



## Mathematical modeling to analyze the efficacy of mental health education in enhancing mental toughness of college students

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**SUMMARY:** *Previous literature indicates that psychological resilience of university students could be affected by mental health education. It is necessary to explore the role of mental health education on psychological resilience. Emotion regulation strategies and self-esteem will be included in the research framework as mediators in the relation of mental health education and psychological resilience. Data will be collected via Adolescent Psychological Resilience Scale, Mental Health Education Curriculum Questionnaire, Emotional Regulation Strategies Questionnaire, and Rosenberg Self-Esteem Scale. Then, AMOS 24.0 will be used for data analysis to establish the structural equation model connecting mental health education, emotion regulation strategies, self-esteem, and psychological resilience. It is found out that overall mental health education is conducive to students' psychological resilience through two paths: increased level of self-esteem and better emotion regulation strategies. Several model fit indicators were above 0.9, and thus the causal mechanism between variables was clearly identified. This study has verified the mediation effect of cognitive reappraisal and self-esteem, which provides sufficient evidence to develop curricula of mental health education at universities.*

**KEYWORDS:** *psychological resilience; mental health education; emotional regulation strategies; self-esteem; structural equation modeling*

## 1 Introduction

The ability to be psychologically resilient is an essential skill that modern college students need to develop in order to overcome stressful situations. In the rapidly changing environment of college, various factors like academic pressure, interpersonal interactions, and career plans are interconnected. Therefore, a person who successfully develops psychological resilience will not only succeed during the college years but also have a great chance to benefit from it throughout their entire lives [1-3]. The ability to be psychologically resilient is not an inborn skill but rather depends on various factors including students' family environment, social environment, and college itself [4-7].

Mental health education allows students to attain awareness about themselves. University mental health classes offer various ways of learning for students to learn more about themselves. For example, by means of various strategies including lectures, cases and discussions, students learn more about themselves in terms of how their thoughts, behaviors, and emotions function

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[8, 9]. This is helpful for better awareness. Students are taught positive thinking. They learn to think positively, learn lessons from their mistakes, and see problems as chances to improve themselves [10, 11]. This positive outlook will empower them to overcome difficulties and find solutions, thus making their psychological resilience stronger day after day [12-14]. Emotional regulation skills learned through mental health education allow students to calm down and relieve pressure when they are under great stress by using deep breathing, meditation, and exercise among other strategies [15, 16]. Additionally, mental health education allows students to learn to set right goals and values. When they know where they want to go and why they need to work hard, they are inspired to face challenges with confidence [17, 18]. In sum, mental health education is like making powerful armor for students, allowing them to build great psychological resilience. [19-21].

Reference [22] reviewed the evaluation of stress resilience for college students and compared the Conner-Davidson Resilience Scale. In their study, the results suggested that multi-items stress resilience scales were suitable and reliable measures, with higher values found in ordinary students. According to reference [23], issues like academic pressure and financial burden were among the reasons causing various mental health problems in college students. Resilience can serve as an essential tool for relieving psychological pressure and maintaining mental health, which means that the higher the degree of resilience, the less the occurrence of occupational burnout and mental health problems. Reference [24] demonstrated the benefits of resilience interventions as ways to facilitate students' coping with academic difficulties and other threats. Given the challenges posed by the COVID-19 pandemic, remote education has become especially necessary. Reference [25] systemically explicated the concept of "resilience." It highlighted that although students sought assistance to solve problems, some struggling with adapting to everyday life incidents needed to get help. Therefore, building up resilience was identified as a significant challenge for counseling college students. Reference [26] explored psychological resilience as a mediator between general self-efficacy and mental health, finding out that psychological resilience played an entirely mediating role in the association between general self-efficacy and mental health. Reference [27] was aimed to explore the effect of structured group sandplay therapy (SGSM) on psychological resilience of Chinese university students. Utilizing both quantitative and qualitative approaches involving process and outcome analysis, it illustrated the SGSM process. As can be seen from the above literature review, the studies systemically explicated "resilience," indicating that it was one of the most important aspects in relieving work, financial and everyday life pressure faced by university students. They also proposed the following approaches.

Reference [28] with the objective of assessing the impact of psychoeducational approaches on the perception of mental health, proved through a student survey that there were considerable changes in the students' perception and understanding of mental health once they completed the psychology classes, indicating the effect of educational experiences on the attitude towards mental health. Reference [29] assessed the effectiveness of the education psychology courses. Applying the PRISMA methodology, the paper concluded that introducing elements such as mental health awareness and stress reduction measures in the syllabus increased psychological resiliency among students and reduced academic stress. Reference [30] notes that mental health education is comprehensive and sustainable, contributing to the development of social adjustment skills. In that regard, it is necessary to develop mental health education initiatives, which are specifically designed based on the reality of students, to improve their general wellbeing. Reference [31] examined the effects of brief psychoeducational interventions on the students' attitudes towards seeking professional psychological services. Findings showed that conducting mental health education programs in class is an excellent strategy that can alter

students' attitudes towards professional help. Literature [32] used qualitative research methods to assess the impact of mental health education on students' health and wellbeing and academic performance. Interview results show that mental health education was vital for enhancing emotional regulation skills among students and reducing stress and anxiety levels. Literature [33] highlights the significance of mental health education and applies psychological theories and educational methods based on students' development stages, which resulted in more holistic growth and improved educational outcomes.

