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Negative life events, inadequate mental health literacy, and emotional symptoms among Chinese college students: a school-based longitudinal prospective study

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Abstract

Background Emotional symptoms have emerged as a major public health concern, affecting the mental and physical well-being of college students worldwide. Negative life events and mental health literacy are commonly recognized as significant predictors of emotional symptoms. However, research on their combined effects remains limited, particularly in longitudinal studies. This study aimed to investigate the interaction between negative life events and mental health literacy in relation to emotional symptoms among college students.

Methods A longitudinal study was conducted from November 2021 to June 2022 to assess negative life events, mental health literacy, and emotional symptoms among college students. A total of 3,210 students (mean age: 19.49 ± 0.87 years) were selected using a cluster sampling method in Anhui Province, China. Multivariate logistic regression models were employed to evaluate the combined effects of negative life events and mental health literacy on emotional symptoms.

Results The prevalence of depressive symptoms, anxiety symptoms, and stress symptoms was 15.3%, 19.7%, and 4.2%, respectively. Negative life events were significantly associated with an increased risk of depressive symptoms (*RR* = 1.568, 95%*CI*: 1.282–1.918), anxiety symptoms (*RR* = 1.603, 95%*CI*: 1.338–1.919), and stress symptoms (*RR* = 1.717, 95%*CI*: 1.194–2.470). Additionally, students with inadequate mental health literacy exhibited a higher incidence of depressive symptoms (*RR* = 1.286, 95%*CI*: 1.035–1.597) and anxiety symptoms (*RR* = 1.343, 95%*CI*: 1.105–1.632) compared to those with adequate mental health literacy. Furthermore, students who experienced high levels of negative life events and had inadequate mental health literacy were at the highest risk of developing depressive symptoms (*RR* = 2.447, 95%*CI*: 1.709–3.504) and anxiety symptoms (*RR* = 2.466, 95%*CI*: 1.802–3.375).

Conclusion This study did not confirm a direct correlation between mental health literacy and general psychological health. Moreover, due to contextual differences across societies, the generalizability of these findings should be

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approached with caution. Nonetheless, the results highlight that negative life events and mental health literacy jointly influence emotional symptoms. These findings underscore the importance of interventions aimed at improving college students' mental health literacy and enhancing their ability to cope with negative life events.

Keywords Mental health literacy, Negative life events, Depression, Anxiety, Stress

Background

The college years represent a distinct developmental phase during which individuals transition from adolescence to adulthood. This period is characterized by significant changes in academic responsibilities, personal growth, and social interactions, which can contribute to mental health challenges [1]. Emotional symptoms such as depression, anxiety, and stress are particularly common during this transition [2]. Anxiety and depression share several symptoms, including sleep disturbances, fatigue, muscle tension, and irritability [3]. However, they are distinct conditions: depression is marked by persistent low mood, hopelessness, lack of energy, and anhedonia (the inability to experience pleasure) [4], whereas anxiety is characterized by a pervasive sense of unease, irritability, restlessness, and difficulty in relaxing [4]. Stress, on the other hand, is an emotional state associated with biochemical, physiological, cognitive, and behavioral changes [2]. While stress is a normal part of life, chronic stress can contribute to a range of psychological issues [5].

According to the World Health Organization, more than 300 million people worldwide suffer from depression and anxiety [6]. The **2019 Global Burden of Disease Study** ranked depression and anxiety as the fourth and sixth leading causes of disease burden among individuals aged 10–24, respectively, underscoring their significant global economic impact [7]. Stress is a major risk factor for both conditions, adversely affecting quality of life and productivity. A meta-analysis has indicated that nearly half of college students experience moderate stress-related psychological issues, including anxiety and depression [8].

Research on youth mental health suggests that subclinical symptoms or high-risk psychological states frequently progress into full-blown disorders such as depression, anxiety, or psychotic conditions [9]. Therefore, in the absence of clinical diagnoses, reliable self-assessment tools are often employed to identify individuals at risk for depression, anxiety, and stress [10]. A survey of U.S. college students found that 33.0% reported depressive symptoms, 40.0% experienced anxiety, and 38.0% exhibited symptoms of stress [11]. Similarly, a study of students from 15 universities in China found that 32.0%, 43.0%, and 26.0% of freshmen exhibited symptoms of depression, anxiety, and stress, respectively [12]. Emotional symptoms not only impair social functioning—leading to reduced work capacity, professional burnout, and strained interpersonal relationships—but also diminish overall quality of life, thereby exacerbating societal disease burden and economic losses [13]. Moreover, emotional symptoms have been linked to increased risks of suicidal behavior [14] and substance abuse [15], with adolescent emotional disturbances often persisting into adulthood [16]. As a result, emotional symptoms have emerged as a significant public health concern, warranting greater attention to the mental well-being of college students.

Mental health literacy plays a pivotal role in mental health promotion and the prevention of mental disorders. It encompasses the knowledge and beliefs necessary to recognize, manage, and prevent mental health conditions, thereby fostering both personal well-being and the well-being of others [17–18]. Specifically, mental health literacy includes the ability to identify mental health issues, reduce stigma, seek professional help, and provide support to individuals experiencing psychological crises [19–20]. Studies have demonstrated a strong link between low mental health literacy and the presence of depressive and anxiety symptoms in adolescents [21]. This association may stem from limited symptom recognition and misconceptions regarding mental illness management. Individuals with low mental health literacy often struggle to identify symptoms of anxiety and depression accurately and tend to believe that emotional issues should be resolved independently, without seeking professional help [22]. Conversely, adequate mental health literacy enables individuals to maintain both physical and psychological well-being, thereby reducing the likelihood of developing mental health conditions [23]. Mindfulness-based interventions that enhance awareness, coping skills, and self-efficacy have been shown to significantly reduce stress, anxiety, depression, burnout, and fatigue among medical students [24]. Wei et al. conducted an intervention study on mental health literacy among students from five Canadian universities and found that participants in the intervention group exhibited increased mental health knowledge, reduced stigma, improved attitudes toward help-seeking, and lower stress levels [25]. Given these findings, improving mental health literacy can positively influence students' behavior, encourage them to seek mental health services, and ultimately reduce emotional symptoms. Therefore, promoting mental health education and support services is essential for enhancing mental health literacy

and equipping students with the skills needed to manage emotional challenges effectively.

