Journal of Affective Disorders 388 (2025) 119593

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Latent class analysis on mental health and associated factors in medical and non-medical college students

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ARTICLE INFO

Keywords:
Depression
Anxiety
Suicidal ideation
Suicidal planning
Suicidal attempt
Mental health
College students
Latent class analysis

ABSTRACT

Background: This study aimed to identify latent classes of mental health status among Chinese college students and to explore the influencing factors that differ between medical and non-medical students.
Methods: A cross-sectional survey was conducted among 4768 students from four institutions located in Anhui Province, China, utilizing stratified cluster sampling. The survey assessed depressive symptoms, anxiety symptoms, sleep chronotypes, sleep disorders, and suicidal behaviors. Latent class analysis was employed to identify mental health subgroups, and multinomial logistic regression was utilized to analyze the influencing factors.
Results: Three latent classes were identified: C1 (Low Depression/Anxiety - Low Suicidal Behavior, 88.1 %), C2 (High Depression/Anxiety - Low Suicidal Behavior, 8.6 %), and C3 (Moderate Depression/Anxiety - High Suicidal Behavior, 3.3 %). Alcohol consumption, sleep disorders, academic burden, gender, grade, and daily online time significantly predicted these classes. Students with alcohol consumption and sleep disorders were more likely in C2 and C3. Medical students with heavy academic burdens were more likely in C2, while those with light burdens were more likely in C3. Male medical students were more likely in C2 and C3. Non-medical students with heavy and light academic burdens, as well as those in higher grades, were more likely in C2. Non-medical students with 1.5–3 h of daily online time were more likely in C2, and those with <1.5 h were more likely in C3.
Conclusions: College students' mental health demonstrates significant heterogeneity, with factors such as alcohol consumption, sleep disorders, academic burden, gender, grade, and daily online time serving as key predictors. These findings highlight the pressing need for targeted interventions aimed at addressing specific risk factors, thereby enhancing mental health support services.

1. Introduction

As the pillar of the younger generation, the physical and mental development of college students is in the crucial period of transition from adolescence to adulthood. Furthermore, the increasingly fierce external competitive environment and the complex and challenging employment situations have led to mental health issues among college students becoming increasingly frequent (Chan and Sun, 2021). Poor mental health not only makes it difficult for college students to adjust academically and affects their academic engagement and performance, but also leads to negative outcomes such as repeating classes and dropping out (Kalkbrenner et al., 2021). It also impairs their quality of life and sense of well-being (Ridner et al., 2016), and even hinders their social adjustment and career development (Gao et al., 2020). A meta-analysis reveals a significant increase in the prevalence of mental health issues among mainland Chinese college students over the past decade, with a high prevalence of sleep problems (23.5 %), depression (20.8 %), self-harm (16.2 %), anxiety (13.7 %), suicidal ideation (SI, 10.8 %), and suicidal attempts (SA, 2.7 %) (Chen et al., 2022). These issues not only cause great losses and sufferings to the family but also have a profound impact on surrounding classmates, friends, the school, and society. Therefore, enhancing research on mental health issues among college students and accurately identifying their mental health status is a crucial direction in crisis intervention research for college students, as it enables timely and effective interventions tailored to different groups with varying mental health conditions.

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https://doi.org/10.1016/j.jad.2025.119593
Received 25 February 2025; Received in revised form 27 May 2025; Accepted 3 June 2025
Available online 5 June 2025

Currently, there is significant room for improving the assessment and identification of mental health among college students in China. A prominent issue is that most studies rely on critical values from scales to assess the severity of mental health, a method that, while convenient, oversimplifies the complexity of mental health issues. However, research indicates that mental health is not a binary phenomenon of presence or absence (Widiger et al., 2009). Individuals with similar mental health levels may show diverse symptoms. Therefore, it is crucial to scientifically identify the typical characteristics of mental health issues across different subgroups to enhance the accuracy of mental health identification and diagnosis among college students.

Some researchers have employed latent profile analysis (LPA) or latent class analysis (LCA) to explore the profiles of adolescents' mental health, identifying three to five distinct categories (Baptista et al., 2019; Choi and Baek, 2024; Dai et al., 2024; Liu et al., 2021; Sun et al., 2023). For instance, Dai et al. categorized depression/anxiety symptoms among 7422 Chinese adolescents into three groups: low, moderate, and high depression/anxiety (Dai et al., 2024). Similarly, Liu et al. classified depression/anxiety symptoms in a sample of 29,663 medical students into three categories: poor mental health, mild mental health, and low symptoms (Liu et al., 2021). A study of 7300 Korean adolescents divided suicide-related behaviors into four groups: SI only, suicidal planning (SP) without ideation or attempt, SA with ideation and planning, and SA without ideation or planning (Choi and Baek, 2024). As an individual-centered analytical approach, LCA enables a more nuanced understanding of group heterogeneity and individual differences in mental health, offering empirical evidence and theoretical guidance for the accurate identification and personalized intervention of students' mental health.

Numerous studies have found that medical students are at a higher risk of experiencing mental health issues compared to non-medical students (Li et al., 2022; Puthran et al., 2016). It is crucial to identify the factors affecting mental health issues in both medical and non-medical students separately, enabling the implementation of targeted intervention measures in the future.

Previous studies have indicated that college students' mental health is significantly influenced by a spectrum of interrelated factors, including demographic variables (e.g., gender, only child, hometown, grade, class cadres), academic stressors (e.g., academic performance, academic burden), health behavior factors (e.g., smoking, alcohol consumption, coffee consumption frequency, daily online time), and sleep problems (e.g., sleep disorders, sleep chronotype).

Gender, as a significant influencing factor in mental health, exhibits distinct patterns of influence characterized by cultural variations and context-specific effects. Systematic review evidence indicates that female students face higher risks of depression, anxiety, and SI (Al Mamun et al., 2021; AlJaber, 2020; Anbesaw et al., 2023; Conteh et al., 2022; Dragioti et al., 2022; García-Rivas et al., 2024; Mateen et al., 2024; Peng et al., 2023; Rahman et al., 2025). One systematic review and meta-analysis found that the risk of suicidal behaviors was significantly higher among female medical students than males in Bangladesh, with female gender being a risk factor for SI but not for SP or SA (Rahman et al., 2025). This phenomenon may be attributed to sociocultural pressures, biological factors, and factors within the educational environment. Conversely, other systematic review evidence demonstrates that males have a higher risk of suicide-related outcomes than females, potentially resulting from the combined effects of sociocultural pressures, economic factors, and psychological help-seeking barriers (Kabir et al., 2024; Shaw et al., 2022; Varshney et al., 2024). It is hypothesized that gender may influence the mental health of college students in this study.

