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Influencing factors, prediction and prevention of depression in college students: A literature review

Liu X *et al*. Depression in college students

Abstract

The high prevalence of depression among college students has a strong negative impact on individual physical and mental health, academic development, and interpersonal communication. This paper reviewed the extant literature by identifying nonpathological factors related to college students' depression, investigating the methods of predicting depression, and exploring nonpharmaceutical interventions for college students' depression. The influencing factors of college students' depression mainly fell into four categories: biological factors, personality and psychological state, college experience, and lifestyle. The outbreak of COVID-19 has exacerbated the severity of depression among college students worldwide and poses grave challenges to the prevention and treatment of depression, given that the coronavirus has spread quickly with high infection rates, and the pandemic has changed the daily routines of college life. To predict and measure mental health, more advanced methods, such as machine algorithms and artificial intelligence, have emerged in recent years apart from the traditional commonly used psychological scales. Regarding nonpharmaceutical prevention measures, both general measures and professional measures for the prevention and treatment of college students' depression were examined in this study. Students who experience depressive disorders need family support and personalized interventions at college, which should also be supplemented by professional interventions such as cognitive behavioral therapy and online therapy. Through this

literature review, we insist that the technology of identification, prediction, and prevention of depression among college students based on big data platforms will be extensively used in the future. Higher education institutions should understand the potential risk factors related to college students' depression and make more accurate screening and prevention available with the help of advanced technologies.

Core Tip: This study reviewed the extant literature by identifying nonpathological factors related to college students' depression, investigating the methods of predicting depression, and exploring nonpharmaceutical interventions for depression among college students. The influencing factors can be categorized into students' demographic characteristics, college experience, lifestyle, and social support. For the prediction of depression, methods such as machine algorithms and artificial intelligence have been employed together with the traditional psychological scales. This study summarizes general and professional measures that can be taken for the prevention and treatment of college students' depression.

INTRODUCTION

The prevalence of depression among college students has gradually increased in recent years, even exceeding that of the general public, which has become a global phenomenon[1]. Mounting research has focused on the topic, and the consensus is that the high prevalence of depression among college students cannot be ignored. For instance, in Asia, a follow-up survey and analysis based on 1401 undergraduates in China over four consecutive years showed that approximately 20% to 40% of

undergraduates suffered from depression, anxiety and stress to different degrees, and approximately 35% of them had higher depression levels than the normal population[2]. An online survey based on 7,915 freshmen students at Hong Kong University in China showed that 21%, 41% and 27% of individuals had moderate or higher levels of depression, anxiety and stress, respectively, far exceeding the average in the general population[3]. The median prevalence rate for depression among 15,859 college students in six ASEAN countries (Cambodia, Laos, Malaysia, Myanmar, Thailand and Vietnam) was 29.4%, and 7% to 8% of students committed suicide; despite the high prevalence of mental illness, their willingness to seek professional help was relatively low[4]. Among 642 college students in Saudi Arabia, the proportions of moderate depression, anxiety and stress were 53.6%, 65.7% and 34.3%, respectively[5]. In Africa, among 1,206 Nigerian college students, 5.6% had mild depression, and 2.7% suffered severe depressive disorder[6]. In North America, 53% of 1,455 American college students reported that they had experienced depression since the beginning of college, and 9% said they had considered suicide since the beginning of college[7]. Thirty percent of 7,800 Canadian undergraduates reported that their psychological stress increased, and the degree of depression was significantly higher than that of the general population[8]. In Europe, more than one-third of college students from three higher education institutions in the UK suffered from long-term mental health diseases, the prevalence rate of which was higher than the average level of national surveys, and the scores of the eight dimensions of mental health, measured by the MOS 36-item short-form health survey, were all significantly lower than those of local peers aged 18 to 34[9]. In Oceania, 21.8% of 751 Australian college students reported depression, and their depression scores were higher than the standard scores of the general Australian population[10].