Negative life events are significant predictors of anxiety and depressive symptoms [26–27]. These events disrupt an individual's environmental and interpersonal equilibrium, serving as major triggers for both physical and mental health issues [28]. The diathesis-stress model suggests that negative life events are among the most critical external risk factors for depression [29]. Studies indicate that experiencing negative life events can precipitate an initial depressive episode, and recurrent exposure to such events in adulthood increases the likelihood of developing major depression [30]. Furthermore, both the frequency and subjective perception of negative life events can predict early-onset depression and even symptoms persisting five years later [31]. Theoretical models of anxiety also highlight negative life events as key contributors to the development and persistence of anxiety disorders. Research has found that children with separation anxiety disorder report significantly more negative life events within the past year compared to their peers [32]. Zou et al. investigated the association between various negative life events and emotional symptoms in Chinese male college students and found that interpersonal relationship conflicts were strongly linked to anxiety and stress, while difficulties adapting to new environments were associated with increased risks of both depression and anxiety [33]. The college years are marked by profound transitions, including newfound independence, evolving social relationships, and increased academic pressures [26]. As a result, college students inevitably encounter negative life events, and their ability to adapt plays a crucial role in determining their emotional well-being [27, 34–35].

Individuals respond differently to negative life events—some develop psychological disorders, while others exhibit resilience, experiencing only mild or no symptoms. This variability suggests that protective factors, such as mental health literacy, may buffer the psychological impact of negative life events. Previous research has predominantly examined mental health literacy and negative life events as independent predictors of emotional symptoms. However, it is possible that these factors interact, influencing emotional symptoms in college students beyond their individual effects. Prior studies conducted by our research group have demonstrated that the interaction between mental health literacy and physical activity is associated with depressive and anxiety symptoms. Additionally, sleep disturbances have been found to mediate the relationship between low mental health literacy and depressive symptoms in college students [36–37]. Building on these findings, we hypothesize that the combination of negative life events and mental health literacy plays a significant role in shaping emotional symptoms among college students. This study aims to explore their interaction and its implications for mental health interventions in this population.

Methods

Design and participants

This longitudinal study was conducted from November 2021 to June 2022 to assess the impact of negative life events and mental health literacy on emotional symptoms among college students. Since freshmen are in a critical transition period from adolescence to adulthood and are particularly vulnerable to emotional symptoms [16], we selected freshmen from two colleges in Anhui Province using a cluster sampling method. Based on economic and demographic composition, we selected two colleges: one in Hefei, the provincial capital of Anhui Province, and one in Anqing, the former provincial capital of Anhui Province. Participants with a history of psychiatric disorders or those currently receiving psychiatric treatment were excluded from the study. The baseline survey was conducted in November 2021, followed by a six-month follow-up in June 2022 (Fig. 1).

This study was approved by the Ethics Committee of Anhui Medical University (approval number 20200573). All participants were informed about the study's purpose and their right to withdraw at any time. Those who agreed to participate provided informed consent and completed a questionnaire during a 20- to 30-minute session in the classroom under the supervision of their counselors. The survey was administered via the Web-based questionnaire platform 'WenJuanXing', which is freely accessible to the public. A research team member was present to oversee quality control, answer participants' questions, and proofread responses in the classroom. The survey did not include mandatory questions, and no incentives were offered to the participants.

At baseline, demographic data, mental health literacy, and negative life events were assessed using an electronic questionnaire. A total of 5,297 students (2,278 males and 3,019 females) aged 18.91 years (SD = 0.87) with complete baseline data were eligible for follow-up. The follow-up survey primarily focused on participants' emotional symptoms (Fig. 1). Among the eligible students, 468 were excluded due to unwillingness to participate, school absences, missing data, or obviously inconsistent or fictitious responses. Table S1 presents the demographic characteristics of participants with missing data, showing no significant differences in most characteristics. As a result, missing values were excluded from the analysis. Ultimately, data from 4,829 participants (91.16% retention rate) were collected during follow-up. Since emotional symptoms at follow-up could persist from baseline, we included only participants who did not exhibit emotional symptoms in the baseline survey. After applying this criterion, the final study sample consisted of 3,210 students