Previous studies have suggested that being an only child may be a risk factor for mental health problems such as depression, anxiety, and suicidal behaviors among college students (Hou et al., 2024; Narita et al., 2024). Some research has found that only children exhibit significantly higher risks of suicidal behaviors compared to their non-only-child counterparts (Zhang and Zhang, 2013). Existing evidence indicates that socioeconomic pressures, a poor family environment, a lack of educational resources, low accessibility to mental health services, and left-behind experiences may all contribute to depression, anxiety, and suicidal behavior among rural adolescents more than their urban counterparts (Biddle et al., 2010; Blanco et al., 2008; Fellmeth et al., 2018; Luo et al., 2024; Qu et al., 2021; Shamsuddin et al., 2013; Yang et al., 2015). However, some studies have found that individuals living in urban areas exhibit higher rates of depression, anxiety and SI than those living in rural areas (Al Mamun et al., 2021; Chinawa et al., 2023; Garcia-Rivas et al., 2024), while another found no difference in depression scores between urban and rural college students (Pillay et al., 2002). Evidence indicates that first-year students may be at a higher risk of depression, anxiety, and suicidal behavior due to the pressures of adapting to a new environment, such as academic transitions and social restructuring. Similarly, older students may face mental health challenges due to the combined burdens of academic demands and employment concerns (Al Mamun et al., 2021; AlJaber, 2020; Farrer et al., 2016; Kaggwa et al., 2022; Peng et al., 2023; Varshney et al., 2024). In Chinese higher education, class cadres (student leaders responsible for managing class affairs, facilitating communication between students and faculty, and organizing collective activities) are less likely to experience mental health problems (Jing et al., 2023; Sun et al., 2024). This may be because being a class cadre broadens the scope of interpersonal communication and promotes mental well-being (Wen and Yang, 2023). The academic performance and mental well-being of college students are closely intertwined, with evidence suggesting that heavy academic pressures and associated stressors can significantly contribute to psychological challenges such as anxiety, depression and suicidal behaviors (Kabir et al., 2024; Nwabueze et al., 2025; Rahman et al., 2025; Seo et al., 2021; Steare et al., 2023; Xiao et al., 2021). Building on the aforementioned evidence, this study postulates that college students who are only child, who come from rural areas, who are freshmen, who have served as class cadres, who exhibit poor academic performance, and who bear a heavy academic burden may face a heightened risk of mental health challenges.

Systematic review evidence indicates that smoking and alcohol consumption are risk factors for mental health issues such as depression, anxiety, and suicidal behaviors among college students (AlJaber, 2020; Anbesaw et al., 2023; Fentahun et al., 2024; Fredman Stein et al., 2022; Hosen et al., 2021; Ramon-Arbues et al., 2020). However, a meta-analysis of cohort studies revealed inconsistent evidence regarding the impact of smoking and alcohol consumption on mental health (Hutchesson et al., 2025). Notably, another meta-analysis specifically found that smoking was not associated with SI in medical students, nor was alcohol consumption linked to SA (Seo et al., 2021). A growing body of evidence suggests a complex relationship between coffee/caffeine consumption and mental health. Several large-scale observational studies have found an inverse relationship between moderate coffee consumption and the risk of depression and suicide (Grosso et al., 2016; Lucas et al., 2014; Narita et al., 2024; Park et al., 2019; Torabynasab et al., 2023; Wang et al., 2016). However, findings among college students have been inconsistent. Some studies have reported associations between coffee consumption and depression/anxiety (Emmy et al., 2024), while others have found no such association (Makki et al., 2023). Still others have observed decreased depressive symptoms but increased anxiety symptoms with caffeine consumption (Bertasi et al., 2021). Prolonged screen time has been consistently associated with increased risks of depression, anxiety, and suicidal behaviors among adolescents (Alyas et al., 2025; Frielingsdorf et al., 2025; Hokby et al., 2025; Hrafnkelsdottir et al., 2018; Leventhal et al., 2021; Prafull et al., 2024; Tang et al., 2023; Wang et al., 2023). A randomized controlled trial demonstrated that reducing screen time leads to significant improvements in mental health symptoms (Leventhal et al., 2021). Substantial evidence indicates that individuals with sleep disorders and evening chronotype exhibit significantly elevated risks of depression, anxiety, SI,

SP, and SA (AlJaber, 2020; Gau et al., 2007; Gili et al., 2019; Liu et al., 2022b; Morssinkhof et al., 2020; Pandi-Perumal et al., 2020; Park et al., 2018; Rahman et al., 2025; Rumble et al., 2018; Wang et al., 2021b). Current evidence suggests that, in this study, college students who smoke, consume alcohol, have prolonged screen time, as well as those with sleep disorders and an evening chronotype, may be at an increased risk of mental health disorders. Regarding coffee consumption, the relationship with mental health is complex and may vary depending on individual factors and consumption patterns.

Previous studies have predominantly used depression, anxiety, or suicidal behaviors as separate indicators to assess the mental health status of college students. This study aims to employ LCA to analyze the characteristics of college students' mental health by simultaneously considering depression, anxiety, SI, SP, and SA as comprehensive indicators. By doing so, it seeks to explore and summarize the heterogeneity and related characteristics of college students' mental health, as well as investigate the influencing factors, particularly comparing medical and non-medical students. The findings are expected to provide valuable insights for colleges and universities to develop personalized intervention strategies.

2. Methods

2.1. Study designs and participants

This large, cross-sectional survey was carried out between November and December 2020. The participants were recruited from four colleges and universities located in Wuhu, Anhui Province, China. Our study used a stratified cluster sampling method. Firstly, schools were categorized into medical and non-medical institutions. Secondly, within these categories, two medical schools and two non-medical schools were chosen through convenience sampling. Subsequently, within each of these four schools, convenience sampling was used again to select majors. After this, whole cluster random sampling was employed to select classes from each major, taking into account the composition of classes within each major. Ultimately, every student in the chosen classes was investigated. A total of 5400 students participated in the questionnaire survey as respondents. Out of these, 5063 questionnaires were retrieved, yielding a recovery rate of 93.8 %. After excluding invalid questionnaires, 4768 questionnaires remained valid, resulting in an effective rate of 94.2 %.

