



Observational Study

Investigation of contemporary college students' mental health status and construction of a risk prediction model

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Abstract

BACKGROUND

Due to academic pressure, social relations, and the change of adapting to independent life, college students are under high levels of pressure. Therefore, it is very important to study the mental health problems of college students. Developing a predictive model that can detect early warning signals of college students' mental health risks can help support early intervention and improve overall well-being.

AIM

To investigate college students' present psychological well-being, identify the contributing factors to its decline, and construct a predictive nomogram model.

METHODS

We analyzed the psychological health status of 40874 university students in selected universities in Hubei Province, China from March 1 to 15, 2022, using online questionnaires and random sampling. Factors influencing their mental health were also analyzed using the logistic regression approach, and R4.2.3 software was employed to develop a nomogram model for risk prediction.

RESULTS

We randomly selected 918 valid data and found that 11.3% of college students had psychological problems. The results of the general data survey showed that the mental health problems of doctoral students were more prominent than those of junior college students, and the mental health of students from rural areas was more likely to be abnormal than that of urban students. In addition, students who had experienced significant life events and divorced parents were more likely to have an abnormal status. The abnormal group exhibited significantly higher Patient Health Questionnaire-9 (PHQ-9) and Generalized Anxiety Disorder-7 scores than the healthy group, with these differences being statistically significant ($P < 0.05$). The nomogram prediction model drawn by multivariate analysis included six predictors: The place of origin, whether they were single children, whether

there were significant life events, parents' marital status, regular exercise, intimate friends, and the PHQ-9 score. The training set demonstrated an area under the receiver operating characteristic (ROC) curve (AUC) of 0.972 [95% confidence interval (CI): 0.947-0.997], a specificity of 0.888 and a sensitivity of 0.972. Similarly, the validation set had a ROC AUC of 0.979 (95%CI: 0.955-1.000), with a specificity of 0.942 and a sensitivity of 0.939. The H-L deviation test result was $\chi^2 = 32.476$, $P = 0.000007$, suggesting that the model calibration was good.

CONCLUSION

In this study, nearly 11.3% of contemporary college students had psychological problems, the risk factors include students from rural areas, divorced parents, non-single children, infrequent exercise, and significant life events.

Key Words: College; Predictive models; Psychological health; Risk factors; Logistic regression analysis; Influencing factors

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Core Tip: Mental health problems in college students have a marked impact on their physical and mental health, and learning capacity, and are also one of the key issues of concern to educators and society. This study analyzed the mental health status of 40874 college students in selected colleges and universities in Hubei Province, China. A logistic regression model was used to explore the factors affecting the mental health of college students. A risk prediction nomogram model was constructed by R software, which improved the visualization and comprehensibility of the research.

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INTRODUCTION

Mental health refers to all aspects and activities of the psyche that are balanced and harmonious, and is manifested in the individual's correct cognition, good mood, and appropriate behavior[1,2]. Research has demonstrated an annual yearly increase in the detection of psychological health issues among college students over the last three years[3], indicating that this problem has attracted more and more attention. In 2017-2018, a white paper study on the mental health of Chinese urban residents showed that 73.6% of the college students surveyed had sub-health status. This problem requires attention in order to be resolved. College students are the backbone of the future of society[4]; with the development of the social economy, competition is becoming increasingly fierce, and the mental health of these students has attracted extensive attention from society and schools[5]. University students are in the transition stage between school and society, and their mental health is highly susceptible to pressure from all sides. Most of the studies on the mental health of college students have mainly focused on the main influencing factors, and there are few studies on risk prediction analysis[6,7]. However, the diversity, complexity, variability, contingency, and uncertainty of college students' mental health problems pose challenges in mental health risk prediction. Therefore, constructing a risk prediction model is conducive to screening mental health problems, preventing and treating risk factors for disease occurrence, and reducing morbidity. This study determined the mental health of current college students using a questionnaire survey. Based on an analysis of influencing factors, a mental health risk prediction model for college students was constructed using logistic regression, which provided a reference for counseling college students' mental health problems in the future, which was conducive for providing better mental health care for college students.