This research examines the efficacy of mental health education in boosting college students' psychological resilience, using mental health education as the independent variable and self-esteem and emotional regulation strategies as mediating variables. It aims to provide new directions for enhancing students' psychological resilience. First, a whole-class sampling method was employed to administer questionnaires on four relevant variables to 1,000 college students in City A, yielding 900 valid responses. Mathematical statistical methods—including descriptive statistics, demographic variable analysis, correlation analysis, regression analysis, and structural equation modeling of the relevant variables—were used to model and test the complex relationships among mental health education, emotional regulation strategies, self-esteem, and psychological resilience.

## **2 Mental Health Education Curriculum and Psychological Resilience**

### **2.1 Psychological Resilience and Its Related Influencing Factors**

The concept of psychological resilience [34] emerged from 20th-century research by foreign psychologists, who observed that some children could achieve healthy physical and mental development even when facing adversity. Psychological resilience refers to an individual's ability to effectively bounce back from stress through tenacious psychological coping mechanisms when confronting a series of pressures and negative emotions. Different scholars hold varying interpretations of the concept's essence. Hong Kong scholars define psychological resilience as the capacity to emerge from adversity, translating it as “resilience against adversity.” Others liken it to the physics concept of “elasticity,” translating it as “psychological elasticity.” Still others view it as an individual's ability to cope and adapt well in traumatic and stressful situations, translating it as “resilience.” To date, scholars have not reached a unified definition of psychological resilience.

The concept of psychological resilience has been extensively studied across multiple fields including medicine, psychology, education, and sports training. In medicine, psychological resilience serves as a key mental health indicator related to stressor exposure, buffering potential psychological issues following stress. The CD-RISC scale, which assesses resilience from both capability and trait perspectives, demonstrates strong predictive power for positive emotions, confirming resilience's role in maintaining positive affect during psychotic episodes. Research reveals significant negative correlations between psychological resilience and individual depression, anxiety, and post-traumatic symptoms. Resilience also mediates the relationship between traumatic events and individual mental health. Based on these findings, the concept of psychological resilience can inform structured therapeutic interventions for patients and inform the development of educational programs to promote individual mental health development.

As far as education is concerned, most of the studies conducted by scholars concentrate on the student body. Scholars try to explore the connection between psychological resilience and educational factors including learning, schools, classrooms, and family education. In family

education, affection and empathy in the approach of parents to their children contribute to the development of psychological resilience among children, whereas neglect, denial, and excessive punishment have an inverse relationship with children's psychological resilience. As far as the association between psychological resilience and educational matters, including student learning engagement, school adaptation, and academic procrastination, studies show that psychological resilience affects student learning engagement positively because students can remain focused when learning and effectively deal with challenges encountered in the process. At the same time, psychological resilience has a great influence on students' school adaptation.

Self-esteem is defined as the individual's judgment and feelings about him or herself. Studies reveal that people with higher self-esteem can successfully resist the negativity around them, hence preventing stress and other setbacks while promoting flexibility. Low self-esteem, on the other hand, predisposes people to various psychological and social problems such as anxiety, depression, risky behavior, and substance use. Consequently, self-esteem has a strong positive correlation with psychological resilience.

Emotional regulation strategies refer to individual strategies that help one adapt their cognition, emotions, and behavior based on specific goal requirements. People with high self-control can make good decisions and refrain from making poor ones; hence, resulting in better performance in learning, work, relationships, and overall life satisfaction while avoiding psychological, impulsive, and addictive disorders. The emotional regulation strategies among students are affected by mental health education. From the discussion above, it can be seen that emotional regulation strategies act as a mediator between mental health education and psychological resilience among students. Mental health education plays a role in developing the emotional regulation skills among students.

## **2.2 Mental Health Education Curriculum Design**

### **2.2.1 Objectives of Mental Health Education Courses**

The objectives of a curriculum reflect its desired impact and outcome and can be said to be the beginning and end of all the teaching processes. According to the Outline, the general objective of mental health education is the improvement of the psychological state of the students, the creation of positive and optimistic qualities, complete development of psychological potential, harmonious and sustainable development of physical and mental abilities of students, and the formation of solid ground for healthy development and successful life. One of the main means of achieving these general objectives is the use of a curriculum, which will be developed in correspondence with these objectives but will be set in line with national standards and the specifics of the educational institution. The curriculum objectives for mental health education suggested in this paper include raising awareness about mental health, positive personality development, solving psychological problems, social adaptability, complete development of psychological potential, and harmonious and sustainable development of mind and body.