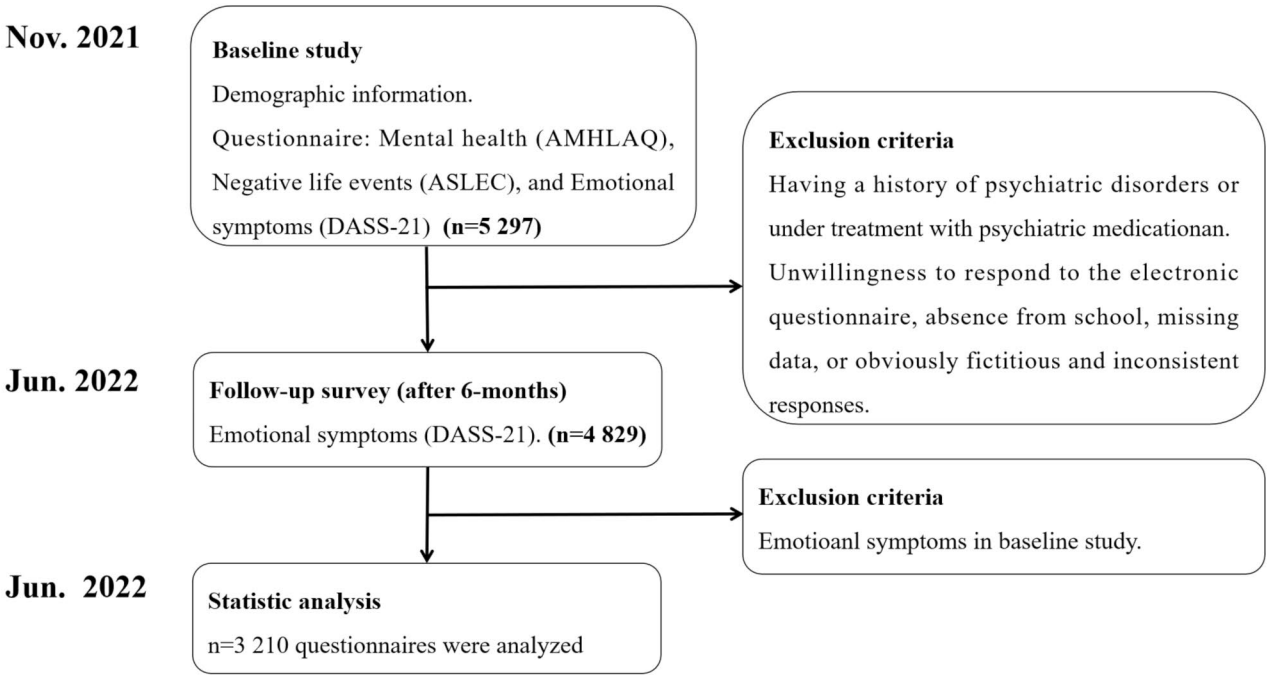

Fig. 1 Flow chart of the study

Table 1 The demographic characteristic of participants

Variable	Total sample (%)
Gender	
Male	1377 (42.9)
Female	1833 (57.1)
Registered residence	
Rural	2268 (70.7)
Urban	942 (29.3)
Any siblings	
Yes	625 (19.5)
No	2585 (80.5)
Father's educational level	
< High school degree	2609 (81.3)
≥ High school degree	601 (18.7)
Mother's educational level	
< High school degree	2806 (87.4)
≥ High school degree	404 (12.6)
Self-reported family economy	
Bad	1068 (33.3)
Medium	2061 (64.2)
Good	81 (2.5)

(mean age: 19.49 ± 0.87 years), including 1,377 males and 1,833 females (Fig. 1). The demographic characteristics of the participants are outlined in Table 1.

Regarding the determination of sample size, according to a recent study, the incidence of depressive symptoms among Chinese college students was found to be 25.1%, with a relative risk (*RR*) value of 0.61 [38]. For both the exposed and control groups, which had the same sample size, α was set at 0.05 (two-tailed) and β at 0.10, as determined using PASS software. Taking into account a 20% dropout rate, the estimated sample size was approximately 1,310. The actual sample size was increased further to accommodate site implementation and the sample size required for the follow-up study.

Measures

Emotional symptoms were assessed using the Depression Anxiety Stress Scale-21 (DASS-21), a standardized questionnaire developed by Lovibond to evaluate emotional distress symptoms over the past seven days [39]. The DASS-21 consists of 21 items covering three dimensions: **depression** (e.g., "No passion for anything."), **anxiety** (e.g., "Feeling scared for no apparent reason."), and **stress** (e.g., "Easily angered."). Each dimension comprises seven items, rated on a 4-point scale ranging from 0 (not true at all) to 3 (often true). The total score for each dimension is calculated by summing the item scores and multiplying by two, resulting in a possible range of 0 to 42. Higher scores indicate more severe symptoms of depression, anxiety, or stress. Participants were classified as having symptoms if their scores met the following thresholds: Depression: ≥10; Anxiety: ≥8; Stress: ≥15. In this study, the Cronbach's α coefficient for DASS-21, DASS-D, DASS-A, and DASS-S was 0.963, 0.901, 0.885, and 0.907, respectively, indicating high internal consistency.

Negative life events experienced in the past six months were measured using the Adolescent Self-Rating Life Events Checklist (ASLEC), developed by Liu Xianchen

et al. [40]. The ASLEC consists of 27 items across six dimensions: **Interpersonal factors** (6 items, e.g., "Being discriminated against or ignored."); **Punishment factors** (5 items, e.g., "Being criticized or punished."); **Learning stress factors** (5 items, e.g., "Heavy study workload."); **Relatives and property loss factors** (3 items, e.g., "Death of a relative or friend."); **Health and adaptation factors** (4 items, e.g., "Suffering from a severe illness."); **Other factors** (4 items, e.g., "Not liking going to school."). Participants rated each item on a 5-point scale (no effect, mild, moderate, severe, extremely severe). The total score ranges from 27 to 135, with higher scores indicating a higher level of negative life events. A total score of ≥ 31 (≥ P_{50})was classified as high-level negative life events, while < 31 (< P_{50}) was classified as low-level negative life events [41]. In this study, the Cronbach's α coefficient for ASLEC was 0.922, with reliability for the six dimensions ranging from 0.604 to 0.888.

Mental health literacy was assessed using the Adolescent Mental Health Literacy Assessment Questionnaire (AMHLAQ), developed by our research team [42]. The questionnaire consists of 22 items categorized into four dimensions: **Knowledge** (6 items, e.g., "Psychological consultation is an effective way to treat mental illness."); **Recognition** (5 items, e.g., "Anxiety patients often have unexplained worry, excessive nervousness, and fear."); **Attitude** (6 items, e.g., "If my relatives or friends had a mental illness, I would feel ashamed."); **Practice** (5 items, e.g., "I can solve my current psychological distress."). Each item is rated on a 5-point scale (strongly disagree, disagree, undecided, agree, strongly agree). The total score is standardized to range from 45 to 110, with higher scores indicating higher mental health literacy [42]. Previous studies have demonstrated good reliability and validity of the AMHLAQ for assessing mental health literacy among Chinese university students [37, 43]. Based on our research team's previous study, scores < 90 were defined as inadequate mental health literacy [36]. In this study, the Cronbach's α coefficient for AMHLAQ was 0.872, with reliability for the four dimensions ranging from 0.816 to 0.888.

The study also examined potential correlations between emotional symptoms and demographic characteristics, including age, gender, registered residence, presence of siblings, parental education level, self-reported family economic status, smoking, and drinking behaviors.

Statistical analysis

Statistical analyses were conducted using SPSS version 23.0 (SPSS Inc., Chicago, IL). The Chi-square test was used to assess group differences and determine statistical significance.

Binary logistic regression models were performed to examine the associations between mental health literacy, negative life events, and symptoms of depression, anxiety, and stress. Additionally, multivariate logistic regression models were used to evaluate the combined effects of mental health literacy and negative life events on emotional symptoms.

To analyze the combined impact of negative life events and mental health literacy, we created three dichotomous indicator variables: **Low negative life events & inadequate mental health literacy**, **High negative life events & adequate mental health literacy**, and **High negative life events & inadequate mental health literacy**. These groups were compared with the **reference group** (**low negative life events & adequate mental health literacy**). **Subgroup analyses** were conducted based on the following demographic factors: **Gender** (male vs. female), **Residence** (urban vs. rural), **Siblings** (yes vs. no), **Parental education level** (< high school vs. ≥ high school), **Self-reported family economic status** (poor, medium, good), **Smoking** (yes vs. no), and **Drinking** (yes vs. no). To examine differences between subgroups, interaction analysis was conducted using a likelihood ratio test. All analyses were adjusted for key demographic and sociodemographic variables. A two-tailed P value < 0.05 was considered statistically significant.