MATERIALS AND METHODS

General information

All college students in some of the universities in Hubei Province were selected as research subjects. An online questionnaire survey was conducted from March 1 to 15, 2022, and the questionnaires were distributed using QQ and WeChat. Based on the principle of voluntariness, the respondents completed the questionnaire after scanning the QR code. Each IP address can only be registered to answer once to ensure the quality of the questionnaire. After the investigation, a total of 41610 survey forms were acquired, of which 40874 data were used, and the effective response rate was 98.2%. In these valid data, girls accounted for 45.4% (18547) and boys accounted for 54.6% (22327). A random sampling method selected 2% of valid questionnaires from 40874 valid data.

Research methods

The general questionnaire included data on age, grade, gender, family situation, academic performance, major life events, and other social demographic data. Using the symptom self-rating scale (SCL-90)[8,9], a total of 90 items were scored at 5 levels (0-4), with scores ranging from 0 (none) to 4 (severe); the scale is divided into physical status, interpersonal sensitivity, obsessive-compulsive symptoms, anxiety, depression, hostility, paranoia, terror, psychosis and another 10 symptoms. This scale is commonly used in mental health screening tools due to its comprehensiveness and ease of understanding. The Patient Health Questionnaire (PHQ-9)[10,11] was used to evaluate depression in college students. There were 9 criteria in total and the scoring ranged from 0 (never) to 3 (almost every day). The total score was the sum of the scores of each item (0-27 points). The score was divided into 5 levels (no depression to severe depression): 0-4, 5-9, 10-14, 15-19, and 20-27. Assessment of generalized anxiety symptoms was carried out using The Generalized Anxiety Disorder score[5], with a total of 7 items (0-3 points: From none to almost always), 4 levels of the total score 0-21 points (no anxiety to severe anxiety: 0-4, 5-9, 10-14, 15-21), and the higher the score, the more pronounced the anxiety state.

Statistical analysis

Statistical analysis was conducted using SPSS23.0 software. The experimental data obeyed normal distribution, expressed as mean $\pm$ SD in terms of homogeneity of variance, and were compared by independent samples *t*-test. Count data were expressed as *n* (%) using the χ^2 test; data with a value of $P < 0.05$ were considered statistically significantly different. Single-factor analysis was performed with SPSS23.0, and logistic regression was used for multivariate analysis of statistically significant variables. The prediction model was then constructed, and a nomogram model was constructed using R4.2.3. This research used the receiver operating characteristic (ROC) curve to predict the model performance and used the H-L to test the goodness of fit of the model.

RESULTS

Sample characteristics

We randomly selected 918 cases consisting of 2% of the valid data, including 814 cases in the mental health group and 104 cases in the abnormal mental health group. The incidence of mental health abnormalities was 11.3%. Educational background, place of origin, parent's marital status, whether they were single children, whether they had significant life events, and whether they had intimate friends showed statistical significance ($P < 0.05$) (Table 1).

Logistic regression analysis

Logistic regression analysis was performed to determine whether mental health was abnormal as the dependent variable (mental health = 0, mental health abnormality = 1) and independent variables comprising factors with a significant statistical correlation or association in single-factor analysis (Table 2). The results showed that parents who were divorced/widowed, non-single children, major life events, infrequent exercise, and no close friends were independent risk factors for mental health abnormalities in college students ($P < 0.05$) (Table 3).

Construction of the nomogram model and validation of its predictive performance

Based on the independent factors in the regression model (education, place of origin, exercise, parents' marital status, close friends, and whether major life events occurred), variables with significant differences ($P < 0.05$) were included and a nomogram model was constructed (Figure 1). The Bootstrap method was used to verify the model. The results of the H-L deviation test were $\chi^2 = 32.476$, $P = 0.000007$, suggesting that the model exhibited favorable calibration. According to the training set, the area under the ROC curve was 0.972 [95% confidence interval (CI): 0.947-0.997], and the specificity and sensitivity were 0.888 and 0.972, respectively. The validation set ROC area under the (AUC) was 0.979 (95%CI: 0.955-1.000), with a specificity of 0.942 and a sensitivity of 0.939. In the training set, the nomogram-based prediction model yielded a mean absolute error (MAE) of 0.01, and the mean square error (MMSE) was 0.00022. The MAE of the validation set was 0.007, and the MMSE was 0.00026. The smaller the statistics, the higher the calibration of the prediction model (Figures 2 and 3).