### **2.2.2 Teaching Methods for Mental Health Education Courses**

The teaching methods refer to both how teachers teach and how students learn. Not all subjects can be taught with identical techniques. Therefore, the teaching methods used for the mental health education classes should be in accordance with the basic philosophy of the new curriculum reform, which encourages students' independence, self-initiative, and creative spirit. The teaching methods employed in this study primarily include the following:

**Lecture Method:** In this method, the process of imparting knowledge includes narrating, describing, explaining, and reasoning by the teachers. This is the most commonly used method

of instruction. Though the topic at hand is not purely theoretical, some theoretical knowledge is necessary for the understanding and mastery of the content. In the case of the emotion regulation topic under study, students required understanding and mastery of the ABC Theory of Emotion and “I” message technique. Teachers used the lecture method to teach these concepts.

Discussion entails the process whereby students debate about various topics within the classroom setting in order to learn from each other. Being one of the popular teaching techniques, discussion ensures that all learners actively participate, hence enhancing active learning experiences. Discussion also enhances curiosity and encourages teamwork. Discussion was frequently employed in this research’s classes. For example, in “Changing Perspectives, Changing Moods,” students discussed the different techniques employed by each individual in managing his/her moods. In the lesson titled “Reshuffle the Cards of Destiny,” students engaged in intense discussion regarding how they could confront their destinies.

The goal of the cognitive method is reached by focusing on students' cognitive processes. This method relies heavily on storytelling and association methods to change the perception. For example, during the activity "Me in Twenty Years," the teacher helped the students visualize their future, thus reflecting on their career plans. During the lesson “Communication Postures," students were introduced to the topic by using a story that sparked reflection about the subject matter. In the case of “Changing Perspectives, Changing Moods," rational emotive therapy is taught through questioning students about their irrational beliefs and discussing them. Thus, by restructuring their cognition, they will be able to regulate negative emotions. “Harmonious Parent-Child Relationships" utilizes the campus drama psychology method, where students create a script and then discuss their problems as a whole group. In “Active Listening," students play different roles, namely being a listener or a speaker. In doing so, students become aware of what a good listener should have.

### **3 Research Hypotheses and Research Design**

#### **3.1 Research Hypotheses**

This study posits the following hypotheses:

Hypothesis 1: Mental health education predicts psychological resilience among college students.

Hypothesis 2: Emotion regulation strategies mediate the relationship between mental health education and psychological resilience [35].

Hypothesis 3: Self-esteem mediates the relationship between mental health education and psychological resilience.

Hypothesis 4: Emotional regulation strategies and self-esteem jointly mediate the relationship between mental health education and psychological resilience.

#### **3.2 Research Subjects**

A class-based sampling approach was adopted across three universities in City A, with 1,000 questionnaires distributed and 900 valid responses collected, yielding a valid response rate of 90%. Participants ranged in age from 18 to 23 years ( $M \pm SD = 20.34 \pm 0.91$ ), comprising 425 males and 475 females.

### 3.3 Research Tools

#### 3.3.1 Adolescent Psychological Resilience Scale

The Adolescent Psychological Resilience Questionnaire is composed of five scales, including positive cognition, goal orientation, emotion regulation, family support, and interpersonal relationship, with a total of 27 questions. Its measurement scale is from 1 to 5 with “never” being marked as 1 and “always” being marked as 5. The higher score means more psychological resilience at that scale. Cronbach's  $\alpha$  of the whole questionnaire is 0.84 in this research.

#### 3.3.2 Self-Esteem Scale

The Chinese version of the Rosenberg Self-Esteem Scale [36] was used in its Chinese version. This measure consists of 10 questions answered on a 4-point Likert scale (strongly agree = 1, agree = 2, disagree = 3, strongly disagree = 4). It includes five positive questions and five negative questions. Total score on the scale can vary between 0 and 40; the higher the score, the higher is self-esteem. In this study,  $\alpha$  coefficient for the scale was 0.76.

#### 3.3.3 Emotion Regulation Strategies Questionnaire

The Emotion Regulation Questionnaire (ERQ) introduced in 2003 was used. This scale includes ten questions which include two dimensions of emotion regulation, that is, cognitive reappraisal and expressive suppression. ERQ uses a seven point likert scale where participants select responses on a continuum from strongly agree to strongly disagree with values 1-7 respectively. The scale alpha was 0.714 with expression suppression and cognitive reappraisal subscales obtaining 0.782 and 0.799, respectively.