All students were informed of the purpose of the study, voluntarily engaged in it, and provided their written informed consent. This study received ethical approval from the Ethics Committee of the School of Public Health, Wannan Medical College, with approval number LL-2020BH8003.

2.2. Instruments

2.2.1. Sociodemographic characteristics

Sociodemographic characteristics for participants were collected by questionnaire, including age, gender (female or male), only child (yes or no), hometown location (urban or rural), grade level (freshman, sophomore, or junior student), class cadres (yes or no), academic performance in the past year (good, general, or poor), academic burden in the past year (light, general, or heavy), smoking (yes or no), alcohol consumption (yes or no), coffee consumption frequency (not at all, rarely, or frequently), daily online time (<1.5 h, 1.5–3.0 h, >3.0 h).

2.2.2. Pittsburgh Sleep Quality Index (PSQI)

The PSQI was employed to assess the sleep quality of college students and screen for sleep disorders (Dong et al., 2022; Lund et al., 2010). It encompasses 19 items covering seven dimensions: subjective evaluation of sleep quality, sleep latency, total sleep time, sleep efficiency, sleep disturbances, use of hypnotic medications, and daytime dysfunction. Each dimension is rated on a scale of 0–3 points, yielding a composite score between 0 and 21, with higher scores signifying poorer sleep quality. In this study, a PSQI score >7 was defined as having sleep disorder. The Cronbach's α coefficient for the present study was 0.675.

Morningness-Eveningness Questionnaire 19 (MEQ-19).

The Chinese version of MEQ-19 was used to assess the chronotype of college students (Beaulieu et al., 2020; Zhang et al., 2006). It consists of 19 items, with overall scores ranging from 16 to 86. A higher score indicates a stronger tendency toward having a morning chronotype. According to the total scores, individuals were categorized into three distinct groups: evening-type (E-type, score 16 to 49), neutral-type (N-type, score 50 to 62), and morning-type (M-type, score 63 to 86). The Cronbach's α coefficient for the present study was 0.708, indicating acceptable internal consistency.

2.2.3. The two-item Patient Health Questionnaire (PHQ-2)

The PHQ-2, a screening instrument, is intended to evaluate depression symptoms over the past fortnight (Kroenke et al., 2003; Richardson et al., 2010). It comprises two questions ("Having little interest or pleasure in doing things" and "Feeling down, depressed, or hopeless"). Participants respond to each question using a Likert scale, which ranges from 0 (not at all) to 3 (nearly every day), yielding a composite score between 0 and 6. Higher scores reflect a greater severity of depressive symptoms. In this study, a score >3 was defined as having depression symptoms. The Cronbach's α coefficient for the present study was 0.769.

2.2.4. The 2-item General Anxiety Disorder (GAD-2)

The GAD-2, a screening instrument, is intended to evaluate anxiety symptoms over the past fortnight (Kroenke et al., 2007; Luo et al., 2019). It comprises two questions ("Feeling nervous, anxious, or on edge" and "Not being able to stop or control worrying"). Participants respond to each question using a Likert scale, which ranges from 0 (not at all) to 3 (nearly every day), yielding a composite score between 0 and 6. Higher scores reflect a greater severity of anxiety symptoms. In this study, a score >3 was defined as having anxiety symptoms. The Cronbach's α coefficient for the present study was 0.860.

2.3. Suicidal behavior

Participants were asked three straightforward questions regarding suicidal behavior over the past year: 1) SI ("Have you ever seriously thought about attempting suicide in the past year?"); and 2) SP ("Have you ever planned to commit suicide in the past year?"); and 3) SA ("Have you ever made an attempt to commit suicide in the past year?") (Casey et al., 2022; Duffy et al., 2019; Kessler et al., 2005; Ning et al., 2022; Oh et al., 2021). These three questions serve as general screening tools for suicidal behavior. Participants could answer 'yes' or 'no', with 'yes' indicating the presence of suicidal behavior and 'no' indicating the absence of suicidal behavior.

2.4. Data analysis

All data were analyzed using SPSS 26.0 and Mplus 8.3. Common method bias was assessed using Harman's single-factor test. Depression and anxiety scales were dichotomized into 0 and 1. LCA was performed in Mplus 8.3 to identify the number of latent categories of mental health status among college students. Homogeneous mental health profiles were grouped into distinct latent categories based on posterior probabilities. The analysis began with a one-class model and incrementally increased the number of classes until the optimal model was identified, guided by the following criteria (Kim, 2014): (1) lower values of Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), and adjusted BIC (aBIC) indicated better model fit; (2) entropy values, ranging from 0 to 1, with values ≥0.80 indicating classification accuracy exceeding 90 % (higher values indicating better fit); (3) significant *P*-values (< 0.05) for the Lo-Mendell-Rubin Likelihood Ratio Test (LMR-LRT) and Bootstrapped Likelihood Ratio Test (BLRT), suggesting that

the k-class model outperformed the (k-1)-class model; and (4) each latent class comprising at least 3 % of the sample. Based on these criteria, a three-class solution was selected as the optimal model. Descriptive statistics for qualitative data were presented as frequencies (n) and percentages (%). Differences in demographic variables across the three mental health categories were assessed using chi-squared (χ^2) tests. Multinomial logistic regression was employed to explore factors influencing college students' mental health. Statistical significance was set at $P < 0.05$ (two-tailed). The specific analysis proceeded in three sequential phases as follows: 1) conducted LCA with all participants to identify latent classes based on five mental health factors, 2) conducted univariate analyses separately with medical and non-medical students to ascertain which variables (such as demographics and other mental health factors) differed across latent classes, 3) conducted multinomial logistic regressions separately with medical and non-medical students, using significant predictors from the earlier univariate analyses, to ascertain which variables predicted membership in different classes.

2.5. Common method biases

The Harman single-factor test was used to assess the presence of common method deviation. The factor analysis indicated that there were 12 factors with characteristic roots exceeding 1, with the first factor alone accounting for 13.90 % of the variance (below the threshold of 40 %) (Podsakoff et al., 2003). It was therefore concluded that there was no significant common method bias.