DISCUSSION

University is an important stage in the life of college students and a crucial period for personality completion and self-improvement[12]. College students are active and accept a wide range of information but do not have complete psychological defense abilities. They are easily disturbed by external factors, causing anxiety, panic, and other negative emotions, resulting in blind conformity and impulsive behavior. For college students, entering university means they are about to enter society. At this crossroad, they face pressure and confusion due to learning, love, employment, and family. These aspects of stress, to a certain extent, affect the psychological health of college students[13]. Due to the increased risk of mental health problems, mental health research has become a priority for many scholars[14]. Studies have found that different nationalities, genders, grades, only children, different subjects, and different school types are all related to the mental health of college students[15]. In addition, some studies have found that only children, parental relationships, and domestic violence directly affect the mental health of college students[16]. These results are not entirely consistent with those of this study. This phenomenon can be explained by the vulnerability of mental health to environmental/social

Table 1 Univariate analysis of the mental health of contemporary college students

Variables	Grouping	Healthy, <i>n</i> = 814	Abnormal, <i>n</i> = 104	Statistic	<i>P</i> value
Age (mean ± SD)		22.98 ± 3.02	23.12 ± 3.16	0.443	0.658
Education, <i>n</i> (%)	Specialized	42 (87.50)	6 (12.50)	8.684	0.034
	Undergraduate	629 (92.36)	52 (7.64)		
	Master	116 (76.32)	36 (23.68)		
	Doctor	27 (72.97)	10 (27.03)		
Gender, <i>n</i> (%)	Female	317 (90.06)	35 (9.94)	0.952	0.329
	Male	497 (87.81)	69 (12.19)		
Native place, <i>n</i> (%)	Countryside	308 (82.35)	66 (17.65)	25.079	< 0.001
	City	506 (93.01)	38 (6.99)		
Nationality, <i>n</i> (%)	Han	720 (88.45)	94 (11.55)	0.308	0.579
	Ethnic minority	94 (90.38)	10 (9.62)		
Education level of parents, <i>n</i> (%)	Junior high school and below	500 (87.11)	74 (12.89)	5.361	0.069
	Senior high school/technical secondary school	223 (89.92)	25 (10.08)		
	College and above	91 (94.79)	5 (5.21)		
Have major life events occurred, <i>n</i> (%)	Yes	36 (36.73)	62 (63.27)	153.396	< 0.001
	No	778 (94.88)	42 (5.12)		
Academic record, <i>n</i> (%)	Excellent	38 (86.36)	6 (13.64)	5.378	0.146
	Good	246 (88.81)	31 (11.19)		
	Moderate	493 (89.64)	57 (10.36)		
	Poor	37 (78.72)	10 (21.28)		
Parental marital status, <i>n</i> (%)	Normal	622 (93.96)	40 (6.04)	64.313	< 0.001
	Divorced/widowed	192 (75.00)	64 (25.00)		
Only child, <i>n</i> (%)	Yes	633 (93.92)	41 (6.08)	69.467	< 0.001
	No	181 (74.18)	63 (25.82)		
Underlying disease, <i>n</i> (%)	Yes	698 (87.91)	96 (12.09)	3.306	0.069
	No	116 (93.54)	8 (6.46)		
Take regular exercise, <i>n</i> (%)	Yes	371 (93.92)	24 (6.08)	19.054	< 0.001
	No	443 (84.70)	80 (15.30)		
Close friends, <i>n</i> (%)	Yes	493 (94.63)	28 (5.37)	42.524	< 0.001
	No	321 (80.86)	76 (19.14)		
PHQ-9 (mean ± SD)		36.29 ± 3.59	42.59 ± 4.35	99.409	< 0.001
GAD-7 (mean ± SD)		32.16 ± 8.13	35.24 ± 6.78	52.650	< 0.001

PHQ: Patient Health Questionnaire; GAD: Generalized Anxiety Disorder.

conditions. A survey conducted in the United States found that more than one-third of students suffered from depression, while between 2007 and 2008, approximately 10 percent of college students were found to have considered suicide[17]. According to a study conducted in China in 2010, approximately 10% to 30% of university students were affected by mental health issues, which aligns with the findings of this research. According to the National Mental Health Development Report of China (2019-2020), 18.5% of college students tend towards depression, 4.2% have a high risk of depression, and 8.4% have an anxiety tendency. A sample survey by the former State Education Commission found that 20.3% of college students have psychological problems. The above research results are not entirely different to the results in this study.