#### 3.3.4 Mental Health Education Course Statistics Scale

In this study, the Mental Health Education Questionnaire simplified Chinese version was utilized, which is consisted of 21 questions. The four-level scoring method was applied, with the higher score representing a higher tendency to implement this form of mental health education. This research contains two aspects of mental health education, namely complete mental health education and incomplete mental health education. A confirmatory factor analysis was performed on the mental health education questionnaire, and the model shows a good fit for all the indicators. The reliability coefficient of Cronbach's  $\alpha$  of the whole scale in this study is 0.88.

## 4 Research Findings

### 4.1 Descriptive Statistical Analysis

Four variables were analyzed by means of descriptive statistics; these variables include mental health education for university students, psychological resilience, self-esteem, and emotional regulation techniques. These findings are presented in Table 1 below.

The mean for comprehensive mental health education is 2.816, while that for inadequate mental health education is 1.822. It is clear from these findings that mental health education has been prioritized by most universities, providing good mental health education programs to their students.

The mean value of the self-esteem scale is 2.855, which means that the self-esteem scale of college students is in the high range.

The mean value of the cognitive reappraisal strategy is 4.854, which means that college

students regularly use cognitive reappraisal strategies. The mean value of the expressive suppression strategy is 3.338, which means that college students use expressive suppression strategies to some extent. On the whole, college students regularly use cognitive reappraisal strategies.

The mean value of psychological resilience is 3.418, which means that college students have a high level of psychological resilience.

*Table 1: Variable descriptive statistics*

	N	Minimum value	Maximum value	M	SD
Perfect mental health education course	900	1.22	4	2.816	0.632
Imperfect mental health education course	900	1	3.5	1.822	0.381
Cognitive review	900	1	7	4.854	1.305
Expression inhibition	900	1	7	3.338	1.381
Self-esteem	900	1.2	4	2.855	0.641
Psychological toughness	900	1.42	5	3.418	0.857

## 4.2 Demographic Variable Analysis

In order to investigate the existence of any gender differences for all the variables in college students, independent sample tests were performed on each variable. These results are shown in Table 2.

The data suggests that there are no significant differences by gender in the following indicators: adequacy of mental health education, self-esteem, cognitive reappraisal, expressive suppression, and psychological resilience. The corresponding p-values are 0.175, 0.162, 0.204, 0.521, 0.105, and 0.112, respectively. Society is continuously developing; the attitude towards children by parents and educators has become gender-equal. An identical approach towards mental health education is used for different genders, which means that there are no gender differences in terms of the quality of mental health education. With an improvement in women's status, equal educational opportunities are provided to men and women. There is a reduced gender gap because of the increased proportion of highly educated people. The physical and psychological development of university students has become more mature. In this period, one is able to develop his or her own self-concept, regulate emotions properly and make an objective analysis of various situations.

*Table 2: Differences in different gender college students on various variables*

Variable	Gender	N	M	SD	t	p
Psychological toughness	man	425	3.497	0.82	1.562	0.112
	female	475	3.319	0.882		
Perfect mental health education course	man	425	2.854	0.612	1.365	0.175
	female	475	2.777	0.641		
Imperfect mental health education course	man	425	1.802	0.37	-1.402	0.162
	female	475	1.843	0.38		
Cognitive review	man	425	4.983	1.221	0.811	0.204
	female	475	4.807	1.369		
Expression inhibition	man	425	3.299	1.349	-0.648	0.521
	female	475	3.275	1.425		
Self-esteem	man	425	2.902	0.605	0.874	0.105
	female	475	2.873	0.612		

In order to explore if there are any differences among college students of different grades in terms of these variables, we analyzed variance through ANOVA and performed post-hoc analyses on each one. The exact results are shown in Table 3 and the distribution of mean value in Figure 1. On the y-axis, B, C, D, E, F, and G stand for six variables including well-developed mental health education, underdeveloped mental health education, self-esteem, cognitive reappraisal strategy, expression suppression and psychological resilience, respectively. There were no statistical differences between mental health education and expression suppression among different grades ( $F=0.451$ ,  $P=0.758$ ;  $F=0.589$ ,  $p=0.433$ ;  $F=0.312$ ,  $p=0.754$ ). It suggests that mental health education and expression suppression are stable among different grades without notable differences.

There were statistical differences among students of different grades in terms of self-esteem, cognitive reappraisal strategy and psychological resilience with senior students performing significantly better than freshmen in these three variables. The reason could be that students become more mature physically and psychologically with higher grade and age, thus possessing higher level of self-consciousness and self-cognition ability. Senior students have formed an understanding of themselves and focus on evaluating themselves rather than evaluations of others. In addition, senior students have had more successful experience in college life, which further improves their self-confidence. Besides, senior students tend to have stronger adaptability and make use of positive emotion regulation strategies such as cognitive reappraisal to decrease negative emotions.