The global outbreak of the COVID-19 pandemic in 2020 brought in additional pressure and challenges for the prevention and treatment of depression among college students. Many reports worldwide voiced that college students had a greater probability of struggling with higher levels of depression after the pandemic. The data show that after the outbreak of the pandemic, acute stress, anxiety, and depressive

symptoms were widespread among Chinese college students, and the incidence rate was significantly higher than before[11]. The prevalence rates of moderate depression and suicide-related symptoms among 212 Japanese college students were 11.7% and 6.7%, respectively[12]. Among 2,031 American college students, 48.14% suffered from moderate to severe depression, 38.48% experienced moderate to severe anxiety, 18.04% had suicidal thoughts, and 71.26% reported that their stress/anxiety level increased during the pandemic[13]. More than a quarter of Swiss university students had depressive symptoms during the pandemic, which was much higher than that of the general population and higher than that before the pandemic[14].

The transition from high school to university is full of tension and adaptation. It is a critical period for the shift from late adolescence to adulthood or emerging adulthood, which is neither adolescence nor young adulthood but theoretically and empirically distinct from both periods[15]. Arnett stressed that this is a stage full of self-exploration, instability, possibility, self-focus, and something in between[16]. At this phase, individuals will face the challenges of identity and role transformation and more diversification and complexity from families and institutions. Specifically, compared with middle schools, universities put forward higher requirements for freshmen's independence and self-regulation, such as the independence of living in a new place, the autonomy of learning patterns, and the complexity of social networks. However, confronted with these challenges, college students entering the campus for the first time often wander between independence and dependence. On the one hand, they are eager to enjoy new freedoms; on the other hand, it is difficult to eliminate their attachment and economic dependence on their parents; thus, they are often in a state of "pseudoindependence"[17].

In summary, compared with teenagers and adults, college students are the key group at significantly higher risk of poor mental health. A series of factors, including family, college, studies, and social interactions, are likely to induce college students' depression. However, few publications have reviewed the literature on risk factors for college students' depression. Given that most studies examined individual risk factors

based on samples from a certain country or region, this paper reviewed the extant literature related to college students' depression and aimed to systematically present the nonpathological factors, predictions and nonpharmaceutical interventions for college students' depression to provide a reference for stakeholders worldwide.

NONPATHOLOGICAL INFLUENCING FACTOR OF DEPRESSION

The related factors can be roughly divided into four categories: biological factors, personality and psychological state, college experience, and lifestyle. The literature review presented the specific risk factors under four categories in Table 1. Subsequently, this paper explained certain factors with controversial research conclusions.

[Table 1 about here.]

Sex. Some studies have asserted that the risk of depression in female college students is significantly higher than that in male students[24,26,40,41]. The possible mechanism lies in physiological differences between the sexes (such as genetic vulnerability, hormone, and cortisol levels), differences in self-concept, and different role expectations from society lead to different emotional responses and behavior patterns. Females are more likely to internalize their negative feelings, whereas males resort to externalizing behaviors such as smoking and alcoholism[42-44]. However, some analyses did not find significant sex differences[28, 45, 46]. Other studies have shown that men have a higher prevalence of depression[20,47]. This may be ascribed to their conservative attitudes toward mental health counseling and treatment under certain social expectations. For instance, women are more help-seeking than men and therefore tend to have more diagnoses and treatment. In particular, gregarious women are more likely to discuss their difficulties with others, such as family and friends, as a form of coping. Nevertheless, considering that societal expectations for men might be different, with those who express vulnerable emotions being regarded as weak, the depressive

symptoms of men may manifest as anger and excessive indulgence in smoking and drinking, which are more acceptable masculine expressions in society[43,44].

Year of study. Most studies have found significant differences in the depression level of college students in different years of their education, although some found the difference to be insignificant[28]. Some research has suggested that undergraduates with lower grades suffer more from depression, which can be attributed to separation from relatives and friends, social adaptation, academic pressure, and increased investment in social activities. A survey of Chinese students showed that the highest scores for depression, anxiety and stress all appeared in the first three years of college, and students' mental health status was relieved in the fourth year with the passage of time[48]. A survey of medical students in Saudi Arabia found that students' depression levels continued to rise from the first year of enrollment, reached maximum intensity in the third year, and then dropped significantly with graduation in the last year[22]. However, other studies found that compared with other undergraduates, senior students had a higher risk of depression. The graduation year is a critical period for individuals to further their studies or go into society, and students are faced with many new stressors, such as graduation pressure, pressure from grades and applications to other institutions, difficulties in future career planning and employment discrimination in the labor market[49]. Compared with undergraduates, postgraduates may be exposed to greater pressure in obtaining financial security, stable employment, getting married and other aspects of life, which results in a higher risk of depression[19,41].