Our findings show that parental' divorce/widowhood is a risk factor affecting college students' mental health [odds ratio (OR) = 5.628, (95%CI: 2.450-12.927)]. Family is the crucial environment for personal growth. The family atmosphere

Table 2 Independent variable assignment

Variables	Assignment
Education	Specialized = 0 Undergraduate = 1 Master = 2 Doctor = 3
Only child	No = 1 Yes = 0
Native place	Countryside = 1 City = 0
Have major life events occurred	No = 0 Yes = 1
Take regular exercise	No = 1 Yes = 0
Parental marital status	Normal = 0 Divorced/widowed = 1
Close friends	Yes = 0 No = 1
PHQ-9	Primitive value input
GAD-7	Primitive value input

PHQ: Patient Health Questionnaire; GAD: Generalized Anxiety Disorder.

Table 3 Logistic regression analysis of the influencing factors on college students' mental health

Variables	β	SE	Wald	P value	OR (95%CI)
Education			12.166	0.007	
1	-2.449	1.173	4.357	0.037	0.086 (0.009-0.861)
2	-2.507	0.725	11.957	0.001	0.081 (0.020-0.337)
3	-1.974	0.795	6.168	0.013	0.139 (0.029-0.660)
Native place	1.131	0.419	7.290	0.007	3.099 (1.363-7.043)
Exercise	-2.380	0.554	18.439	0.068	0.093 (0.031-0.274)
Parents' marriage	1.728	0.424	16.597	< 0.001	5.628 (2.450-12.927)
Non-only child	3.616	0.583	38.489	< 0.001	37.175 (11.862-116.500)
Significant events	3.706	0.498	55.318	< 0.001	40.709 (15.329-108.111)
No close friends	1.563	0.443	12.424	< 0.001	4.773 (2.002-11.384)
PHQ-9	0.530	0.061	48.915	< 0.001	1.537 (1.363-1.734)
GAD-7	0.055	0.025	4.014	0.045	1.051 (1.001-1.103)
Constant	-22.220	2.895	58.096	< 0.001	0.000

PHQ: Patient Health Questionnaire; GAD: Generalized Anxiety Disorder; OR: Odds ratio; CI: Confidence interval.

significantly relates to the formation of a person's personality[18] and impacts personal psychological development. A large number of research surveys have shown that family has a significant impact on students' mental health[19,20]. A good family environment is conducive to college students' physical and mental health[21], which can reduce the risk of abnormal mental health. An unhealthy family environment (*e.g.*, parental divorce or widowhood, family conflicts) can

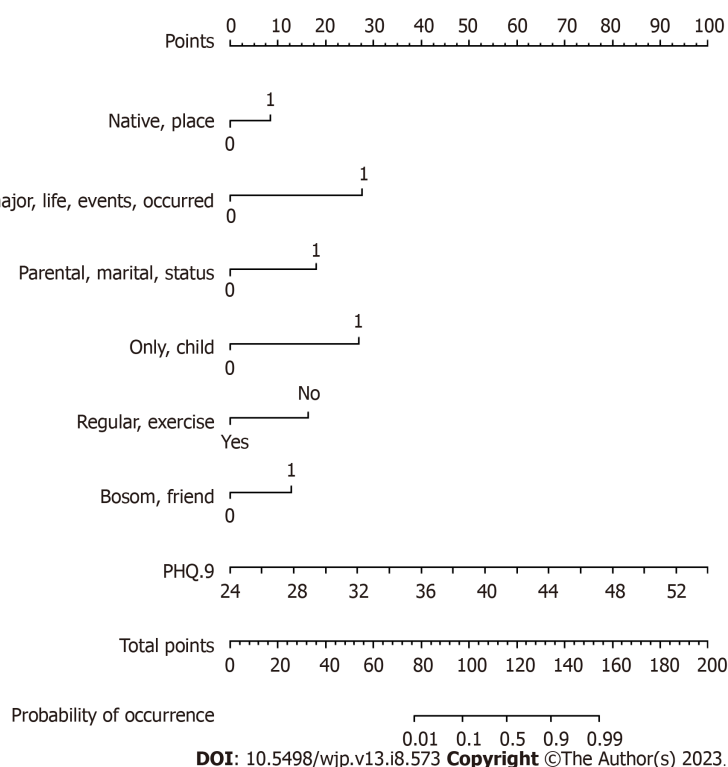


Figure 1 Risk nomogram prediction model of college students' mental health status. PHQ: Patient Health Questionnaire.

