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Associations Between Psychological Stress and the Risk of First Onset of Major Depression Disorder: Results from a Longitudinal Study in 6,985 Chinese First-Year Students

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Background: Youth and young adults have a high prevalence of major depressive disorder (MDD). Limited longitudinal research has explored the relationship between different dimensions of psychological stress and MDD. This study aimed to estimate the effect of psychological stress on the risk of first onset MDD in a sample of Chinese freshmen.

Methods: Using a longitudinal design, 8079 Chinese first-year students were recruited at baseline, and 6985 were followed up one year later. The Psychological Stress Scale for College Students was utilized to evaluate the levels of psychological stress. MDD was evaluated using the Chinese version of the Composite International Diagnostic Interview (CIDI-3.0). Logistic regression modeling was utilized to estimate the associations between dimensions of psychological stress and the risk of MDD.

Results: Two dimensions of psychological stress, namely learning stress (OR=1.05, 95% CI:1.01–1.09, *P*=0.017) and economic stress (OR=1.11, 95% CI:1.04–1.19, *P*=0.001), were significantly associated with the risk of MDD. Other dimensions of psychological stress (specify family stress, interpersonal stress, intimate relationship stress, employment stress and appearance stress) were not associated with MDD.

Conclusion: Psychological stress, especially learning and economic stresses, could increase the risk of MDD in university students. These factors should be incorporated into mental health prevention and intervention programs at universities to reduce the risks of MDD.

Keywords: major depressive disorder, psychological stress, longitudinal study, freshmen

Introduction

Major depressive disorder (MDD) is a leading global disease burden and is projected to be a major contributor to disability by 2030.[1–3] MDD is diagnosed when an individual experiences at least five specific symptoms over a two-week period, with at least one symptom being either a depressed mood or a loss of interest or pleasure. Other symptoms include significant weight changes, sleep disturbances, fatigue, feelings of worthlessness, and recurrent thoughts of death.[4] Compared to older individuals, the prevalence of MDD is higher in youth and young adults.[5–7] MDD is one of the most prevalent mental health disorders among college students, significantly impacting their academic performance,

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social interactions, and overall well-being, and even increasing their suicidal thoughts.[8–10] MDD is much more prevalent among medical students, with prevalence as high as 25%, as medical schools have the highest levels of psychological stress and burnout.[11,12] Therefore, preventing the first onset of MDD in this population is essential to reduce the associated disease burden. There are many factors affecting MDD in university students, eg, perceived parenting styles, self-efficacy, physical condition and social support.[13–16] However, the influence of psychological stress on the first onset of MDD is rarely studied.

Psychological stress is a state of psychological tension that occurs when an individual is confronted with stressors (such as daily life events, sudden traumatic experiences, and chronic tension) and perceives that they are unable to adapt to the environmental demands.[17,18] In today's fast-paced social life and increasingly competitive job market, college students are facing more and more psychological stressors, and their psychological stress and mental health have become the focus of attention of all sectors of society. Research has shown that medical students experience much higher levels of psychological stress than students in other disciplines,[19] because medical students face multiple stressors such as the demanding nature of medical education, constant academic evaluations,[20] patient illness and death.[21]

Previous studies have revealed that psychological stress is positively associated with depression. For instance, a study from Egypt found that medical students, who are subject to high levels of academic and clinical stress, exhibit elevated levels of depression and anxiety.[19] Similarly, a survey of graduate students in Traditional Chinese Medicine found a significant positive correlation between psychological stress and depression. Their findings suggest that academic pressures, coupled with personal and professional stressors, play a crucial role in the development of depressive symptoms among this group.[22] However, these studies were cross-sectional studies, which could not examine the causal relationship between psychological stress and MDD. The evidence on this relationship remains to be insufficient, and our understanding of the effects of specific psychological stress on the risk of MDD in university students is limited. Early intervention programs may be enhanced by identifying which dimensions of psychological stress confer the greatest risk to MDD in young people. Therefore, the current study aims to assess the effects of specific psychological stress on the risk of first-onset MDD by analyzing longitudinal cohort data from Chinese first-year college students.

Materials and Methods

Study Population

From April 2018 to October 2019, a longitudinal study was carried out in first-year students at Jining Medical University and Weifang Medical University (now renamed as Shandong Second Medical University) in Shandong Province, P.R. China. Jining Medical University is located in Jining and has satellite campuses in Rizhao. These students were from different majors. Their family residence encompassed a variety of geographic areas, ranging from urban cities and rural counties to villages.