Results

Overall, 490 students (15.3%) reported depressive symptoms, 631 students (19.7%) reported anxiety symptoms, and 136 students (4.2%) reported stress symptoms during the 6-month follow-up period. Table 2 presents the incidence of emotional symptoms based on frequency characteristics. Statistically significant differences in all emotional symptoms were observed based on self-reported family economic status and drinking habits ($P < 0.05$ for each, Table 2). Male students had a significantly higher incidence of depressive symptoms compared to females, while smokers reported a higher incidence of anxiety symptoms than non-smokers ($P < 0.05$, Table 2). No significant differences were found for other sociodemographic variables.

Table 3 presents the associations between negative life events, mental health literacy, and emotional symptoms over the 6-month follow-up period. Both negative life events and mental health literacy were independently associated with anxiety and depressive symptoms. Additionally, negative life events were independently associated with stress symptoms. After adjusting for the socio-demographic characteristic, high level of negative life events were associated with depressive symptoms ($RR = 1.568$, 95%CI: 1.282–1.918), anxiety symptoms ($RR = 1.603$, 95%CI: 1.338–1.919), and stress symptoms ($RR = 1.717$, 95%CI: 1.194–2.470). Meanwhile, students with inadequate mental health literacy had a higher rate of depressive symptoms ($RR = 1.286$, 95%CI:

Table 2 The characteristics of emotional symptoms in different sociodemographic variables among college student

Variable	Depressive symtopms	Anxiety symtopms	Stress symptoms
Gender			
Male	238 (17.3)	288 (20.9)	69 (5.0)
Female	252 (13.7)	343 (18.7)	67 (3.7)
χ^2	7.601	2.415	3.562
p	0.006	0.120	0.059
Registered residence			
Rural	331 (14.6)	427 (18.8)	88 (3.9)
Urban	159 (16.9)	204 (21.7)	48 (5.1)
χ^2	2.686	3.372	2.424
p	0.101	0.066	0.120
Any siblings			
Yes	97 (15.5)	123 (19.7)	29 (4.6)
No	393 (15.2)	508 (19.7)	107 (4.1)
χ^2	0.039	0.001	0.311
p	0.843	0.989	0.577
Father's educational level			
< High school degree	404 (15.5)	517 (19.8)	105 (4.0)
≥ High school degree	86 (14.3)	114 (19.0)	31 (5.2)
χ^2	0.522	0.222	1.547
p	0.470	0.637	0.214
Mother's educational level			
< High school degree	424 (15.1)	547 (19.5)	116 (4.1)
≥ High school degree	66 (16.3)	84 (20.8)	20 (5.0)
χ^2	0.410	0.377	0.580
p	0.522	0.539	0.446
Self-reported family economy			
Bad	195 (18.3)	241 (22.6)	57 (5.3)
Medium	286 (13.9)	379 (18.4)	74 (3.6)
Good	9 (11.1)	11 (13.6)	5 (6.2)
χ^2	11.550	9.712	6.057
p	0.003	0.008	0.048
Smoking			
Yes	61 (18.7)	81 (24.8)	18 (5.5)
No	429 (14.9)	550 (19.1)	118 (4.1)
χ^2	3.333	6.187	1.476
p	0.068	0.013	0.224
Drinking			
Yes	92 (18.5)	117 (23.6)	33 (6.7)
No	398 (14.7)	514 (18.9)	103 (3.8)
χ^2	4.890	5.741	8.443
p	0.027	0.017	0.004

Note. Chi-square test; $^{*}P<0.05$, $^{**}P<0.01$, $^{***}P<0.001$

1.035–1.597), and anxiety symptoms (*RR* = 1.343, 95%*CI*: 1.105–1.632) than those with adequate mental health literacy. Furthermore, compared with the reference group (low negative life events and adequate mental health literacy), students with high negative life events and inadequate mental health literacy had the highest risk of depressive symptoms (*RR* = 2.447, 95%*CI*: 1.709–3.504) and anxiety symptoms (*RR* = 2.466, 95%*CI*: 1.802–3.375). Moreover, students with high negative life events and adequate mental health literacy had the highest rate of stress symptoms (*RR* = 2.210, 95%*CI*: 1.163–2.619) (Table 3).

In subgroup analysis, we explored eight potential effect modifiers (gender, type of residence, any siblings, father's educational level, mother's educational level, self-reported family economy, smoking and drinking). The subgroup analysis revealed no significant interaction between mental health literacy and any of the subgroup variables on anxiety symptoms ($P>0.05$), except for self-reported family economy ($P=0.017$, Table 4). Similarly, no significant interaction was found between negative life events and any of the subgroup variables on anxiety symptoms ($P>0.05$), except for father's educational level ($P=0.041$, Table 5). Moreover, no significant interaction was found between the combination of negative life events and mental health literacy and any of the subgroup variables on anxiety symptoms ($P>0.05$), except for the self-reported family economy ($P=0.036$, Table 6). No significant interactions were found for depressive symptoms or stress symptoms (Tables 4, 5 and 6).

Discussion

The findings of this study suggest that negative life events and mental health literacy are both independently and interactively associated with emotional symptoms over the 6-month follow-up period. Specifically, students with inadequate mental health literacy and high levels of negative life events exhibited a higher incidence of depressive, anxiety, and stress symptoms.