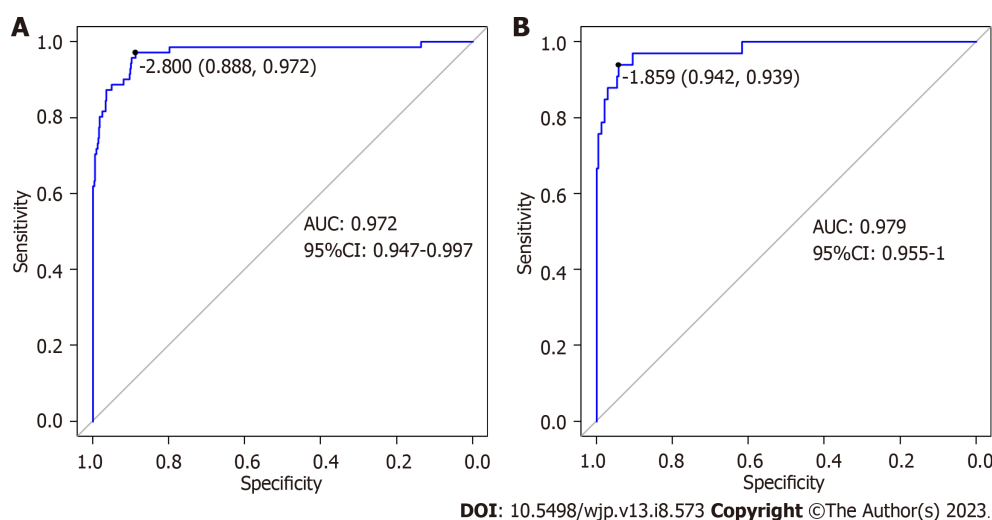


Figure 2 Column chart prediction model receiver operating characteristic curve. A: Receiver operating characteristic (ROC) curve of the training set; B: ROC curve of the validation set. AUC: Area under the curve; CI: Confidence interval.

easily lead to abnormal mental health in college students and even result in students forming bad personalities[22].

Similarly, studies have shown that parental separation is a risk factor for college students' mental health issues[23]. Domestic and foreign research shows that parental relationships affect children's growth and mental health. Paying attention to the influence of parental relationships on college students' mental health and providing improvement strategies can enable parents to play a role in promoting their mental health.

The present study showed that students from rural areas had an increased risk of mental health issues (OR = 3.099, 95% CI: 1.363-7.043). These results are consistent with those of Zhang and Qi[24]: In terms of psychological stress, college students from rural areas have a significantly higher risk than those from urban areas. These results were related to the rural family's economic environment and cultural atmosphere. Due to differences in resources, the economic conditions of college students from rural areas are worse than those from urban areas. In particular, students from rural areas studying in large cities, have higher living expenses. Some families do not have stable economic sources, and their economic deficiencies and life pressure make them prone to inferiority[25].