Data Collection

The baseline data was collected from April to October 2018 (T0) on three campuses. The follow-up data was collected from April to October 2019 (T1). There were a total of 9,928 first-year students invited to participate in the baseline cohort through cluster sampling. Among them, 8,079 students (81.4%) consented to take part and completed baseline survey. From April 2019 to October 2019 (T1), the first annual follow-up survey was conducted, with 7,550 students (93.5%) participating in this survey. Excluding participants with MDD (n = 437) at T0, 6985 participants were included in this analysis.

The baseline and follow-up data were collected in the libraries on the three campuses, utilizing a computerized self-administration system that provided identical voice instructions for every question. The survey system included logical checks and jumps. A total of 365 computers in the libraries were used for the survey. Participants were grouped and given a set amount of time to complete the survey. All participants completed the questionnaire independently and anonymously, with confidentiality maintained by using unique ID numbers generated during a baseline survey. To ensure data integrity, each physical address could be used only once to submit the questionnaire. Multiple submissions from the same device were automatically rejected. A team of six trained investigators answered the participants' questions. Upon completion of the survey, participants' responses were uploaded directly to a local server at Jining Medical University. This system ensured that data was consistently collected across different locations and times, and no discrepancies in data

were introduced by device reuse or participant identification issues. The Health Research Ethics Committee of Jining Medical University approved this study.

Measurements

Psychological Stress

Psychological stress levels were measured with the Psychological Stress Scale for College Students.[18,23] This scale is comprised of 21 self-reported stressors and is categorized into 7 dimensions: learning stress, family stress, economic stress, interpersonal stress, intimate relationship stress, employment stress, and appearance stress. The 21 questions contained in the scale are in Appendix I (Supplementary material). For instance, participants were asked if they agreed with the following statement: "In the past year, you often felt restless while studying". The answer to each question is either "yes" or "no". If the answer is "yes", participants were requested to evaluate the influence of that event on their life on a 5-point Likert scale: (0) no effect, (1) slight effect, (2) moderate effect, (3) severe effect, (4) extremely severe effect. The scores of the questions were added to calculate the total score of each dimension. The Cronbach's α of the Psychological Stress Scale for College Students was 0.95 and the split-half reliability was 0.90.

MDD

MDD was assessed using the Composite International Diagnostic Interview (CIDI 3.0), based on the criteria outlined in the DSM-IV.[24,25] The Chinese version of MDD had a sensitivity of 71.1% and a specificity of 89.0%, and the test-retest reliability was 0.74.[24,25] The lifetime MDD was assessed at T0 and MDD in the past year was measured at T1. MDD was defined as meeting the diagnostic criteria for a major depressive episode, excluding any history of a manic or hypomanic episode, as evaluated by the CIDI-3.0.

Baseline Depressive Symptoms

The Beck Depression Inventory, a self-report rating inventory consisting of 21 items, was used to assess *depressive symptom* at baseline.[26] This inventory measures typical attitudes and symptoms associated with depression. There is high internal consistency with the BDI. In psychiatric and non-psychiatric populations, the BDI has an alpha coefficient of 0.86 and 0.81, respectively.[27] In Chinese university freshmen, the alpha value was 0.85.[28] In this study, the Chinese BDI had a Cronbach's α of 0.91. Participants' depression symptoms in the previous 2 weeks were evaluated using the Chinese edition of BDI at T0.[28] Scores ranged from 0 to 63. Higher scores indicate more severe depression. The severity of depression is classified as: 0–13 (none), 14–19 (mild), 20–28 (moderate), and 29–63 (severe).

Baseline Anxiety Symptoms

The Beck Anxiety Inventory (BAI) was used at T0 to measure anxiety symptoms. The BAI contains twenty-one items and each item is scored on a four-point scale: (1) "None", (2) "Mild", (3) "Moderate", (4) "Severe". It is generally considered that participants with a BAI total score of 45 or higher suffer from general anxiety disorders. The Cronbach's α of the Chinese version BAI was 0.95,[29] while in the current study, it was 0.93.

Demographic Characteristics

A self-prepared general information questionnaire was used to obtain demographic characteristics of freshmen, such as gender, age, major, location (rural or urban) and family structure (one-child or more children).