3. Results

3.1. LCA of college students' mental health

In this study, LCA models were explored using depression, anxiety, SI, SP, and SA as indicators of college students' mental health. Initially, the five-class model was excluded because the *P*-values of the LMR-LRT and BLRT were not statistically significant ($P > 0.05$). Next, the four-class model was disregarded as the smallest class proportion was <3 %. Subsequently, the three-class model was selected as the optimal solution, as it demonstrated the lowest values for AIC, BIC, aBIC, and Log (L), along with ideal entropy values and significant LMR-LRT and BLRT results ($P < 0.05$). Additionally, the proportions of each latent class were reasonable and meaningful for classification. The proportions of college students classified into the three latent categories were approximately 95.4 %, 93.1 %, and 99.5 % in terms of the most likely class membership, indicating high reliability of the three-class model (Table 1).

Each latent category was named based on the probability values of depression, anxiety, SI, SP, and SA. Class 1 (C1), comprising 88.1 % of the sample, exhibited relatively low probabilities for all indicators, reflecting better mental health among students in this group. It was therefore labeled the "Low Depression and Anxiety - Low Suicidal Behavior group". Class 2 (C2), representing 8.6 % of the sample, showed higher probabilities for depression and anxiety but lower probabilities for SI, SP, and SA, and was named the "High Depression and Anxiety - Low Suicidal Behavior group". Class 3 (C3), accounting for 3.3 % of the sample, demonstrated moderate levels of depression and anxiety alongside higher levels of SI, SP, and SA, and was designated the "Moderate Depression and Anxiety - High Suicidal Behavior group" (Fig. 1).

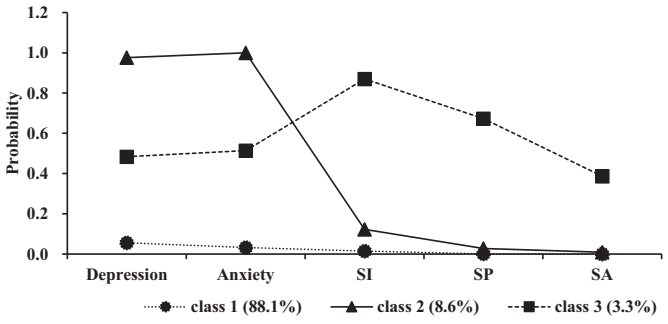

Fig. 1. Three latent categories of college students' mental health status

To examine the heterogeneity of latent categories in college students' mental health status, difference tests were conducted across the three latent categories, with results presented in Table 2. Statistically significant differences were observed among the three categories in terms of mental health and its various dimensions. Post hoc multiple comparison analyses further confirmed that the differences in mental health and its dimensions between the categories were also statistically significant. These findings indicate that the latent classification of college students' mental health effectively distinguishes varying levels of mental health, providing strong empirical support for the validity of our classification approach (Table 2).

3.2. Univariate analysis of potential categories of mental health among medical college students

The results indicated statistically significant differences in the distribution of latent mental health classes among medical students across several variables, including gender, academic performance, academic burden, smoking, alcohol consumption, coffee consumption frequency, daily online time, sleep disorders, and chronotype (all $P < 0.05$). In contrast, no statistically significant differences were observed in the distribution of latent mental health classes among medical students based on being an only child, hometown, grade, or serving as a class cadre (all $P > 0.05$) (Table 3).

3.3. Univariate analysis of potential categories of mental health among non-medical college students

The results indicated statistically significant differences in the distribution of latent mental health classes among non-medical students across several variables, including grade, academic burden, smoking, alcohol consumption, coffee consumption frequency, daily online time, sleep disorders, and chronotype (all $P < 0.05$). In contrast, no statistically significant differences were observed in the distribution of latent mental health classes among non-medical students based on gender, being an only child, their hometowns, grade, academic performance, or serving as class cadres (all $P > 0.05$) (Table 4).

Table 1
Model fit for latent class analysis of college students' mental health.

Model	Number of free parameters	Log (L)	AIC	BIC	aBIC	Entropy	LMR	BLRT	Class probabilities (%)
1	5	−5838.739	11,687.478	11,719.826	11,703.938	–	–	–	100.0
2	11	−4800.416	9622.831	9693.998	9659.044	0.855	<0.001	<0.001	14.9/85.1
3	17	−4584.692	9203.384	9313.369	9259.349	0.965	<0.001	<0.001	8.6/3.3/88.1
4	23	−4553.364	9152.729	9301.532	9228.446	0.939	<0.001	<0.001	8.7/2.1/1.0/88.2
5	29	−4552.464	9162.928	9350.549	9258.398	0.945	0.1895	0.6667	0.3/9.0/88.0/1.7/1.0

Table 2
Differences in mental health and dimensions of mental health among different types of university students [n (%)].

Variables		Latent categories of mental health status of college students				χ^2	*P*	Post hoc
		Total	C1	C2	C3			
Depression	Yes	712 (14.9)	226 (31.7)	409 (57.5)	77 (10.8)	2775.707	<0.001	C3 < C1 < C2
	No	4056 (85.1)	3976 (98.0)	0 (0.0)	80 (2.0)			
Anxiety	Yes	626 (13.1)	135 (21.6)	409 (65.3)	82 (13.1)	3278.932	<0.001	C3 < C1 < C2
	No	4142 (86.9)	4067 (98.2)	0 (0.0)	75 (1.8)			
SI	Yes	259 (5.4)	63 (24.3)	53 (20.5)	143 (55.2)	2413.715	<0.001	C3 > C1 > C2
	No	4509 (94.6)	4139 (91.8)	356 (7.9)	14 (0.3)			
SP	Yes	132 (2.8)	8 (6.1)	11 (8.3)	113 (85.6)	2897.227	<0.001	C1 < C2 < C3
	No	4636 (97.2)	4194 (90.5)	398 (8.6)	44 (0.9)			
SA	Yes	70 (1.5)	0 (0.0)	3 (4.3)	67 (95.7)	1907.045	<0.001	C1 < C2 < C3
	No	4698 (98.5)	4202 (89.4)	406 (8.6)	90 (1.9)			

3.4. Multinomial logistic regression analysis of factors influencing latent mental health classes among medical college students

A multinomial logistic regression analysis was conducted with the latent classes of mental health among medical college students as the dependent variable (using C1 as the reference group) and statistically significant variables from univariate analyses as independent variables, including gender, academic burden, smoking, alcohol consumption, coffee consumption frequency, daily online time, sleep disorders, and chronotype. The results showed that gender, academic burden, alcohol consumption, and sleep disorders were significant predictors of mental health classification among medical college students. Compared to group C1, males were more likely to belong to groups C2 and C3 than females; drinkers and individuals with sleep disorders were more likely to be in groups C2 and C3 than non-drinkers and good sleepers; students with a heavy academic burden were more likely to be in group C2 than those with a moderate burden, while those with a light academic burden were more likely to be in group C3 (Table 5).