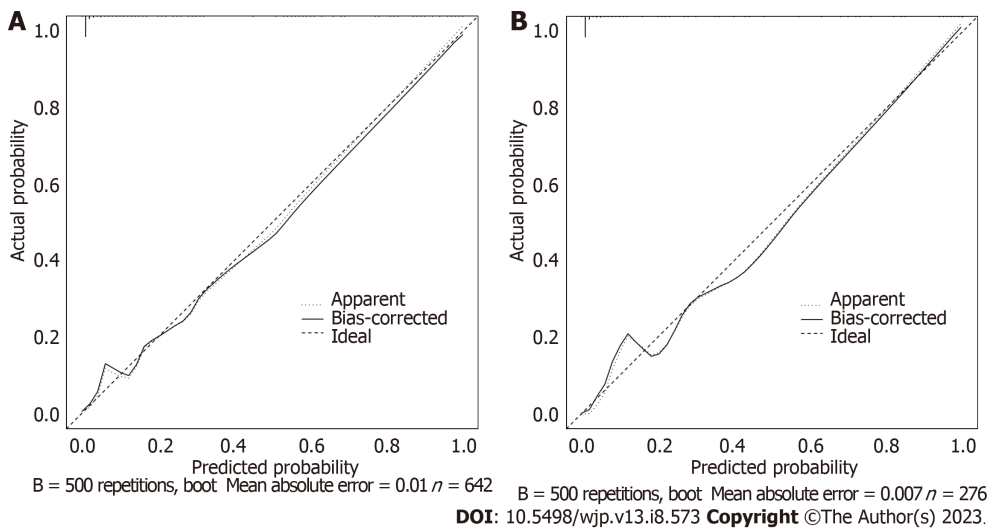


Figure 3 Column chart prediction model calibration curve. A: Calibration curve of the training set; B: Calibration curve of the validation set.

A significant correlation exists between critical life events and the psychological health of university students. In this study, major life events were a risk factor for mental health problems in college students (OR = 40.709, 95%CI: 15.329-108.111). Due to their limited exposure to social and real-life situations, college students are often confined within a sheltered campus environment, lacking sufficient life experience, exhibiting immature cognition, and having insufficient capacity to effectively cope with psychological stressors. When faced with adverse events or unforeseeable circumstances, such as natural disasters or family tragedies, their psychological resilience will be significantly challenged, potentially leading to psychological distress and impediments.

This study showed that regular exercise was a protective factor for mental health (OR = 0.093, 95%CI: 0.031-0.274). Relevant studies have found that moderate physical exercise has a more significant impact on mental health than non-exercise[26]. Fossati *et al*[27] found that participating in sports and exercise benefits an individual's mental state and can improve mood and quality of life. Herbert[28] found that physical activity and exercise help to promote the mental health of emerging adults such as college students. Huang[29] used the intelligent health system to assess the health status of college students before and after dance exercises. The results showed that the mental health of college students participating in dance exercises increased by 7.8%, indicating that sports and dance can promote physical and mental health. Thus, regular exercise can not only promote physical health but also help to improve mental health.

According to the findings of this investigation, a single child has a good mental health status, and being a non-single child is a risk factor for college students' mental health (OR = 37.175, 95%CI: 11.862-116.500). These results are quite different from existing research. Cheng *et al*[30] and others found that the incidence of emotional distress characterized by feelings of unease, apprehension, and low mood in non-single children was higher than that in single children in college and university students from Jinan, Shandong. The reason for this may be that the survey areas were different, and the results do not represent the mental health status of all college students. This may be because most of the single children come from cities, their parents have relatively high educational levels, and their family economic situations are better than those of non-single children. In the one-child family, parents will meet their wishes as much as possible, pay more attention to their education, and get help when they encounter problems. Most of the non-single children were from rural areas, with relatively poor economic conditions and a sense of inferiority[31]; because there are other siblings in the family, parents pay less attention to each child and do not pay attention to communication with their children, resulting in some non-single children encountering problems that cannot be solved and thus affects their mental health.

The findings from this investigation indicated a higher likelihood of psychological problems among college students who lack close friends compared to those who have intimate companions, and was a risk factor for college students' mental health (OR = 4.773, 95%CI: 2.002-11.384). The results by Li *et al*[32] proved this view. Research also shows that good friendships can help people alleviate negative psychology and provide emotional support[33]. The survey by Abraham and Sher[34], it was found that a solid interpersonal relationship was a protective factor against adolescent suicide, which was in line with the findings obtained from the current research: The existence of intimate friends was a protective factor for college students' mental health. In the face of difficulties and pressure, good friends will help and care about each other, which can reduce psychological pressure and is conducive to good mental health. Therefore, getting along with or having close friends is necessary.

The individual is central in resolving their psychological issues. First, they need to develop a scientific understanding of health, proactively foster positive psychological traits, gain accurate comprehension and acceptance of themselves, sustain a favorable emotional outlook, engage with loved ones and acquaintances as support systems when confronting challenges, and cultivate a fully-rounded and harmonious state of health. Secondly, strive to actively acquire and master the techniques for recognizing psychological issues and practicing self-regulation. Individuals should actively exercise, participate in social activities, enrich life experiences, increase social experience, and improve their ability to resist pressure.