Statistical Analysis

To calculate the 1-year incidence of MDD, the number of new cases of MDD at follow-up was used as the numerator, and the number of participants without a history of MDD at baseline was used as the denominator. The analysis of difference among categorical variables was conducted using the Chi-square test ($\chi 2$). The risk of developing MDD was modeled as the dependent variable in a logistic regression. The odds ratios for MDD, given the presence of psychological stress events, were calculated from the logistic regression coefficients, controlling for all the covariates mentioned above. Our final models were determined by stepwise logistic regression, including forward and backward steps, in order to address collinearity issues among independent variables. The statistical analysis was conducted using SPSS 28.0 Version. $P< 0.05$ was considered statistically significant.

Results

Table 1 showed the characteristics of the participants. Out of the 6985 students who did not have MDD at baseline, 2750 (39.37%) were male and 1852 (26.51%) were non-medicine majors. There were 4258 (61.54%) students who were not from one-child family and 2554 (36.56%) came from urban regions. Among these freshmen, the 1-year incidence of MDD was 2.67% (95% CI: 2.33%-3.05%).[30]

The differences between students with and without MDD were listed in Table 1. There was significant difference in the following variables: baseline depressive symptoms ($\chi2$=80.53; P<0.001), baseline anxiety symptoms ($\chi2$=4.74; P=0.029), baseline mean scores of learning stress (P<0.001), interpersonal stress (P<0.001), economic stress (P<0.001), intimate relationship stress (P<0.001), employment stress (P<0.001), family stress (P<0.001), appearance stress (P<0.001), and total psychological stress score (P<0.001) (Table 1).

Univariate logistic regression modeling showed that all dimensional scores of psychological stress were significantly associated with MDD (Table 2). In multivariate analysis, only learning stress (OR=1.05, 95% CI:1.01–1.09) and economic stress (OR=1.11, 95% CI:1.04–1.19) were significantly associated with MDD, controlling for the effects of potential confounding factors (Table 3). The results suggested that participants with higher learning stress and economic stress scores, were more likely to have had MDD over 1 year compared to others.

Table 1 Demographic Characteristics of 6985 First-Year University Students at 1-Year Follow-Up

Variables	Non-MDD (n,%)	New MDD (n,%)	Total	χ^2/τ	*P*
Gender					
Male	2695(98.00)	55(2.00)	2750	1.40	0.235
Female	4132(97.57)	103(2.43)	4235		
Age (mean ± SD)	18.38±0.86	18.29±0.89	6985		0.856
Residence					
Urban	2495(97.69)	59(2.31)	2554	0.04	0.837
Rural	4332(97.77)	99(2.23)	4431		
One-child family					
No	4161(97.72)	97(2.28)	4258	0	0.969
Yes	2600(97.71)	61(2.29)	2661		
Major					
Non-medicine	1809(97.68)	43(2.32)	1852	0.04	0.840
Medicine	5018(97.76)	115(2.24)	5133		
BDI score					
No (0–13)	6440(98.07)	127(1.93)	6567	80.53	<0.001
Mild (14–19)	201(95.26)	10(4.74)	211		
Moderate (20–28)	118(83.39)	14(10.61)	132		
Severe (29–63)	24(82.76)	5(17.24)	29		
BAI score					
<45	6648(97.81)	149(2.19)	6797	4.74	0.029
≥45	135(95.07)	7(4.93)	142		
Psychological stress in past year*					
Learning stress	4.48±4.56	7.17±5.47	6943		<0.001
Interpersonal stress	0.75±1.65	1.79±2.88	6943		<0.001
Economic stress	1.40±2.20	2.73±2.98	6943		<0.001
Intimate relationship stress	1.14±1.94	1.88±2.39	6943		<0.001
Employment stress	1.37±2.39	2.29±3.05	6943		<0.001
Family stress	1.21±1.97	2.03±2.68	6943		<0.001
Appearance stress	0.63±1.13	1.21±1.45	6943		<0.001
Total score	10.99±10.56	19.10±14.43	6943		<0.001

Note: *Screened by Psychological Stress Scale for College Students.