In this study, the incidence of depressive symptoms (15.3%), anxiety symptoms (19.7%), and stress symptoms (4.2%) was lower than in two previous studies (19.0%, 32.6%, and 21.8%; 18.4%, 23.6%, and 34.5%, respectively) [3, 44]. These differences may be attributed to variations in participant origins, social and cultural backgrounds, and economic conditions. Nevertheless, these findings highlight the importance of implementing preventive measures to address emotional symptoms among students. Additionally, male students exhibited a higher incidence of emotional symptoms compared to females, a finding that aligns with Li et al. but contradicts some previous studies [12]. This discrepancy may be due to societal norms and traditional gender stereotypes, which often expect men to exhibit emotional resilience and discourage them from expressing negative emotions and psychological distress [45]. Consistent with previous research, this study found that students from lower-income families had a significantly higher incidence of depressive, anxiety, and stress symptoms [46–47]. This could be due to the heightened academic expectations placed on students from less affluent families, where parents may pressure their children to "strive to become a

Table 3 Hazard ratios and 95% confidence intervals of emotional symptoms according to negative life events and mental health literacy

Variable	Depressive symptoms			Anxiety symptoms			Stress symptoms		
	n (%)	Crude *RR* (95%*CI*)	Adjusted *RR* (95%*CI*)[a]	*n* (%)	Crude *RR* (95%*CI*)	Adjusted *RR* (95%*CI*)[b]	*n* (%)	Crude *RR* (95%*CI*)	Adjusted *RR* (95%*CI*)[c]
NLE									
Low	190 (12.3)	1.000	1.000	242 (15.7)	1.000	1.000	47 (3.0)	1.000	1.000
High	330 (18.0)	1.558 (1.280–1.897)***	1.568 (1.282–1.918)***	389 (23.3)	1.631 (1.365–1.949)***	1.603 (1.338–1.919)***	89 (5.3)	1.791 (1.249–2.568)**	1.717 (1.194–2.470)**
MHL									
Adequate	132 (12.8)	1.000	1.000	169 (16.4)	1.000	1.000	42 (4.1)	1.000	1.000
Inadequate	358 (16.4)	1.332 (1.075–1.652)**	1.286 (1.035–1.597)*	462 (21.2)	1.365 (1.124–1.658)**	1.343 (1.105–1.632)**	94 (4.3)	1.057 (0.729–1.532)	1.034 (0.712–1.501)
Combination of NLE and MHL									
Low NLE and adequate MHL	40 (8.2)	1.000	1.000	55 (11.2)	1.000	1.000	11 (2.2)	1.000	1.000
Low NLE and Inadequate MHL	150 (14.3)	1.867 (1.294–2.694)**	1.804 (1.249–2.606)**	187 (17.8)	1.706 (1.236–2.354)**	1.690 (1.224–2.334)**	36 (3.4)	1.540 (0.777–3.051)	1.506 (0.760–2.988)
High NLE and adequate MHL	92 (17.1)	2.310 (1.559–3.425)***	2.342 (1.575–3.484)***	114 (21.2)	2.117 (1.494–2.999)***	2.096 (1.477–2.975)***	31 (5.8)	2.652 (1.318–5.335)**	2.533 (1.256–5.106)**
High NLE and Inadequate MHL	208 (18.4)	2.352 (1.773–3.618)***	2.447 (1.709–3.504)***	275 (24.3)	2.538 (1.858–3.466)***	2.466 (1.802–3.375)***	58 (5.1)	2.351 (1.223–4.519)*	2.210 (1.163–2.619)**

Note. NLE is Negative life events; MHL is Mental health literacy. *RR* is relative risk; *CI* is confidence interval. $^{*}P<0.05$, $^{**}P<0.01$, $^{***}P<0.001$ compared with reference

[a] Adjusted for gender, self-reported family economy, and drinking

[b] Adjusted for gender, self-reported family economy, smoking and drinking

[c] Adjusted for gender, self-reported family economy, and drinking

dragon or a phoenix," leading to increased psychological distress [48]. Moreover, students who reported recent alcohol consumption had significantly higher levels of depressive, anxiety, and stress symptoms compared to non-drinkers. This aligns with previous research indicating that college students facing psychological distress may resort to alcohol as a coping mechanism, which in turn increases the risk of escalating drinking habits and potential alcohol addiction [49].

Negative life events, commonly recognized as "social stressors," are prevalent in daily life and have a significant impact on mental and physical health [50]. Numerous studies have demonstrated that negative life events contribute to the onset of depressive and anxiety symptoms, a finding that is consistent with our results [34, 51]. The Social Causation Theory suggests that psychosocial factors, including negative life events, play a role in the development and progression of depressive symptoms and clinical depression [30]. Similarly, negative life events are strongly linked to the onset of anxiety disorders, influencing both the frequency and intensity of anxiety episodes [52]. They can also increase psychological stress and reduce overall quality of life [53].

In this study, negative life events and inadequate mental health literacy independently and synergistically increased the risk of emotional symptoms (Table 3). Multivariate logistic regression analysis showed that students with inadequate mental health literacy were more likely to experience depression, anxiety, and stress symptoms, and these associations were exacerbated by negative life events. These findings highlight the crucial role of mental health literacy in helping students develop coping strategies to navigate difficult life situations, identify and manage emotional distress when encountering unavoidable negative events, and seek professional help to mitigate long-term mental health consequences. Given these findings, it is essential to develop intervention strategies aimed at improving mental health literacy among college students. By equipping students with the knowledge and skills to manage psychological distress, universities can help them build resilience against the effects of negative life events, ultimately reducing the prevalence of emotional disorders. Such efforts would contribute to the overall well-being and holistic development of students.

To our knowledge, this is the first study to investigate the long-term impact of negative life events and mental health literacy on emotional symptoms among Chinese college students. This novel approach provides valuable insights into the negative synergistic effects of these two factors, which can inform the development of

Table 4 Subgroup analysis of mental health literacy and emotional symptoms in Chinese college students