Universities and colleges should integrate mental health education into their talent development paradigm by designing courses, organizing psychological quality training sessions, and establishing psychological counseling rooms, among other methods. This would enable college students to acquire knowledge on mental health, enhance their psychological adjustment abilities, and effectively address various psychological issues. In so doing, college students can access timely and effective assistance and guidance during any psychological crises that they may encounter.

Parents ought to lead by example by creating a favorable family environment that fosters effective communication and mutual respect while prioritizing the emotional well-being of their offspring. To achieve this, parents should eagerly listen to their children's emotional needs, encourage them to express themselves fully, and form a close-knit bond with them. They should also aim to foster home-school cooperation towards safeguarding the mental health of college-going students.

CONCLUSION

According to the results of this study, the current college students show a good state in mental health. By using the sample set data of the mental health risk prediction model and modeling and processing it, we provide an important reference for the prevention and intervention of college students' mental health problems. The data obtained from this research is singular, and sourced from a specific region with a limited sample size. As mental health depends on the environment, the representativeness of the sample may have specific limitations. Therefore, it is essential to enhance the model through prospective, multi-center studies with a sufficient sample size.

ARTICLE HIGHLIGHTS

Research background

Mental health problems in college students have become the focus of academic and social attention. The main reason is that college students are facing many pressures and challenges, such as academic pressure, social pressure, career planning pressure, and so on. In addition, the rapid development of modern society and the competitive environment have also brought new challenges and threats to the mental health of college students. Therefore, the study of college students' mental health has profound practical significance and theoretical value.

Research motivation

With the increasing pressure and challenges faced by college students, their mental health problems are becoming more and more serious, and the detection rate is increasing yearly.

Research objectives

Research on the mental health status of current college students and the construction of a risk prediction model can not only help us to understand the mental health problems faced by college students more comprehensively, but also provide a valuable reference for prevention strategies. It can also identify and intervene in mental health problems at an earlier time point to avoid further deterioration of the problem. In addition, future research in this field can also explore the relationship between mental health status and college students' learning, life, and interpersonal communication, and provide useful support for improving the overall quality and development of college students.

Research methods

The objective of the current research was to examine the mental well-being of 40874 undergraduate and graduate students enrolled in various higher education institutions within a particular geographical area. Additionally, using logistic regression analysis, the determinants that exert a substantial influence on the psychological health of university students were investigated. This model has high accuracy and interpretability. This study used R software to construct a risk prediction nomogram model, which enabled researchers to understand the influence and relationship of different variables more intuitively and improved the visualization and comprehensibility of the research. In summary, this study adopted a variety of advanced research methods, which had a wide range of reference values and application prospects.

Research results

The survey found that 11.3% of college students had psychological problems. The risk factors for college students' mental health include being from rural areas, non-single children, major life events, parents' marital divorce, infrequent exercise, and no close friends. The area under the receiver operating characteristic (ROC) curve in the training set was 0.972, the specificity was 0.888, and the sensitivity was 0.972. The area under the ROC curve in the validation set was 0.979, the specificity was 0.942, and the sensitivity was 0.939. These findings reflect the current mental health status of college students and is of great significance for the public to raise attention and awareness of mental health problems. It provides a basis for the government and schools to formulate mental health policies and help to formulate effective mental health management measures. At present, there are still some problems in the design and application of college students' mental health questionnaires, as some students could not understand or answer the questions in the questionnaire. More comprehensive and in-depth analysis and research are still needed to ensure the accuracy and reliability of the analysis.

and statistical results.

Research conclusions

From this research, we conclude that the current mental health status of college students is good. New methods used in this study include the use of a logistic regression model and the use of R software to construct a risk prediction nomogram model to explore the related factors affecting the mental health of college students. These methods can predict the risk factors related to college students' mental health more accurately and provide more effective intervention measures and prevention methods.

Research perspectives

Assessing and monitoring the mental health of college students can help schools and other institutions to better understand the needs of college students and take timely measures to prevent the emergence of mental health problems. Future research should focus on developing more effective assessment tools and establishing tracking and monitoring systems.

FOOTNOTES

Author contributions: Mao XL designed and performed the research and wrote the paper; Chen HM designed the research and contributed to the analysis.

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