Lifestyle. The depression issues of college students can largely be attributed to their lifestyles. First, the lack of regular physical activities increases the risk of depression[11,14], particularly for individuals whose amount of weekly physical activity fails to meet the standards of the World Health Organization[20]. Second, substance abuse, such as excessive smoking, alcohol abuse[6,12,21], or alcohol intake[33], can cause depressive disorders, and it should be noted that their relationship might be bidirectional. Studies have shown that individuals with depression are more likely to drink obsessively to relieve their negative emotions due to their poor self-control, which

will in turn trap them in a vicious cycle between excessive drinking and depressive disorders[32]. Third, unhealthy sleeping habits such as daytime sleepiness[20,34], poor sleep quality[21], and short[35] or long sleep duration[10] may lead to depressive symptoms. Fourth, unhealthy nutritional habits are also among the crucial factors that are strongly correlated with depression[36]. From the perspective of dietary structure and nutritional habits, individuals with depression often report excessive intake of high-fat snacks and margarine/butter/meat fat and inadequate intake of fruits, vegetables, and lean protein[30]. Overeating[14] and skipping breakfast[10], especially for males, are also related to depressive disorders.

Network usage. Relevant studies have indicated that depression in college students is associated with their time spent on the internet[50,51]. Those who suffer from internet addiction and dependence are more likely to struggle with depression[52], and phubbing (a portmanteau of the words "phone" and "snubbing") has been proven to be a mediator of the relationship between depression and problematic internet use[53], mainly focusing on social networking and entertainment[54].

Social software. Some researchers believe that social software, as a complementary mode of providing social support, can provide more help for people with low social support, thus reducing the occurrence of depression[55]. However, there is increasing recognition that social networks, especially excessive use of social media, are closely related to depression[56-60] Regarding the possible contributing factors, first, individuals who frequently use social software are more likely to have a fear of missing out, and they are always worried that they will miss some important information if they do not refresh the social platform dynamics frequently. This persistent social anxiety will increase the risk of depression[61]. Second, college students who are addicted to social media are more likely to have a comparison mentality when checking the status updates of others on social network platforms, especially when they feel that others' lives are better than their own, which can result in symptoms of depression[62]. Third, it is quite impossible for those who struggle with depressive disorders to establish satisfactory interpersonal relationships in virtual space since they usually maintain poor

relationships in the real world. The lack of expected support from social networks undoubtedly aggravates their depression[63].

In addition, because the COVID-19 pandemic has aggravated the depression of college students worldwide, we further analyzed the influencing factors of college students' depression against the background of the COVID-19 pandemic, apart from the general factors mentioned above. (1) Given that COVID-19 is highly contagious and uncertain, the higher risk of becoming infected with COVID-19 is closely related to individuals' level of depression. Research has indicated that individuals who live in high-risk areas for COVID-19, have close contact with the COVID-19 virus, or have acquaintances or relatives infected with COVID-19[19,41] often have a higher prevalence of depression. (2) Considering that the internet serves as the main channel for college students to obtain information about COVID-19, those who browse the internet for a short time will not suffer from too much anxiety because of the small amount of information they receive. Meanwhile, students surfing the internet for a long time will be able to obtain more accurate details about COVID-19, which can prevent misunderstanding relevant information. Nevertheless, individuals with shorter browsing times often have a higher risk for depression given that they may be easily misled by the rumors and have limited time to verify the authenticity of relevant information[64]. (3) Academic stress increases the degree of depression of college students with the closure of schools, the challenges of online courses and the risk of graduation delay[13,65]. (4) Financial pressures include the impact of the pandemic on family economic resources[49] and the increasing uncertainty of individuals about future employment[13]. (5) Environmental changes, home study, self-isolation, isolation from relatives and friends, decreased exercise frequency, uncertainty of school reopening, regular temperature measurement, wearing masks for a long time, cancellation of package deliveries and take-out supplies and other forced changes in daily study and living habits all increase the risk of depression among college students[13,49]. (6) There is less family support, social support and deteriorating family relations[65]. (7) Social

confidence wanes. Research has shown that the prevalence of depression also increases when individuals lack confidence in the government[66].