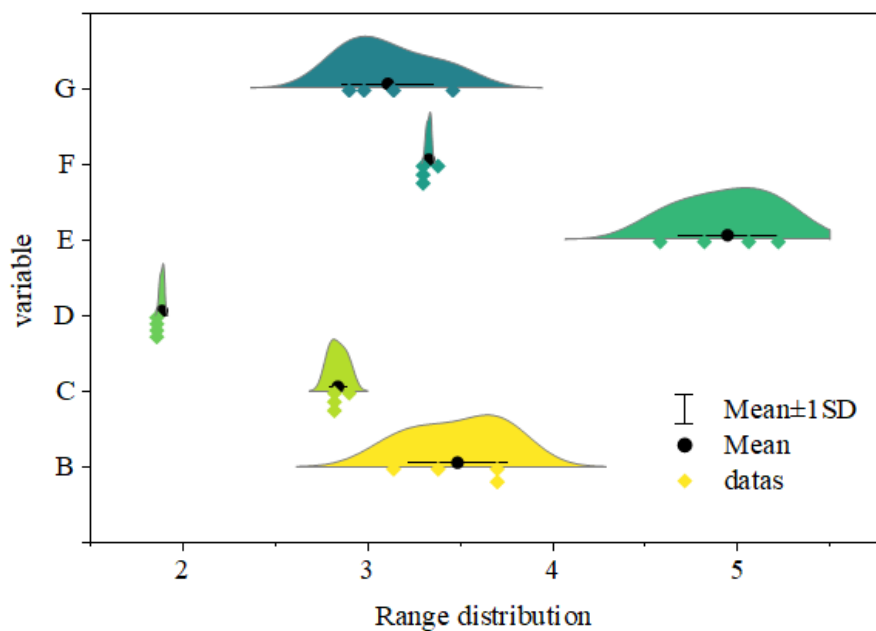


Figure 1: Data distribution

Table 3: In grade

Variable	Gender	N	M	SD	F	p	Post-mortem
Psychological toughness	Freshman year	225	3.158	1.456	3.956	0.012	Freshman year<Senior year
	Sophomore	205	3.379	1.477			
	Gunior	254	3.684	1.481			
	Senior year	211	3.721	1.496			
Perfect mental health education course	Freshman year	225	2.786	0.458	0.451	0.758	
	Sophomore	205	2.813	0.465			
	Gunior	254	2.856	0.425			
	Senior year	211	2.899	0.477			
Imperfect mental health education course	Freshman year	225	1.897	0.462	0.589	0.433	
	Sophomore	205	1.895	0.512			
	Gunior	254	1.874	0.568			
	Senior year	211	1.883	0.514			
Cognitive review	Freshman year	225	4.615	1.215	3.875	0.020	Freshman year<Senior year
	Sophomore	205	4.859	1.336			
	Gunior	254	5.071	1.338			
	Senior year	211	5.235	1.418			
Expression inhibition	Freshman year	225	3.315	1.415	0.312	0.754	
	Sophomore	205	3.341	1.465			
	Gunior	254	3.325	1.477			
	Senior year	211	3.339	1.432			
Self-esteem	Freshman year	225	2.885	1.512	3.958	0.015	Freshman year<Senior year
	Sophomore	205	2.956	1.415			
	Gunior	254	3.154	1.562			
	Senior year	211	3.441	1.613			

### 4.3 Correlation Analysis of Variables

This study employed Pearson's rank correlation coefficient to measure the relationship between variables. As shown in Figure 2, comprehensive mental health education exhibited significant positive correlations with cognitive reappraisal ( $r = 0.380$ ,  $p < 0.001$ ), self-esteem ( $r = 0.440$ ,  $p < 0.001$ ), and psychological resilience ( $r = 0.490$ ,  $p < 0.001$ ). It exhibits a significant negative correlation with expressive suppression ( $r = -0.085$ ,  $p = 0.042$ ). Inadequate mental health education shows a significant positive correlation with expressive suppression ( $r = 0.310$ ,  $p < 0.001$ ), while no significant correlations exist between inadequate mental health education and cognitive reappraisal, self-esteem, or psychological resilience. Cognitive reappraisal showed significant positive correlations with self-esteem and psychological resilience ( $r = 0.340$ ,  $p < 0.001$ ;  $r = 0.410$ ,  $p < 0.001$ ). No significant correlations were found between expressive suppression and self-esteem or psychological resilience. Self-esteem and psychological resilience showed a significant positive correlation ( $r=0.480$ ,  $p<0.001$ ). In summary, comprehensive mental health education, psychological resilience, cognitive reappraisal, and self-esteem all exhibit significant correlations with each other.