3.5. Multinomial logistic regression analysis of factors influencing latent mental health classes among non-medical college students

A multinomial logistic regression analysis was conducted with the latent classes of mental health among non-medical college students as the dependent variable (using C1 as the reference group) and statistically significant variables from univariate analyses as independent variables, including grade, academic burden, smoking, alcohol consumption, coffee consumption frequency, daily online time, sleep disorders, and chronotype. The results showed that grade, academic burden, alcohol consumption, daily online time, and sleep disorders were significant predictors of mental health classification among non-medical college students. Compared to group C1, sophomores and juniors were more likely to be in group C2 than freshmen; students with a heavy or light academic burden were more likely to be in group C2 than those with moderate burden; drinkers and individuals with sleep disorders were more likely to be in groups C2 and C3 than non-drinkers and good sleepers; compared to those spending >3 h online daily, students spending 1.5 to 3 h online were more likely to be in group C2, while those spending <1.5 h were more likely to be in group C3 (Table 6).

4. Discussion

This study revealed that college students' mental health exhibits distinct categorical features, indicating significant group heterogeneity. The LCA identified three qualitatively different mental health categories. Based on their characteristics, these subgroups were labeled as follows: the C1 group, characterized by low depression, low anxiety, and low suicidal behavior; the C2 group, characterized by high depression, high anxiety, and low suicidal behavior; and the C3 group, characterized by moderate depression, moderate anxiety, and high suicidal behavior. The majority of college students in this study belonged to the C1 group, which demonstrated low probability scores across all mental health factors, indicating that most students exhibited good psychological well-being and were better able to regulate their emotional states.

In the C2 group, the probability plot revealed that students' mental health problems tended to co-occur rather than manifest in isolation. This group exhibited higher probabilities of depression and anxiety compared to groups C1 and C3, but lower probabilities of SI, SP, and SA than the C3 group. This suggests that the C2 group was characterized by significant symptoms of depression and anxiety, yet with a minimal risk of suicidal behavior. These findings align with previous studies indicating that depressive and anxiety symptoms often coexist in college students (Liu et al., 2021; Lun et al., 2018; Mao et al., 2019). This co-occurrence may be attributable to shared risk factors (Blanco et al., 2014; Bore et al., 2016; Chen et al., 2021; Mahroon et al., 2018). Additionally, the results are consistent with prior research showing a high likelihood of depressive and anxiety symptoms but a low likelihood of suicidal behavior (Liu et al., 2021). This subtype highlights that high levels of depressive and anxiety symptoms in college students do not necessarily lead to suicidal behavior. While depression and anxiety are recognized as significant risk factors for suicidal behavior (Busby Grant et al., 2023; Gili et al., 2019), the widespread dissemination of mental health knowledge, the emphasis on mental health education in colleges, and the availability of timely psychological interventions may have enabled students in the C2 group to better understand and manage their mental health issues, adopt effective coping mechanisms, and regulate their emotions (Wang et al., 2020; Yu et al., 2023). Nevertheless, despite their low levels of suicidal behavior, the heightened depression and anxiety observed in the C2 group underscore the need for prompt and targeted interventions to address their emotional distress.

In the C3 group, the probability plot revealed that this group exhibited higher probabilities of depression and anxiety than the C1 group but lower probabilities than the C2 group, alongside higher probabilities of SI, SP, and SA compared to both C1 and C2 groups. This suggests that the C3 group was characterized by clinically significant but moderate depressive and anxiety symptoms, yet with a heightened risk of suicidal behavior. Students in this group may experience emotional instability and chronic psychological distress due to academic and employment pressures (Jayanthi et al., 2015; Moxham et al., 2018; Shao et al., 2020; Zhang et al., 2022). This risk is further compounded by a lack of coping skills and psychological resilience (Ramadianto et al., 2022; Siegmann et al., 2018; Teismann et al., 2018), thereby elevating the risk of suicidal behavior. Additionally, maladaptive personality traits may hinder the resolution of moderate depression and anxiety, increasing vulnerability to suicidal acts under stress (Gong et al., 2022; Pitanupong et al., 2024). Despite constituting the smallest proportion, the C3 group warrants urgent attention due to the severity of its outcomes. Targeted interventions at both familial and institutional levels are critical to identifying modifiable risk factors and implementing evidence-based strategies. Through a nuanced understanding of this subgroup, effective support systems can be established to safeguard their physical and mental well-being.

Table 3
Univariate analysis of potential categories of mental health among medical college students [n (%)].