PREDICTING DEPRESSION

Traditional depression prediction methods are based on various self-rated psychological scales, such as the 21-item Depression, Anxiety and Stress Scale (DASS-21) and the Self-rating depression scale (SDS). A growing body of research on the reliability and validity of the DASS-21 scale has been published from throughout the world (such as Britain, Portugal, the Netherlands, Italy, the United States, and Nepal), all of which show that the DASS-21 is a mature tool that can accurately measure the symptoms of depression, anxiety and stress in adult clinical and nonclinical samples and identify and screen people at high risk of depression[67-70]. Similar to the DASS-21, the prediction reliability and validity of the SDS scale for depression have also been confirmed and recognized by relevant studies[71-73]. These are screening tools, and when elevated scores are detected, further evaluation is needed by a clinician. Moreover, the measurement often needs to rely on the patient's own active consultation and cooperation, which is costly, time-consuming, and inaccurate, and there is a risk of social stigma for patients. In recent years, with the progress of science and technology, a series of more advanced methods of depression risk prediction and identification, such as machine learning and artificial intelligence, have emerged, which can deeply learn all types of social and behavioral characteristics of people with potential mental illness risk based on big data and then accurately simulate, identify and predict who they are. Typical methods include support vector machines, decision trees, naïve Bayes classifiers, K-nearest neighbor classifiers and logistic regression[74]. More specifically, support vector machines are applied to classify handwritten digits and organize cancer tissue samples using microarray expression data[75,76]. Decision trees serve as a hierarchical classifier, employing certain rules to divide the predictor space. The naïve Bayes classifier is based on Bayes' theorem and is employed to predict class membership probabilities. K-nearest neighbor classifiers are instance-based learning

classifiers that compare a new datapoint with the k nearest sample datapoints, regarding the class with the nearest neighbors to the new datapoint as the class of the datapoint. Logistic regression, as a probabilistic linear classifier, directly estimates class probabilities with the logit transform[74].

The gait feature analysis method based on machine learning has been developed as a supplementary tool to identify depression among college students. Relevant research found that the gait of depressed and nondepressed college students showed significant differences. The specific gait performance of depressed patients included reduced walking velocity, arm swing, vertical head movement and stride length, increased body sway and a slumped head posture. When the above series of features were applied to classifiers with different machine learning algorithms, the accuracy of depression screening and recognition reached 91.58%[77]. A study collected 121 campus behaviors of college students, including personal basic information, academic achievements, poverty subsidies, consumption habits, daily life, library behaviors, and eating habits, and found that 25 campus behaviors are related to depression, such as failing exams, having bad eating habits, increasing night activities, decreasing morning activities, and seldom participating in social activities (such as eating with friends). On this basis, a depression recognition method was developed by combining machine learning algorithms[78]. There is also research and development of a machine learning method to identify depression based on college students' smartphone and fitness tracker data (e.g., Bluetooth, calls, location, campus map, phone usage, steps, sleep), which extracts many features that can effectively identify depression, such as long-term inactivity and restless sleep at night; the recognition accuracy of this method for college students' depression can reach over 80%[79].

In addition, it is worth noting that social software has increasingly become a nonpathological risk factor for depression among college students. Addiction to social software is often more likely to induce depression, while college students at high risk of depression are more inclined to vent their negative emotions and relieve stress on various online social platforms. In this way, social network behavior analysis was

developed based on machine learning as another effective way to identify and predict depression[80,81]. Through mining, emotion analysis and emotion recognition of personal user information data on social network platforms, we can capture the abnormal behavior patterns of people with depression, among which the most frequently used communication methods are text, emoticons, user log-in information and pictures. The selected research usually uses classic off-the-shelf classifiers to analyze the available information and combines words, such as National Research Council Canada (NRC) Word-Emoticon Association Lexicon, WordNet-Affect, Anew, and Linguistic Inquiry and Word Count (LIWC) tool. It is challenging to analyze the combination of temporal information and different types of information[82]. For example, some studies have conducted text analysis on the Sina Weibo data of Chinese college students. First, the behavioral differences between depressed and nondepressed individuals in language style, emoji usage, number of Weibos, followers and so on were obtained. Then, a deep neural network was applied to feature extraction and dimension reduction for college students with depression, and input data suitable for the classifier were constructed. Finally, a deeply integrated support vector machine (DISVM) was introduced to classify the input data, and more stable and accurate depression identification was realized[83]. Some studies collected historical behavior data of American college students using Google search and YouTube during the COVID-19 pandemic and found that there were strong correlations between depression and the following online behavior changes: long use sessions (multiple comprehensive activities with short time intervals), more online activities in the middle of the night or even staying up late, and searching for more authentic and realistic topics related to work, money or death, which verifies the feasibility of building a machine learning model based on individual behavior signals to predict college students' depression[84].