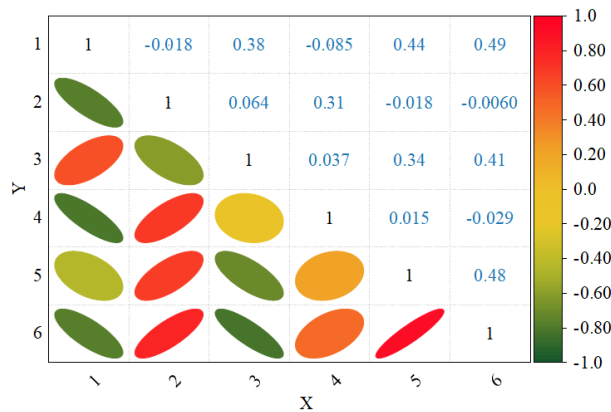


Figure 2: Relevant analysis results

#### 4.4 Regression Analysis of Variables

As shown in Table 4, through a series of hierarchical regression analyses, the first test revealed that comprehensive mental health education significantly influenced psychological resilience, explaining 23.9% of the variance in the dependent variable psychological resilience ( $\beta = 0.495$ ,  $t = 14.090$ ,  $p < 0.001$ ). In the second equation, belief in a just world significantly influenced the mediating variables of cognitive reappraisal and self-esteem, explaining 14.4% of the variance in cognitive reappraisal ( $\beta = 0.376$ ,  $t = 10.037$ ,  $p < 0.001$ ) and 19.4% of the variance in self-esteem ( $\beta = 0.438$ ,  $t = 12.188$ ,  $p < 0.001$ ). In the third regression equation, cognitive reappraisal and self-esteem significantly influenced psychological resilience, explaining 16.0% of its variance ( $\beta = 0.405$ ,  $t = 11.009$ ,  $p < 0.001$ ) and 22.8% of its variance ( $\beta = 0.479$ ,  $t = 13.502$ ,  $p < 0.001$ ), respectively. In the fourth regression analysis, when comprehensive mental health education, cognitive reappraisal, and self-esteem were entered into the equation separately, comprehensive mental health education still significantly influenced psychological resilience ( $\beta = 0.296$ ,  $t = 7.909$ ,  $p < 0.001$ ), ( $\beta = 0.284$ ,  $t = 7.669$ ,  $p < 0.001$ ). When all three were simultaneously included in the equation, although the explanatory power of comprehensive mental health education on psychological resilience increased, its standardized regression coefficient gradually decreased from ( $\beta = 0.296$ ,  $t = 7.909$ ,  $p < 0.001$ ) to ( $\beta = 0.284$ ,  $t = 7.669$ ,  $p < 0.001$ ), 0.198 ( $t = 5.672$ ,  $p < 0.001$ ), which remained significant. The results indicate that cognitive reappraisal and self-esteem serve as mediating factors between comprehensive mental health education and psychological resilience, exerting partial mediating effects.

Table 4: Regression analysis

Regression equation		Integral fitting index			The regression coefficient is significant		
Result variable	Predictor variable	R	R <sup>2</sup>	F	$\beta$	t	p
Psychological toughness	Perfect mental health education	0.495	0.239	198.596	0.495	14.090	<0.001
Cognitive review	Perfect mental health education	0.376	0.144	100.847	0.376	10.037	<0.001
Self-esteem	Perfect mental health education	0.438	0.194	148.635	0.438	12.188	<0.001
Psychological toughness	Cognitive review	0.405	0.160	121.115	0.405	11.009	<0.001
	Self-esteem	0.479	0.228	182.467	0.479	13.502	<0.001
Psychological toughness	Perfect mental health education	0.603	0.356	115.808	0.296	7.909	<0.001
	Cognitive review				0.198	5.672	<0.001
	Self-esteem				0.284	7.669	<0.001

## 4.5 Structural Equation Modeling

### 4.5.1 Structural Equation Modeling Analysis

This study employed AMOS 24.0 to conduct structural equation modeling analysis on the relationships among enhanced mental health education, cognitive reappraisal, self-esteem, and psychological resilience, constructing the structural equation model as depicted in Figure 3.

Within AMOS, the maximum likelihood estimation method was employed to test the structural equation model. The model fit analysis results are presented in Table 5. The fit analysis indicates that  $\chi^2/df$  is 1.305, RMR is 0.032, and RMSEA is 0.021, all below the upper limit of 0.08 for ideal values. GFI = 0.952, CFI = 0.995, NFI = 0.965, IFI = 0.995, TLI = 0.988. All fit indices exceeded the general fit threshold of 0.9. Collectively, the SEM fit indices indicate that the proposed theoretical model fits well with the collected sample data.