Variables	Total	C1	C2	C3	χ^2	*P*
Total	3195 (100.0)	2844 (89.0)	251 (7.9)	100 (3.1)		
Gender					12.857	0.002
Male	1388 (43.4)	1206 (86.9)	125 (9.0)	57 (4.1)		
Female	1807 (56.6)	1638 (90.6)	126 (7.0)	43 (2.4)		
Only child					3.160	0.206
Yes	1061 (33.2)	931 (87.7)	90 (8.5)	40 (3.8)		
No	2134 (66.8)	1913 (89.6)	161 (7.5)	60 (2.8)		
Hometown					3.125	0.210
Urban	1445 (35.2)	1285 (88.9)	107 (7.4)	53 (3.7)		
Rural	1750 (54.8)	1559 (89.1)	144 (8.2)	47 (2.7)		
Grade					4.739	0.315
Freshman	1476 (46.2)	1327 (89.9)	109 (7.4)	40 (2.7)		
Sophomore	1271 (39.8)	1116 (87.8)	112 (8.8)	43 (3.4)		
Junior	448 (14.0)	401 (89.5)	30 (6.7)	17 (3.8)		
Class cadres					1.089	0.580
Yes	2275 (71.2)	2032 (89.3)	176 (7.7)	67 (2.9)		
No	920 (28.8)	812 (88.3)	75 (8.2)	33 (3.6)		
Academic performance					21.649	<0.001
Good	1064 (33.3)	944 (88.7)	78 (7.3)	42 (3.9)		
General	1734 (54.3)	1569 (90.5)	127 (7.3)	38 (2.2)		
Poor	397 (12.4)	331 (83.4)	46 (11.6)	20 (5.0)		
Academic burden					30.516	<0.001
Light	252 (7.9)	215 (85.3)	20 (7.9)	17 (6.7)		
Moderate	1702 (53.3)	1556 (91.4)	105 (6.2)	41 (2.4)		
Heavy	1241 (38.8)	1073 (86.5)	126 (10.2)	42 (3.4)		
Smoking					27.112	<0.001
No	3076 (96.3)	2751 (89.4)	238 (7.7)	87 (2.8)		
Yes	119 (3.7)	93 (78.2)	13 (10.9)	13 (10.9)		
Alcohol consumption					29.052	<0.001
No	2998 (93.8)	2689 (89.7)	226 (7.5)	83 (2.8)		
Yes	197 (6.2)	155 (78.7)	25 (12.7)	17 (8.6)		
Coffee consumption frequency					12.515	0.014
Not	1250 (39.1)	1124 (89.9)	81 (6.5)	45 (3.6)		
Rarely	1643 (51.4)	1462 (89.0)	141 (8.6)	40 (2.4)		
Frequently	302 (9.5)	258 (85.4)	29 (9.6)	15 (5.0)		
Daily online time					18.114	0.001
<1.5 h	126 (3.9)	100 (79.4)	15 (11.9)	11 (8.7)		
1.5–3.0 h	412 (12.9)	363 (88.1)	35 (8.5)	14 (3.4)		
>3.0 h	2657 (83.2)	2381 (89.6)	201 (7.6)	75 (2.8)		
Sleep disorders					198.702	<0.001
No	2608 (81.6)	2416 (92.6)	128 (4.9)	64 (2.5)		
Yes	587 (18.4)	428 (72.9)	123 (21.0)	36 (6.1)		
Chronotype					18.217	0.001
E-type	1793 (56.1)	1560 (87.0)	166 (9.3)	67 (3.7)		
N-type	1308 (40.9)	1196 (91.4)	82 (6.3)	30 (2.3)		
M-type	94 (2.9)	88 (93.6)	3 (3.2)	3 (3.2)		

Multinomial logistic regression analysis revealed that both medical and non-medical students who consumed alcohol and experienced sleep disorders had a significantly higher likelihood of belonging to groups C2 and group C3 compared to the C1 group. Current research on the relationship between alcohol consumption and mental health in college students remains inconclusive (Chhoa et al., 2019; Fentahun et al., 2024; Fite et al., 2023; Ramon-Arbues et al., 2023; Schilling et al., 2009; Seo et al., 2021). College students often lack adaptive coping strategies for stress and are hesitant to seek psychological help (Chew-Graham et al., 2003; Ciarrochi and Deane, 2001; Fischbein and Bonfine, 2019), which may lead them to use alcohol as a maladaptive coping mechanism (Yuan et al., 2024). However, excessive alcohol consumption can disrupt sleep patterns, worsening mental health problems (Yuan et al., 2024). Chronic alcohol use may also foster dependence, heightening emotional sensitivity and vulnerability to mental health disorders (Feng and Newman, 2016; Onaemo et al., 2020). Additionally, at a neurobiological level, alcohol can impair neurotransmitter function, further exacerbating psychological distress (Braby et al., 2022). Sleep disturbances are widely recognized as a critical risk factor for mental health problems in this population (Perotta et al., 2021; Vestergaard et al., 2024; Wang et al., 2021a, 2021b). Poor sleep quality compromises emotional regulation during stress (Galante et al., 2018), increasing vulnerability to mental health issues (Doane et al., 2015). Sleep disorders may also trigger inflammatory responses, and elevated inflammation has been linked to psychiatric risks (Irwin and Opp, 2017; Raison and Miller, 2013). Furthermore, sleep deprivation can cause neuronal hyperactivity, raising the likelihood of cognitive deficits and psychological disorders (Gilley, 2023). Unhealthy behaviors like alcohol use and sleep disturbances may reduce plasma interleukin-10 levels, potentially exacerbating psychological symptoms (Zhai et al., 2022). These findings illustrate the complex interplay between alcohol consumption, sleep disorders, and mental health, emphasizing the need for targeted interventions addressing these modifiable risk factors in college students.

The analysis further revealed that academic burden significantly influenced the latent classes of mental health status among both medical and non-medical college students. Specifically, medical and non-medical students with a heavy academic burden were 1.430 and 2.111 times more likely, respectively, to belong to the C2 group compared to those with a moderate burden. Medical students with a light academic burden showed a 2.447-fold increased risk of being classified into the C3 group versus the moderate burden group, while non-medical students with a light burden had a 2.633-fold higher risk of entering the C2 group. Loneliness may mediate the relationship between academic burden and mental health outcomes (Wang et al., 2025). Students under high academic stress may withdraw socially or perceive inadequate peer/teacher support, exacerbating loneliness (Lan et al., 2023). Loneliness, in turn, is strongly associated with symptoms of depression and anxiety (Cacioppo and Hawkley, 2009; Matthews et al., 2016). Notably, students with lighter academic burdens exhibited worse mental health than those with moderate burdens, contradicting prior findings that light burdens are protective (Xiao et al., 2021). Although this result lacks

Table 4
Univariate analysis of potential categories of mental health among non-medical college students [n (%)].