Generally, machine learning has been widely used in a series of mental health risk predictions about college students' depression, stress[85] and suicidal behavior[86,87]. Big data brings many benefits to the prediction of psychological states by reducing the subjectivity of human judgment or human operations to a certain extent and relieving

the concerns of patients about possible social stigma and discrimination. In other words, big data and machine learning result in no prejudice in predictions. Thus, confirming depression through data and behavioral performance may be the developing trend in identifying and predicting depression among college students and an even broader population in the future. However, issues such as data privacy and data protection are unavoidable. The government needs to set stricter privacy protection policies, while a more extensive collection of personal data needs to be confirmed and approved by the collectors.

NONPHARMACEUTICAL PREVENTION OF DEPRESSION

Both general and professional measures for the prevention and treatment of depression were explored in this study. The former emphasizes the importance of multisubject participation in the prevention and treatment of depression among college students, while the latter focuses on measures with the theoretical support of professional disciplines such as psychology.

General intervention measures

The general interventions are summarized in Table 2 and can be coarsely categorized into support from family, interventions by colleges and universities, cultivation of personal lifestyles, and resilience therapy.

[Table 2 about here.]

High level of family support. A high level of family support can be used as a buffer against the influence of a high-stress reaction to prevent the development of depression[91]. In a study of 62 patients who recovered from depression, a high level of perceived emotional support from their families indicated that family support, especially emotional support, was very important for the relief and even rehabilitation of depression[92]. However, it should be noted that family support and perfect family functioning depend more on objective characteristics related to family socioeconomic

status, such as parents' level of education[93]. In addition, some studies have found that the role family support plays in the prevention and treatment of depression also depends on the levels of perceived stress reactivity of individuals. Specifically, family emotional support can significantly alleviate the symptoms of depression when the perceived stress reactivity is low, but when the individual shows a high level of the perceived stress response, the effect of family emotional support in preventing depression will be greatly reduced[94].

The intervention from colleges and universities. Prior literature has shown that the faculties, peers, and social clubs on campus can help alleviate the negative effects of online games on depression. Students may seek social support from their teachers, peers, or psychological counseling centers to prevent addiction to online video games that may lead to depressive disorders[38]. Therefore, colleges and universities should build mental health services involving faculty, students, and psychological counseling centers. In addition, some studies have indicated that the implementation of related courses and projects in universities, such as resilience programs (including goal-building, mindfulness, and resilience skills), might be effective in improving college students' mental health[95].

Cultivation of healthy lifestyles. Apart from external support from family and intervention by higher education institutions, the prevention of depression also needs to rely on the patient's own efforts. Studies have shown that healthy lifestyles, including proper physical exercise, healthy sleep and diet, and regular sun exposure, can help prevent or reduce the occurrence of depression in college students[96]. For instance, students with a consistent sleep schedule and sufficient sleep duration are less likely to suffer from depression. Meanwhile, regular sun exposure aids in the synthesis of vitamin D in the body, which is crucial to release fatigue and change the negative moods that individuals with mild or moderate depression may experience[46]. Proper physical activities are also important for stress and depression relief among college students[97,98]. Additionally, improving diet and overall nutrition is also an effective way to treat depression[99]. In particular, eating breakfast on time helps reduce the risk of

depression[46]. Certain nutrients, including zinc, magnesium, B vitamins, and cooking fats, have also been proven to be associated with depressive symptoms[100-102]. Therefore, colleges and universities can help prevent the occurrence of depression in college students by providing a regular diet with adequate intake of vitamins and nutrients[103].

Resilience therapy. Some research has shown that resilience therapy can help individuals maintain mental health in the face of negative emotions and stressful events, thereby reducing the occurrence of depression[104]. Others have also found that it can reduce depressive symptoms by modulating the effects of timing and sleep quality on depression[105].