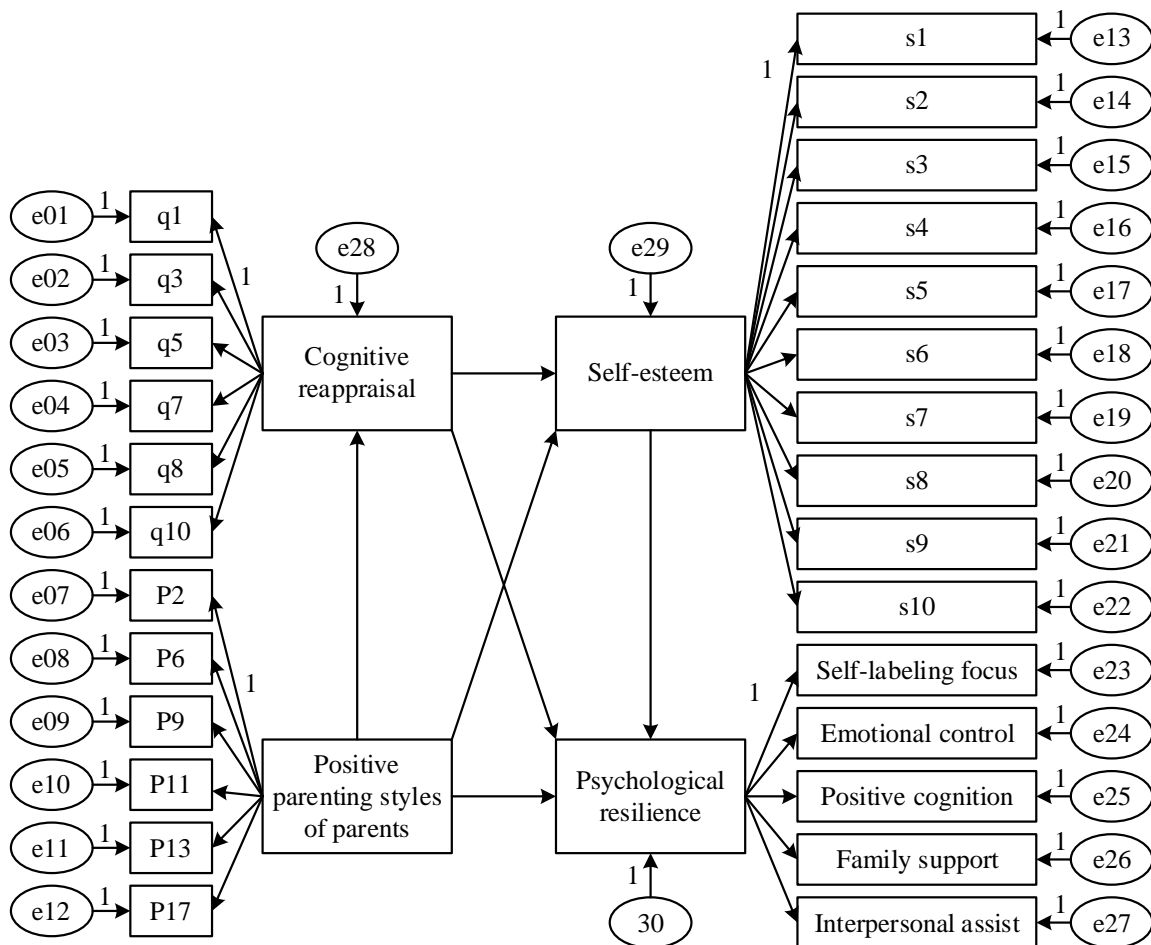


Figure 3: Structural equation model diagram

Table 5: Model fitting result

Index	$\chi^2/df$	RMR	RMSEA	GFI	CFI	NFI	ILI	TLI
Actual value	1.305	0.032	0.021	0.952	0.995	0.965	0.995	0.988

### 4.5.2 Path Analysis of Structural Equation Models

When the aforementioned fit indices reach their ideal values, the model fit in this study achieves an acceptable level. The path significance results of this study are presented in Table 6.

According to the SEM model output, the standardized path coefficient for comprehensive mental health education on psychological resilience is 0.335, with a p-value less than 0.001. This indicates that comprehensive mental health education has a significant positive effect on psychological resilience, thus partially supporting Hypothesis 1. The standardized path coefficient for comprehensive mental health education on cognitive reappraisal is 0.424, with a p-value less than 0.001. This indicates that comprehensive mental health education has a significant positive effect on cognitive reappraisal. The standardized path coefficient of comprehensive mental health education on self-esteem is 0.414, with a p-value less than 0.001. This indicates that comprehensive mental health education has a significant positive effect on self-esteem. The standardized path coefficient of cognitive reappraisal on self-esteem is 0.179, with a p-value less than 0.001. This indicates that cognitive reappraisal has a significant positive effect on self-esteem. The standardized path coefficient of cognitive reappraisal on psychological resilience is 0.213, with a p-value less than 0.001, indicating that cognitive reappraisal has a significant positive effect on psychological resilience. The standardized path coefficient of self-esteem on psychological resilience is 0.302, with a p-value less than 0.001, indicating that self-esteem has a significant positive effect on psychological resilience.