Variables	Total	C 1	C 2	C 3	χ^2	*P*
	1573 (100.0)	1358 (86.3)	158 (10.1)	57 (3.6)		
Gender					0.573	0.751
Male	671 (42.7)	578 (86.1)	66 (9.8)	27 (4.0)		
Female	902 (57.3)	780 (86.5)	92 (10.2)	30 (3.3)		
Only child					3.273	0.195
Yes	527 (33.5)	457 (86.7)	46 (8.7)	24 (4.6)		
No	1046 (66.5)	901 (86.1)	112 (10.7)	33 (3.2)		
Hometown					5.603	0.061
Urban	581 (36.9)	517 (89.0)	46 (7.9)	18 (3.1)		
Rural	992 (63.1)	841 (84.8)	112 (11.3)	39 (3.9)		
Grade					33.468	<0.001
Freshman	784 (49.8)	698 (89.0)	53 (6.8)	33 (4.2)		
Sophomore	571 (36.3)	492 (86.2)	62 (10.9)	17 (3.0)		
Junior	218 (13.9)	168 (77.1)	43 (19.7)	7 (3.2)		
Class cadres					0.432	0.806
Yes	1109 (70.5)	959 (86.5)	112 (10.1)	38 (3.4)		
No	463 (29.5)	398 (86.0)	46 (9.9)	19 (4.1)		
Academic performance					8.025	0.091
Good	583 (37.1)	494 (84.7)	70 (12.0)	19 (3.3)		
General	811 (51.6)	714 (88.0)	65 (8.0)	32 (3.9)		
Poor	179 (11.4)	150 (83.8)	23 (12.8)	6 (3.4)		
Academic burden					44.231	<0.001
Light	225 (14.3)	174 (77.3)	37 (16.4)	14 (6.2)		
Moderate	1009 (64.1)	913 (90.5)	67 (6.6)	29 (2.9)		
Heavy	271 (21.6)	271 (79.9)	54 (15.9)	14 (4.1)		
Smoking					9.185	0.010
No	1455 (92.5)	1267 (87.1)	138 (9.5)	50 (3.4)		
Yes	118 (7.5)	91 (77.1)	20 (16.9)	7 (5.9)		
Alcohol consumption					26.390	<0.001
No	1467 (93.3)	1284 (87.5)	135 (9.2)	48 (3.3)		
Yes	106 (6.7)	74 (69.8)	23 (21.7)	9 (8.5)		
Coffee consumption frequency					20.246	<0.001
Not	598 (38.0)	523 (87.5)	58 (9.7)	17 (2.8)		
Rarely	836 (53.1)	731 (87.4)	28 (20.1)	7 (5.0)		
Frequently	139 (8.8)	104 (74.8)	72 (8.6)	33 (3.9)		
Daily online time					16.422	0.003
<1.5 h	121 (7.7)	95 (78.5)	15 (12.4)	11 (9.1)		
1.5–3.0 h	299 (19.0)	254 (84.9)	38 (12.7)	7 (2.3)		
>3.0 h	1153 (73.3)	1009 (87.5)	105 (9.1)	39 (3.4)		
Sleep disorders					88.235	<0.001
No	1291 (82.1)	1161 (89.9)	88 (6.8)	42 (3.3)		
Yes	282 (17.9)	197 (69.9)	70 (24.8)	15 (5.3)		
Chronotype					9.715	0.046
E-type	647 (41.1)	564 (87.2)	57 (8.8)	26 (4.0)		
N-type	844 (53.7)	731 (86.6)	85 (10.1)	28 (3.3)		
M-type	63 (5.2)	63 (76.8)	16 (19.5)	3 (3.7)		

broad empirical support, we postulate that internet addiction may play explain this paradox. The transition from China's exam-centric Gaokao system to university self-directed learning can create a psychological void for some students, leading to unclear academic goals and low motivation. This, combined with poor self-regulation in the absence of parental supervision (Li, 2015; Liu and Wu, 2024), may result in students allocating excessive time to entertainment activities such as online gaming. Consequently, they may develop internet addiction and subsequent mental health issues (Li et al., 2020; Melca et al., 2023; Tang et al., 2024). Additionally, the relatively small sample sizes of Groups C2 and C3 in this study may introduce bias into the results. Future multicenter longitudinal studies with larger samples are needed to validate these associations.

The analysis indicated that gender significantly influenced latent mental health class membership exclusively among medical students. Specifically, males were more likely to enter groups C2 (OR = 1.492, 95%CI: 1.131, 1.969) and C3 (OR = 1.622, 95%CI: 1.060, 2.483) than females when compared with the C1 group, indicating more prominent mental health issues among males. These findings are consistent with established gender differences in university students' mental health (Ma et al., 2022) but contrast with previous reports specific to medical students (Jestin et al., 2023; Liu et al., 2021). This discrepancy may be explained by gender-specific coping patterns: female students typically exhibit greater emotional expressiveness and utilize more diverse emotion regulation strategies when facing psychological distress, while male students tend to internalize emotions and are less likely to seek social support (Nolen-Hoeksema, 2012). However, these explanations remain tentative, highlighting the need for further investigation into gender-specific mechanisms affecting mental health classification among medical students.

The analysis further identified grade level as a significant predictor of latent mental health classes exclusively among non-medical students. Specifically, sophomores (OR = 2.683, 95%CI: 1.686, 4.272) and juniors (OR = 1.498, 95%CI: 1.001, 2.241) were more likely to enter the C2 group compared to freshmen when referenced against the C1 group. Previous studies on grade-level differences in depressive symptoms among college students have yielded inconsistent conclusions. Some research suggests that first-year students may be particularly vulnerable to depression during university transition (Liu and Wang, 2022), while other studies have found that lower-year students exhibit significantly lower depression levels than upper-year students (Huang, 2015), which aligns with the findings of this study. This discrepancy may be attributed to the fact that senior non-medical students face numerous challenges, such as academic stress, internship pressures, employment uncertainties, or interpersonal relationships, which may in turn lead to elevated levels of anxiety and depression (Gao et al., 2020).

The analysis further demonstrated that daily online time significantly influenced the latent classes of mental health status only among non-medical students. Specifically, compared to students who spent >3 h a day online, those who spent <1.5 h a day online were more likely to belong to group C3 (OR = 2.486, 95%CI: 1.170, 5.281), while those who spent 1.5 to 3 h a day online were more likely to be in group C2 (OR =

Table 5
Multinomial logistic regression analysis of factors influencing the latent class of mental health of medical college students.

Variables (Ref.)		C2 (high depression and anxiety-low suicidal behavior)						C3 (moderate depression-anxiety and high suicidal behavior)					
		B	SE	*P*	OR	*CI* (95 %)		B	SE	*P*	OR	*CI* (95 %)	
Gender (female)	Male	0.400	0.141	0.005	1.492	1.131	1.969	0.484	0.217	0.026	1.622	1.060	2.483
Academic burden (moderate)	Light	0.209	0.265	0.430	1.232	0.734	2.07	0.895	0.306	0.003	2.447	1.342	4.461
	Heavy	0.358	0.144	0.013	1.430	1.078	1.897	0.296	0.228	0.193	1.345	0.861	2.102
Alcohol consumption (No)	Yes	0.478	0.242	0.048	1.614	1.004	2.593	0.982	0.293	0.001	2.670	1.503	4.743
Sleep disorders (No)	Yes	1.670	0.140	<0.001	5.311	4.037	6.987	1.174	0.221	<0.001	3.236	2.099	4.987

Table 6
Multinomial logistic regression analysis of factors influencing the latent class of mental health of non-medical college students.

