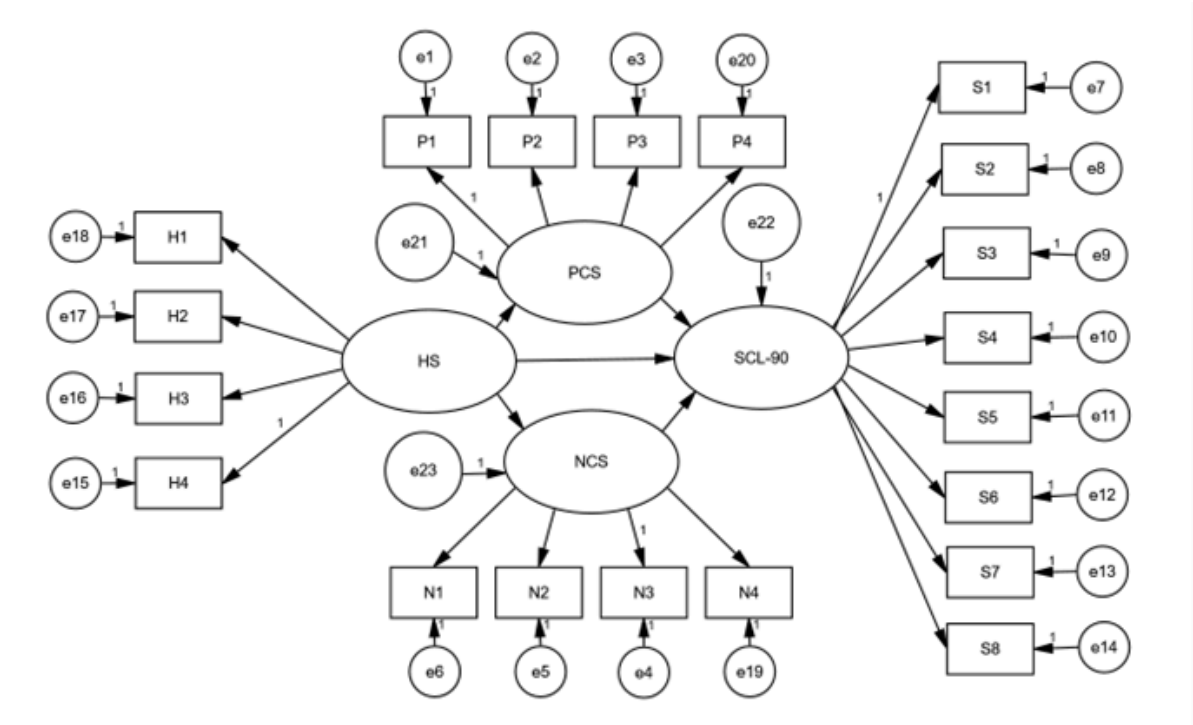


Figure 2

Structural equation modeling of hardiness personality and coping styles affecting the mental health of Chinese medical students