*Table 6: The path analysis standardization estimation and significance*

Assumption path	Nonnormalized coefficient	Normalization factor	S.E.	C.R.	P
Perfect mental health education → psychological toughness	0.444	0.335	0.067	6.999	<0.001
Perfect mental health education → cognitive review	1.003	0.424	0.107	9.579	<0.001
Perfect mental health education and self-esteem	0.466	0.414	0.059	8.668	<0.001
Cognitive review → self-esteem	0.078	0.179	0.023	4.046	<0.001
Cognitive review → psychological toughness	0.117	0.213	0.023	4.943	<0.001
Self-esteem → psychological toughness	0.352	0.302	0.059	6.449	<0.001

### 4.5.3 Mediating Effect Analysis

As shown in Table 7, in the mediating path “P1: Comprehensive Mental Health Education → Cognitive Reappraisal → Psychological Resilience,” the 95% confidence interval for the indirect effect of comprehensive mental health education on cognitive reappraisal is [0.052, 0.126], which does not include zero. Therefore, the mediating effect is significant. The 95% confidence interval for the direct effect is [0.229, 0.441], which does not include zero, thus indicating a significant partial mediating effect. The specific indirect effect value is 0.085, the direct effect value is 0.337, and the total effect value is 0.571. The ratio of indirect effect to total effect is  $0.085/0.571 = 0.149$ . This indicates that when comprehensive mental health education influences psychological resilience, 14.9% of the variance is attributable to cognitive reappraisal. Therefore, part of Hypothesis 2 holds.

In the mediating path “P2: Comprehensive Mental Health Education → Self-Esteem → Psychological Resilience,” the 95% confidence interval for the indirect effect of comprehensive mental health education on psychological resilience is [0.073, 0.185], which does not include zero. Thus, the mediating effect is significant. The direct effect is also significant, indicating

that the partial mediating effect is significant. The specific indirect effect value was 0.124. The ratio of the indirect effect to the total effect was  $0.124/0.571 = 0.217$ . This indicates that when comprehensive mental health education influences psychological resilience, 21.7% of the variation is attributable to self-esteem. Therefore, Hypothesis 3 holds.

In the mediating path “P3: Comprehensive Mental Health Education → Cognitive Reappraisal → Self-Esteem → Psychological Resilience,” the 95% confidence interval for the specific indirect effect of comprehensive mental health education on psychological resilience is [0.008, 0.035], which does not include zero, indicating a significant mediating effect. The direct effect is significant, thus confirming a partial mediating effect. The specific indirect effect value is 0.025. The ratio of indirect effect to total effect is  $0.025/0.571 = 0.044$ . This indicates that when self-esteem influences psychological resilience, 4.4% of the variance is mediated through cognitive reappraisal affecting self-esteem, which in turn affects psychological resilience. Therefore, Hypothesis 4 holds.

*Table 7: The mediation effect bootstrap test results*

	The effect is (SE)	Confidence interval	p	Effect ratio(%)
Total indirect effect	0.234(0.036)	[0.170,0.308]	0.001	40.50
P1: perfect mental health education, cognitive review, psychological toughness	0.085(0.023)	[0.052,0.126]	0.001	15.60
P2: perfect mental health education, self-esteem and psychological toughness	0.124(0.029)	[0.073,0.185]	0.001	20.40
P3: perfect mental health education, cognitive review, self-esteem and psychological resilience	0.025(0.008)	[0.008,0.035]	0.001	4.50
Direct effect	0.337(0.055)	[0.229,0.441]	0.001	59.50
Total effect	0.571(0.038)	[0.4850.635]	0.001	

## 5 Conclusion

The findings from this research on the impact of mental health education courses on psychological resilience amongst college students as well as its underlying processes were as follows:

(1) Mental health education has an immense positive effect on the components of cognitive reappraisal, self-esteem, and psychological resilience. This is because mental health education does not only directly enhance psychological resilience in students but indirectly enhances psychological resilience through improving self-esteem and emotional regulation strategies such as cognitive reappraisal. All the fitting indices for the structural equation model were above 0.9, thus confirming a multipath effect between mental health education, self-esteem, emotional regulation strategy, and psychological resilience. This implies that mental health education courses have overall positive effects on college students.

(2) Moreover, demographic analysis shows no significant difference based on gender for any of the variables tested. However, significant grade-level differences were observed in self-esteem, cognitive reappraisal strategies, and psychological resilience, with senior students scoring higher than freshmen. This suggests that mental health education should be tailored to student characteristics through differentiated design.

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