Professional intervention measures

Cognitive behavioral therapy (CBT), which aims to change individual thoughts and behaviors, has been the most widely used treatment method for depression thus far[106-110,113-115]. Mindfulness intervention programs[111] based on cognitive behavioral therapy and dialectal behavior group therapy[112] can effectively alleviate the depressive symptoms of college students.

In recent years, a growing number of online technologies have been applied to the treatment of depression among college students thanks to the rapid development of internet technology and mobile terminal devices [116-120], and some of the technologies were even skillfully combined with behavioral cognitive therapy[121,122]. For example, there are many apps that incorporate elements of CBT and mindfulness. A study from Switzerland revealed that apps such as MoodKit, MoodMission and MoodPrismying can successfully deliver ecological momentary interventions (EMIs) based on cognitive behavioral therapy principles to users through smartphones, thereby improving their well-being and effectively reducing the symptoms of depression. The study also noted that EMI has been generally accepted by users of different ages, sex, educational backgrounds and occupations and is expected to provide scalable global mental health solutions[123]. Compared with behavioral cognitive therapy and online interventions, the efficacy of traditional educational/personalized feedback interventions in the past has

been slightly inferior. Some projects have evaluated the effectiveness of mailing personalized standardized alcohol surveys for college students' depression prevention, but unfortunately, there is no obvious improvement[124].

LIMITATIONS

Limitations of this study include the following. First, this paper analyzed relevant literature written in English, but research in other languages, such as Chinese, Japanese, German, and Italian, were not included. Second, the paper is a narrative review of extensive studies including the influencing factors, prediction, and prevention of depression in college students. We did not undertake explicit methods such as systematic reviews, nor did we involve substantial clinical results and corroborate the evidence in prior literature such as retrospective reviews. The study merely presents studies in the pertinent field by summarizing their main conclusions, which cannot be directly applied to clinical treatment.

CONCLUSION

This paper reviewed the extant literature by identifying nonpathological factors related to depression among college students, investigating methods of predicting their depressive symptoms, and summarizing nonpharmaceutical interventions. The nonpathological related factors of college students' depression mainly fell into four categories: biological factors, personality and psychological state, college experience, and lifestyle. The outbreak of COVID-19 exacerbated the severity of depression among college students worldwide and posed grave challenges to the prevention and treatment of depression, given that the coronavirus spread quickly with high infection rates, changing the daily routines of college life and creating financial stress, academic stress, and long-term home isolation. Regarding prediction of vulnerability to depression, machine algorithms and artificial intelligence based on big data have emerged in addition to the commonly used psychological scales. A series of big data, such as text, pictures, video and audio, based on individual social network behaviors

was widely discussed and applied to identify and predict college students' depression. Regarding preventive measures, both general measures and professional interventions were discussed for the prevention and treatment of college students' depression, which required not only help from family, professionals, and institutions (cognitive behavioral therapy and online therapy) and society but also the individuals themselves through the cultivation of healthy habits.

Technology based on the internet and big data platforms will become more widely used in the future to identify, predict, and prevent depression among college students. Higher education institutions should clearly understand the potential risk factors related to college students' depression and employ advanced technology for more accurate screening and prevention. They should also work on increasing access to resources and clinical support considering the common difficulties in making appointments and long-term waits for psychological consultation.

Furthermore, this paper proposed three prospects for the future development of nonpharmaceutical interventions for college students' depression. First, the risk of stigma should be minimized. Many traditional precautionary measures are used to help students identify whether they suffer from depression, including e-mail, posters, campus activities, pamphlets, and first aid training courses about mental health. However, these measures may result in further concerns about the risk of stigmatization and psychological worries of students[125]. Therefore, in the future, we should avoid stigmatizing issues in the prevention of depression among college students and pay more attention to personalization and privacy in the development and application of precautionary measures. Second, the importance of general measures for the prevention and treatment of college students' depression should be combined with professional interventions such as cognitive intervention therapy and other evidenced-based treatment. A meta-analysis showed that apart from cognitive behavioral therapy and mindfulness-based interventions, other measures, such as art, exercise, and peer support, are also effective in relieving depressive symptoms in college students[126].

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