Variable	Total sample (%)	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
Overall	3210 (100)	1.33 (1.07–1.65)	0.009		1.37 (1.12–1.66)	0.002		1.06 (0.73–1.53)	0.770	
Gender				0.733			0.897			0.456
Male	1377 (42.9)	1.36 (0.97–1.89)	0.074		1.37 (1.01–1.87)	0.046		0.88 (0.51–1.50)	0.632	
Female	1833 (57.1)	1.26 (0.95–1.67)	0.116		1.33 (1.04–1.72)	0.025		1.17 (0.69–1.96)	0.563	
Registered residence				0.657			0.980			0.636
Rural	2268 (70.7)	1.39 (1.06–1.81)	0.016		1.38 (1.08–1.75)	0.009		1.14 (0.71–1.83)	0.58	
Urban	942 (29.3)	1.25 (0.87–1.81)	0.233		1.37 (0.98–1.92)	0.069		0.95 (0.52–1.74)	0.866	
Any siblings				0.247			0.282			0.549
Yes	625 (19.5)	1.74 (1.05–2.86)	0.031		1.70 (1.09–2.67)	0.02		1.33 (0.58–3.05)	0.506	
No	2585 (80.5)	1.25 (0.99–1.59)	0.066		1.30 (1.04–1.61)	0.019		1.00 (0.66–1.51)	0.99	
Father's educational level				0.622			0.669			0.171
< High school degree	2609 (81.3)	1.29 (1.02–1.64)	0.034		1.39 (1.12–1.73)	0.003		1.24 (0.80–1.93)	0.331	
≥High school degree	601 (18.7)	1.49 (0.90–2.45)	0.119		1.25 (0.81–1.93)	0.308		0.69 (0.33–1.42)	0.312	
Mother's educational level				0.882			0.833			0.504
< High school degree	2806 (87.4)	1.34 (1.06–1.69)	0.013		1.36 (1.10–1.67)	0.004		1.12 (0.74–1.68)	0.586	
≥High school degree	404 (12.6)	1.28 (0.73–2.27)	0.392		1.44 (0.85–2.44)	0.173		0.79 (0.32–1.99)	0.624	
Self-reported family economy				0.057			0.017			0.776
Bad	1068 (33.3)	0.95 (0.67–1.33)	0.747		0.97 (0.71–1.32)	0.826		0.89 (0.50–1.59)	0.699	
Medium	2061 (64.2)	1.63 (1.22–2.17)	0.001		1.69 (1.31–2.18)	< 0.001		1.18 (0.71–1.96)	0.526	
Good	81 (2.5)	1.35 (0.31–5.83)	0.689		0.75 (0.21–2.71)	0.665		0.98 (0.15–6.21)	0.981	
Smoking				0.957			0.515			0.944
No	2884 (89.8)	1.33 (1.05–1.67)	0.016		1.33 (1.08–1.63)	0.007		1.05 (0.70–1.56)	0.82	
Yes	326 (10.2)	1.35 (0.71–2.56)	0.357		1.63 (0.91–2.95)	0.102		1.09 (0.38–3.15)	0.873	
Drinking				0.847			0.996			0.571
No	2714 (84.5)	1.32 (1.04–1.67)	0.023		1.36 (1.10–1.69)	0.005		1.11 (0.72–1.71)	0.624	
Yes	496 (15.5)	1.39 (0.83–2.33)	0.21		1.36 (0.85–2.17)	0.198		0.87 (0.41–1.84)	0.709	

Note. *RR* is relative risk; *CI* is confidence interval

Table 5 Subgroup analysis of negative life events and emotional symptoms in Chinese college students

Variable	Total sample (%)	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
Overall	3210 (100)	1.56 (1.28–1.90)	< 0.001		1.63 (1.37–1.95)	< 0.001		1.79 (1.25–2.57)	0.002	
Gender				0.835			0.754			0.293
Male	1377 (42.9)	1.67 (1.26–2.21)	< 0.001		1.73 (1.33–2.25)	< 0.001		1.59 (0.98–2.59)	0.061	
Female	1833 (57.1)	1.60 (1.21–2.12)	0.001		1.64 (1.28–2.10)	< 0.001		2.38 (1.35–4.21)	0.003	
Registered residence				0.823			0.333			0.977
Rural	2268 (70.7)	1.59 (1.25–2.01)	< 0.001		1.74 (1.40–2.16)	< 0.001		1.80 (1.15–2.82)	0.010	
Urban	942 (29.3)	1.51 (1.07–2.14)	0.020		1.44 (1.05–1.97)	0.023		1.78 (0.97–3.27)	0.061	
Any siblings				0.484			0.756			0.678
Yes	625 (19.5)	1.80 (1.15–2.82)	0.010		1.73 (1.15–2.59)	0.008		1.55 (0.72–3.34)	0.262	
No	2585 (80.5)	1.50 (1.21–1.87)	< 0.001		1.61 (1.32–1.96)	< 0.001		1.86 (1.24–2.80)	0.003	
Father's educational level				0.006			0.041			0.134
<High school degree	2609 (81.3)	1.36 (1.10–1.69)	0.005		1.49 (1.22–1.81)	< 0.001		1.56 (1.04–2.34)	0.031	
≥High school degree	601 (18.7)	2.87 (1.77–4.65)	< 0.001		2.42 (1.59–3.69)	< 0.001		3.08 (1.40–6.82)	0.005	
Mother's educational level				0.819			0.706			0.339
<High school degree	2806 (87.4)	1.55 (1.25–1.92)	< 0.001		1.66 (1.37–2.01)	< 0.001		1.95 (1.31–2.90)	0.001	
≥High school degree	404 (12.6)	1.66 (0.97–2.82)	0.062		1.50 (0.93–2.43)	0.098		1.21 (0.49–2.97)	0.682	
Self-reported family economy				0.590			0.522			0.734
Bad	1068 (33.3)	1.51 (1.09–2.10)	0.014		1.73 (1.27–2.36)	< 0.001		1.45 (0.82–2.57)	0.205	
Medium	2061 (64.2)	1.47 (1.14–1.89)	0.003		1.49 (1.19–1.87)	< 0.001		1.93 (1.19–3.12)	0.008	
Good	81 (2.5)	3.14 (0.73–13.60)	0.125		2.79 (0.74–10.43)	0.128		2.18 (0.34–13.80)	0.409	
Smoking				0.779			0.973			0.406
No	2884 (89.8)	1.59 (1.29–1.97)	< 0.001		1.65 (1.36-2.00)	< 0.001		1.93 (1.30–2.86)	0.001	
Yes	326 (10.2)	1.46 (0.84–2.55)	0.183		1.67 (1.01–2.76)	0.048		1.25 (0.48–3.23)	0.648	
Drinking				0.471			0.508			0.282
No	2714 (84.5)	1.50 (1.21–1.86)	< 0.001		1.67 (1.37–2.03)	< 0.001		1.59 (1.06–2.38)	0.026	
Yes	496 (15.5)	1.82 (1.13–2.93)	0.014		1.42 (0.93–2.18)	0.104		2.62 (1.16–5.92)	0.021	

Note. *RR* is relative risk; *CI* is confidence interval

Table 6 Subgroup analysis of combination of negative life events and mental health literacy and emotional symptoms in Chinese college students