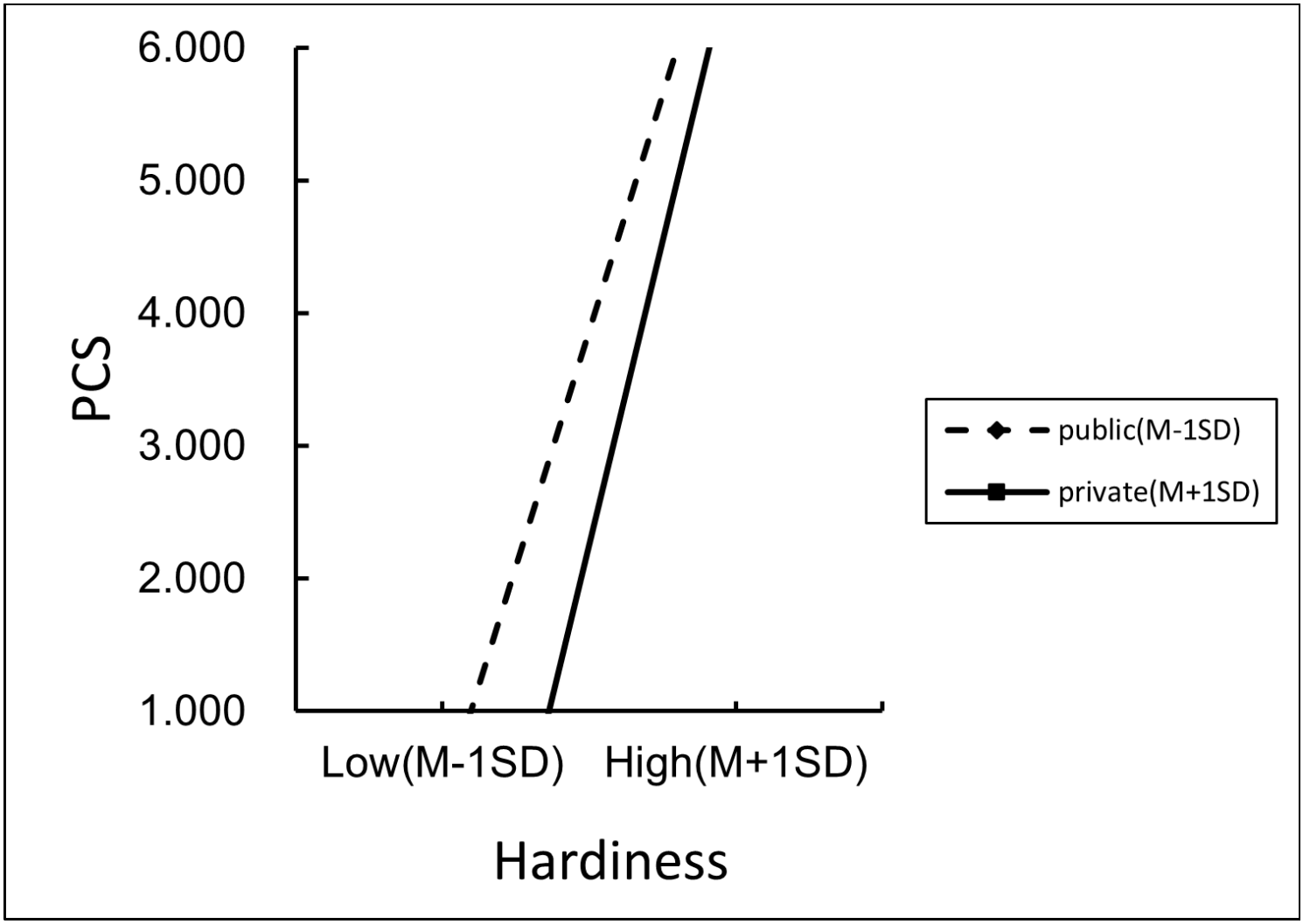


Figure 3

Moderating effect of school nature on hardiness personality and positive coping styles

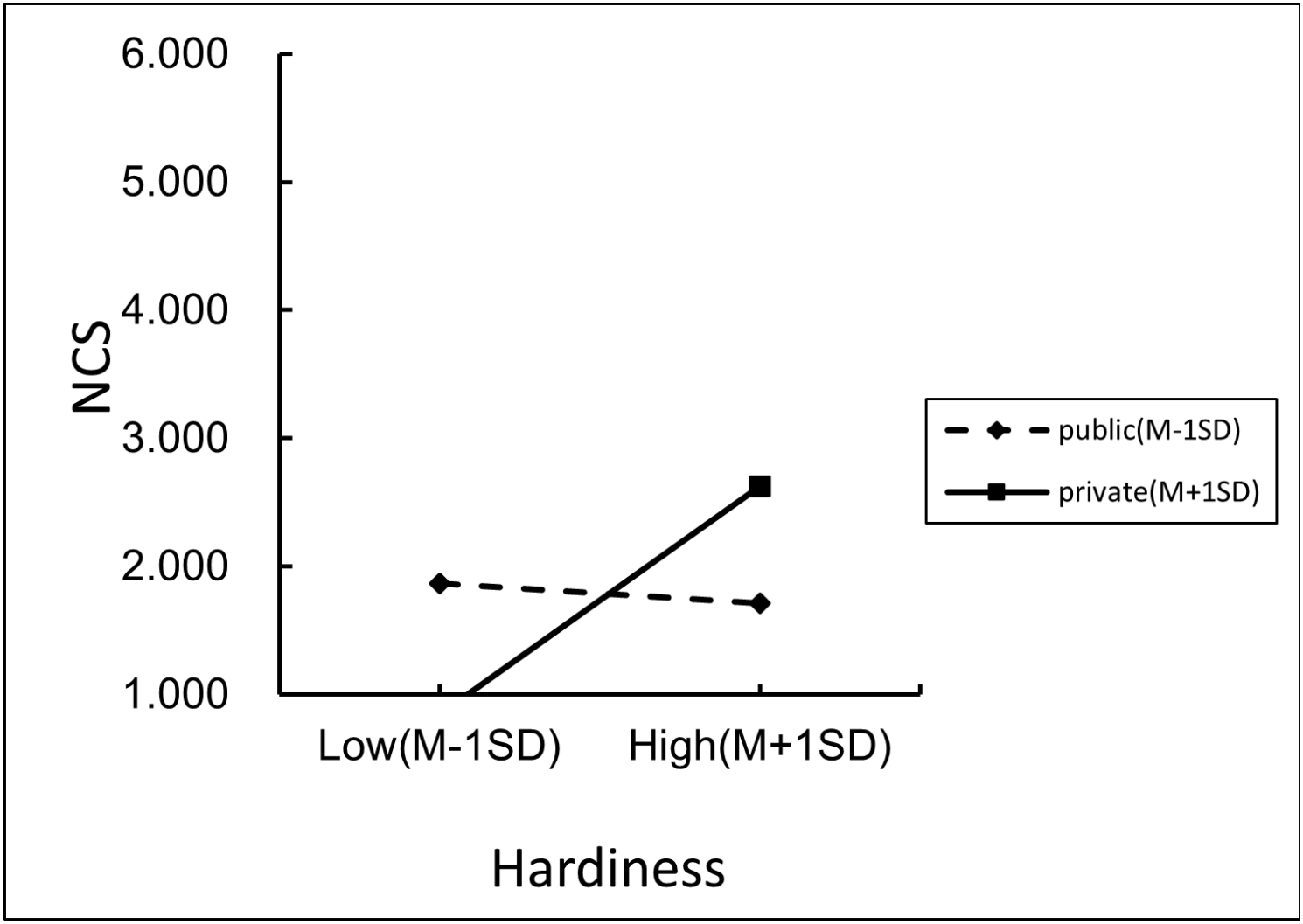


Figure 4

Moderating effect of school nature on hardiness personality and negative coping styles