Variables (Ref.)		C2 (high depression and anxiety-low suicidal behavior)						C3 (moderate depression-anxiety and high suicidal behavior)					
		B	SE	*P*	OR	*CI* (95 %)		B	SE	*P*	OR	*CI* (95 %)	
Grade (freshman)	Junior	0.987	0.237	<0.001	2.683	1.686	4.272	-0.345	0.435	0.428	0.708	0.302	1.662
	Sophomore	0.404	0.205	0.049	1.498	1.001	2.241	-0.404	0.310	0.192	0.667	0.364	1.225
Academic burden (moderate)	Light	0.968	0.241	<0.001	2.633	1.640	4.227	0.685	0.360	0.057	1.983	0.980	4.016
	Heavy	0.747	0.209	<0.001	2.111	1.403	3.177	0.366	0.342	0.285	1.442	0.737	2.819
Alcohol consumption (No)	Yes	0.874	0.282	0.002	2.395	1.379	4.161	1.056	0.391	0.007	2.875	1.335	6.188
Daily online time (>3 h)	<1.5 h	0.058	0.330	0.859	1.060	0.556	2.023	0.911	0.384	0.018	2.486	1.170	5.281
	1.5-3 h	0.549	0.218	0.012	1.731	1.128	2.655	-0.255	0.422	0.545	0.775	0.339	1.771
Sleep disorders (No)	Yes	1.567	0.189	<0.001	4.792	3.309	6.941	0.739	0.320	0.021	2.093	1.117	3.921

1.731, 95%CI: 1.128, 2.655). Current evidence on the relationship between online time and mental health among students remains inconsistent (Santos et al., 2023; Tang et al., 2021), which may be attributed to differences in the types of screen devices, purposes of use, or content focus across studies (Tang et al., 2021). Furthermore, we hypothesize that this relationship is not primarily driven by shorter daily online time, but rather that academic involution (neijuan) may play a partial role in it. Within the context of Chinese higher education, college students face not only academic, employment, and peer competition pressure, but also bear the expectations of families and society, which collectively fostering an involutionary academic environment (Chen and Lee, 2023; Wang et al., 2024; Yan et al., 2022; Zheng et al., 2022; Zhou et al., 2022). This environment compels students to invest excessive time and effort in academic performance and skill acquisition to gain competitive advantages in the job market, consequently exacerbating psychological distress (Chen and Lee, 2023; Liu et al., 2022a, 2022b; Yang, 2021). Additionally, the involuted competitive landscape contributes to social isolation by reducing opportunities for peer interaction and support acquisition, and/or prompting excessive academic focus at the expense of building crucial social support networks (Zhang, 2024). Consequently, involution behaviors may contribute to the emergence of adverse emotions among college students (Liu et al., 2024; Pascoe et al., 2020; Yi et al., 2022; Zhou et al., 2022). For students who spent 1.5 to 3 h online daily, moderate internet use facilitated information access and social interactions. However, exposure to negative online content may still contribute to anxiety and depressive symptoms (Frielingsdorf et al., 2025). It is crucial to emphasize that this does not imply prolonged internet use is beneficial for mental health. The relationship between internet use duration and mental health is complex. Future research should further explore the specific mechanisms through which different online durations affect mental health, providing a basis for targeted interventions. Colleges and society should strengthen mental health education and counseling, helping students develop healthy attitudes toward internet use and life, thereby improving their mental well-being.

Although this study employed latent class analysis to explore the heterogeneity of college students' mental health status, identifying three distinct latent classes and investigating their influencing factors—thereby addressing some limitations of the variable-centered research approach—several limitations remain. Firstly, this study was a cross-sectional survey, making it difficult to infer causal relationships between variables. Future research could incorporate multi-center, large-sample longitudinal studies to examine the cause-and-effect relationships. Secondly, the study only included college students from one province, limiting the generalizability of the findings to other regions and populations. Thirdly, although LCA was used, data collection relied on self-reports, which may introduce information bias. Future studies could adopt multi-angle assessment methods to improve the reliability and validity of the findings. Then, the samples in this study were exclusively recruited from medical and non-medical institutions, and the institution type itself may confound the results. Specifically, the observed differences between medical and non-medical students may stem more from the institution type itself (such as institutional resources, curriculum intensity, or academic pressure) rather than the student type per se. Future studies should include more diverse institution types or control for institutional variables to disentangle the effects of student type and institution type. Finally, potential interactions among independent variables were not considered, which should be addressed in subsequent research.

5. Conclusions

This study identified three distinct latent classes of mental health status among Chinese college students and examined the differential factors influencing these classifications between medical and non-medical students. By doing so, it provides a novel perspective for understanding the diversity and complexity of college students' mental health, challenging the traditional oversimplified view of mental health status. Additionally, it enriches the classification system of mental health, offering a scientific basis for future intervention practices. The findings also contribute new ideas and methods for theoretical innovation and practical exploration in the field of mental health.

CRediT authorship contribution statement

Li-ying Wen: Writing – review & editing, Writing – original draft, Methodology. **Liu Zhang:** Writing – review & editing, Methodology. **Li-jun Zhu:** Software, Methodology. **Jian-gen Song:** Resources. **An-shi Wang:** Investigation. **Ying Feng:** Investigation. **Yu-jing Tao:** Investigation. **Yu Zhu:** Validation. **Yue-long Jin:** Conceptualization. **Wei-wei Chang:** Methodology, Conceptualization.

Ethics statement

The study involving human participants were reviewed and approved by the Ethics Committee of School of Public Health, Wannan Medical College. The participants provided their written informed consent to participate in this study.

Funding

This study was supported by Wannan Medical College young and middle-aged humanities and social project (WK2024ZQNZ17), National innovation and Entrepreneurship Project (202310368056; 202310368055), Talents Program for Academic Leaders and Reserve Candidates of Wannan Medical College (No. School Administration Letter [2021] No. 46), the Key Research Project of Anhui Provincial Department of Education (2024AH052741), the Excellent and top-notch talent cultivation project in colleges and universities in Anhui Province (gxgnfx2022039).

Declaration of competing interest

The authors declare no conflict of interest.

Acknowledgements

Gratitude was given to all participants and contributors who had participated in this study.

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