Variable	Levels	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
Overall	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.87 (1.29–2.69)	0.001		1.71 (1.24–2.35)	0.001		1.54 (0.78–3.05)	0.216	
	High NLE+ Adequate MHL	2.31 (1.56–3.42)	< 0.001		2.12 (1.49-3.00)	< 0.001		2.65 (1.32–5.34)	0.006	
	High NLE+ Inadequate MHL	2.53 (1.77–3.62)	< 0.001		2.54 (1.86–3.47)	< 0.001		2.35 (1.22–4.52)	0.01	
Gender				0.921			0.969			0.510
Male	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.96 (1.16–3.30)	0.012		1.66 (1.05–2.64)	0.031		1.33 (0.57–3.14)	0.510	
	High NLE+ Adequate MHL	2.87 (1.56–5.28)	0.001		2.35 (1.35–4.08)	0.002		2.79 (1.08–7.16)	0.033	
	High NLE+ Inadequate MHL	2.77 (1.65–4.67)	< 0.001		2.61 (1.65–4.14)	< 0.001		1.72 (0.73–4.03)	0.216	
Female	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.70 (1.01–2.85)	0.046		1.70 (1.09–2.68)	0.021		1.68 (0.54–5.26)	0.373	
	High NLE+ Adequate MHL	2.17 (1.28–3.66)	0.004		2.10 (1.33–3.32)	0.002		3.30 (1.10–9.85)	0.033	
	High NLE+ Inadequate MHL	2.38 (1.46–3.89)	0.001		2.51 (1.64–3.84)	< 0.001		3.49 (1.22–9.94)	0.019	
Registered residence				0.897			0.631			0.953
Rural	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.89 (1.20–2.99)	0.006		1.63 (1.09–2.44)	0.016		1.78 (0.72–4.40)	0.211	
	High NLE+ Adequate MHL	2.28 (1.39–3.73)	0.001		2.11 (1.37–3.25)	0.001		2.88 (1.14–7.30)	0.026	
	High NLE+ Inadequate MHL	2.68 (1.72–4.18)	< 0.001		2.67 (1.81–3.92)	< 0.001		2.73 (1.14–6.51)	0.024	
Urban	Low NLE+ Adequate MHL	1.00			1.00			1.00		

Table 6 (continued)

Variable	Levels	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
	Low NLE+ Inadequate MHL	1.87 (1.01–3.46)	0.045		1.92 (1.12–3.31)	0.018		1.28 (0.44–3.71)	0.645	
	High NLE+ Adequate MHL	2.42 (1.26–4.65)	0.008		2.17 (1.20–3.91)	0.01		2.43 (0.84–7.07)	0.103	
	High NLE+ Inadequate MHL	2.32 (1.27–4.22)	0.006		2.33 (1.37–3.96)	0.002		1.95 (0.71–5.32)	0.192	
Any siblings				0.464			0.621			0.899
Yes	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	3.23 (1.21–8.59)	0.019		2.59 (1.16–5.79)	0.02		2.23 (0.47–10.51)	0.312	
	High NLE+ Adequate MHL	3.64 (1.30-10.21)	0.014		2.81 (1.19–6.65)	0.019		2.77 (0.55–14.05)	0.219	
	High NLE+ Inadequate MHL	4.81 (1.85–12.56)	0.001		3.89 (1.77–8.54)	0.001		2.85 (0.63–12.99)	0.176	
No	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.67 (1.13–2.49)	0.011		1.56 (1.10–2.22)	0.014		1.39 (0.65–2.99)	0.394	
	High NLE+ Adequate MHL	2.12 (1.38–3.25)	0.001		2.00 (1.36–2.93)	< 0.001		2.63 (1.21–5.70)	0.015	
	High NLE+ Inadequate MHL	2.22 (1.51–3.26)	< 0.001		2.31 (1.65–3.25)	< 0.001		2.24 (1.09–4.63)	0.029	
Father's educational level				0.035			0.179			0.320
<High school degree	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.76 (1.18–2.61)	0.005		1.63 (1.14–2.32)	0.007		1.72 (0.78–3.79)	0.178	
	High NLE+ Adequate MHL	1.97 (1.28–3.03)	0.002		1.80 (1.22–2.66)	0.003		2.26 (0.98–5.18)	0.055	
	High NLE+ Inadequate MHL	2.10 (1.43–3.08)	< 0.001		2.27 (1.61–3.20)	< 0.001		2.37 (1.11–5.06)	0.026	
≥High school degree	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	2.53 (0.93–6.84)	0.068		2.04 (0.94–4.44)	0.071		1.03 (0.25–4.19)	0.969	

Table 6 (continued)

Variable	Levels	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
	High NLE+ Adequate MHL	4.76 (1.72–13.21)	0.003		3.92 (1.75–8.77)	0.001		4.04 (1.10-14.91)	0.036	
	High NLE+ Inadequate MHL	6.34 (2.41–16.69)	< 0.001		4.12 (1.92–8.85)	< 0.001		2.57 (0.70–9.44)	0.154	
Mother's educational level				0.983			0.982			0.454
<High school degree	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.92 (1.28–2.87)	0.001		1.70 (1.19–2.41)	0.003		2.01 (0.88–4.61)	0.099	
	High NLE+ Adequate MHL	2.35 (1.53–3.61)	< 0.001		2.15 (1.47–3.14)	< 0.001		3.57 (1.54–8.29)	0.003	
	High NLE+ Inadequate MHL	2.58 (1.74–3.80)	< 0.001		2.57 (1.83–3.60)	< 0.001		3.16 (1.42–7.02)	0.005	
≥High school degree	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.62 (0.66–3.99)	0.293		1.78 (0.80–3.98)	0.161		0.72 (0.20–2.63)	0.617	
	High NLE+ Adequate MHL	2.16 (0.80–5.78)	0.127		1.94 (0.79–4.80)	0.149		1.05 (0.25–4.36)	0.951	
	High NLE+ Inadequate MHL	2.45 (1.00-6.02)	0.051		2.47 (1.10–5.57)	0.029		0.94 (0.25–3.44)	0.92	
Self-reported family economy				0.275			0.036			0.606
Bad	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.34 (0.72–2.49)	0.36		1.28 (0.72–2.29)	0.404		2.11 (0.60–7.41)	0.246	
	High NLE+ Adequate MHL	2.17 (1.15–4.10)	0.017		2.32 (1.28–4.18)	0.005		3.43 (0.97–12.10)	0.056	
	High NLE+ Inadequate MHL	1.75 (0.97–3.15)	0.062		1.97 (1.15–3.40)	0.014		2.23 (0.66–7.52)	0.197	
Medium	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	2.09 (1.32–3.31)	0.002		1.84 (1.25–2.72)	0.002		1.16 (0.50–2.67)	0.732	
	High NLE+ Adequate MHL	2.03 (1.21–3.40)	0.007		1.67 (1.07–2.62)	0.024		1.88 (0.78–4.53)	0.162	

Table 6 (continued)

Variable	Levels	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
	High NLE+ Inadequate MHL	2.79 (1.77–4.39)	< 0.001		2.68 (1.82–3.94)	< 0.001		2.26 (1.03–4.95)	0.041	
Good	Low NLE+ Adequate MHL	—			—			—		
	Low NLE+ Inadequate MHL	—	—		—	—		—	—	
	High NLE+ Adequate MHL	—	—		—	—		—	—	
	High NLE+ Inadequate MHL	—	—		—	—		—	—	
Smoking				0.343			0.274			0.681
No	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.71 (1.16–2.53)	0.007		1.53 (1.09–2.15)	0.015		1.77 (0.80–3.89)	0.156	
	High NLE+ Adequate MHL	2.13 (1.40–3.22)	< 0.001		1.93 (1.34–2.79)	< 0.001		3.26 (1.48–7.22)	0.003	
	High NLE+ Inadequate MHL	2.46 (1.69–3.58)	< 0.001		2.39 (1.72–3.32)	< 0.001		2.78 (1.31–5.91)	0.008	
Yes	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	3.38 (1.12–10.23)	0.031		3.66 (1.34–9.96)	0.011		0.92 (0.22–3.83)	0.912	
	High NLE+ Adequate MHL	5.21 (1.52–17.85)	0.009		5.20 (1.67–16.15)	0.004		0.97 (0.15–6.11)	0.977	
	High NLE+ Inadequate MHL	3.24 (1.05–9.94)	0.04		4.24 (1.55–11.62)	0.005		1.26 (0.31–5.07)	0.745	
Drinking				0.565			0.947			0.425
No	Low NLE+ Adequate MHL	1.00			1.00			1.00		
	Low NLE+ Inadequate MHL	1.97 (1.32–2.94)	0.001		1.69 (1.19–2.40)	0.004		1.87 (0.85–4.11)	0.118	
	High NLE+ Adequate MHL	2.41 (1.57–3.72)	< 0.001		2.15 (1.47–3.14)	< 0.001		2.81 (1.24–6.35)	0.013	
	High NLE+ Inadequate MHL	2.48 (1.67–3.67)	< 0.001		2.57 (1.82–3.61)	< 0.001		2.38 (1.11–5.12)	0.027	
Yes	Low NLE+ Adequate MHL	1.00			1.00			1.00		

Table 6 (continued)

Variable	Levels	Depressive symptoms			Anxiety symptoms			Stress symptoms		
		RR (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction	*RR* (95% *CI*)	*P* value	*P* for interaction
	Low NLE+ Inadequate MHL	1.38 (0.56–3.41)	0.481		1.74 (0.78–3.86)	0.177		0.66 (0.15–2.86)	0.581	
	High NLE+ Adequate MHL	1.78 (0.68–4.62)	0.237		1.88 (0.80–4.44)	0.15		2.00 (0.51–7.86)	0.321	
	High NLE+ Inadequate MHL	2.57 (1.10–6.04)	0.030		2.28 (1.05–4.94)	0.037		1.98 (0.56–6.98)	0.290	

Note.NLE is Negative life events; MHL is Mental health literacy. *RR* is relative risk; *CI* is confidence interval. "—", the number of people in the reference group was 0, so the *RR* (95% *CI*) value could not be calculated

targeted mental health interventions. This study has several strengths, including a longitudinal design that allows for a more comprehensive understanding of changes in emotional symptoms over time, a large sample size that ensures robust statistical power, and minimal missing data that enhances the reliability of the findings.

However, several limitations should be acknowledged. Firstly, the research is based on self-reported data, which may lead to potential recall and reporting biases. Secondly, the study sample was drawn from only two colleges in a single province, which may limit the generalizability of the findings to other populations. Thirdly, although we controlled for several covariates, we did not consider genetic factors, such as family history, which should be considered in future research. Lastly, the study included only a 6-month follow-up period, which may not fully capture the long-term development of mental health issues, a longer follow-up period should be conducted for in-depth research.

Conclusion

The present study illustrates the potential association between emotional symptoms, negative life events, and mental health literacy within the context of Chinese culture. Exposure to negative life events and inadequate mental health literacy significantly increases the risk of poorer health outcomes. Therefore, both factors should be considered when designing interventions aimed at preventing emotional symptoms among college students. Additionally, most previous studies have primarily focused on the independent associations among these variables, overlooking their interactive relationships, despite the growing attention to the importance of mental health literacy. The findings from this study clearly indicate that enhancing an individual's level of mental health literacy is crucial for reducing emotional symptoms. While prior interventions have primarily targeted the reduction of negative life events, we argue that enhancing mental health literacy is equally vital, as it is both cost-effective and significantly impactful.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13033-025-00672-y.

Supplementary Material 1

Supplementary Material 2

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Author contributions

SCZ contributed in the designed, data gathering, statistical analyses, funding acquisition, preparing and approving the draft and final version of manuscript; RY contributed in the designed, data gathering, statistical analyses, preparing and approving the draft and final version of manuscript; YYC contributed in the data gathering, preparing and approving the draft and final version of manuscript; YZ contributed in the data gathering, preparing and approving the draft and final version of manuscript; LLJ contributed in the data gathering, funding acquisition, preparing and approving the draft and final version of manuscript; JJX contributed in the data gathering, funding acquisition, preparing and approving the draft and final version of manuscript; JF contributed in the designed, statistical analyses, funding acquisition, preparing and approving the draft and final version of manuscript. All authors approve the submitted version. All authors agree both to be personally accountable for the author's own contributions and to ensure that questions related to the accuracy or integrity of any part of the work, even ones in which the author was not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature. All authors read and approved the fnal manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics statement and consent to participate

The design and data collection procedures were approved by the Ethics Committee of Anhui Medical University (approval number 20200573).

Informed consents were obtained from all participants before completing the survey Written. The study was performed in accordance with the Declaration of Helsinki. Informed consents were obtained from all participants before completing the survey, and all of them could withdraw from the survey at any time without any reason. Data were processed at a restricted location using a personal unidentifiable code for each subject.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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