Table 2 The Univariate Logistic Regressions Analyses for New-Onset MDD Among 6985 Freshmen

Variables	*P*	OR	95% CI
Gender (Female/ Male)	0.236	1.22	0.88–1.70
Residence (Rural/ Urban)	0.837	0.97	0.67–1.34
From one-child family (Yes/No)	0.969	1.01	0.73–1.39
Major (Medicine/Non- medicine)	0.840	0.96	0.68–1.37
BDI score			
No (0–13)(reference)			
Mild (14–19)	0.006	2.52	1.31–4.88
Moderate (20–28)	<0.001	6.02	3.36–10.76
Severe (29–63)	<0.001	10.56	3.97–28.13
BAI score			
<45 (reference)			
≥45	0.034	2.31	1.06–5.03
Psychological stress in past year*			
Learning stress	<0.001	1.11	1.08–1.14
Interpersonal stress	<0.001	1.23	1.16–1.30
Economic stress	<0.001	1.21	1.15–1.27
Intimate relationship stress	<0.001	1.16	1.09–1.24
Employment stress	<0.001	1.13	1.07–1.19
Family stress	<0.001	1.18	1.10–1.25
Appearance stress	<0.001	1.42	1.27–1.58
Total score	<0.001	1.05	1.04–1.06

Note: *Screened by Psychological Stress Scale for College Students.

Table 3 The Multivariate Logistic Regression Results for New-Onset MDD Among 6985 Freshmen

Variables	*P*	OR	95% CI
Gender	0.280	1.22	0.85–1.75
Age	0.325	0.91	0.75–1.10
Residence	0.752	0.94	0.64–1.38
Major	0.419	1.17	0.80–1.72
Single child	0.515	1.14	0.77–1.69
BDI score			
None (0–13) (reference)			
Mild (14–19)	0.508	1.27	0.63–2.57
Moderate (20–28)	<0.001	3.74	1.95–7.17
Severe (29–63)	<0.001	7.74	2.34–25.60
BAI score			
<45 (reference)			
≥45	0.363	0.66	0.26–1.63
Psychological stress in past year*			
Learning stress	0.017	1.05	1.01–1.09
Interpersonal stress	0.221	1.05	0.97–1.13
Economic stress	0.001	1.11	1.04–1.19
Intimate relationship stress	0.809	0.99	0.91–1.08
Employment stress	0.557	1.02	0.96–1.09
Family stress	0.760	1.01	0.94–1.10
Appearance stress	0.382	1.07	0.92–1.23

Note: *Screened by Psychological Stress Scale for College Students.

Table 4 The Stepwise Logistic Regression Results for New-Onset MDD by Depression and Anxiety Level

Variables	BDI score (0–19)			BDI score (20–63)		
	P	OR	95% CI	*P*	OR	95% CI
Psychological stress in past year*						
Learning stress	0.019	1.05	1.01–1.09	0.378	1.05	0.94–1.18
Economic stress	0.001	1.12	1.05–1.21	0.597	1.05	0.88–1.26
	BAI score (<45)			BAI score (≥45)		
	P	OR	95% CI	*P*	OR	95% CI
Learning stress	0.028	1.05	1.00–1.09	0.059	1.41	0.99–2.01
Economic stress	0.001	1.12	1.04–1.19	0.162	1.57	0.84–2.94

Note: *Screened by Psychological Stress Scale for College Students.

We examined the interactions between psychological stress, baseline depression and baseline anxiety scores in relation to the risk of MDD. A significant interaction was found between learning stress and baseline depression scores (P= 0.007), and economic stress interacted with baseline anxiety scores (P= 0.010). We further excluded participants with severe depression and anxiety based on BDI and BAI. The data showed that learning stress and economic stress of psychological stress were still risk factors for MDD in participants with minimal depressive or anxiety symptoms; whereas the associations became non-significant in students with moderate or severe symptoms (Table 4).

Discussion

Main Findings

Our data showed that there was a strong association between psychological stress and first-onset MDD. The associations between dimensional scores and MDD attenuated after controlling for confounding factors. However, the associations between learning stress, economic stress, and the risk of MDD were still significant, even after accounting for the impact of baseline depression and anxiety.

Some cross-sectional studies found that learning stress was positively correlated with depression among college students.[31–34] These studies focused on the mediating roles of different factors in the relationship between academic stress and depression among college students, such as sleep quality,[31] negative emotions, social support,[33] anxiety symptoms, and hopelessness.[34] We have not found a longitudinal study on this topic. Our longitudinal study confirmed that learning stress was a risk factor for MDD in freshmen. Learning is the primary task and main activity of college students. Therefore, it has a great impact on their mental health and psychological development. Compared with high school, the university has a wide variety of courses, and the depth and breadth of learning have been greatly improved. Many students may not be able to adapt to the learning intensity and management style of the university, leading to poor academic performance. Persistent sub-optimal academic performance problems could negatively affect students' self-confidence, making them feel inferior and tired of learning, and then developing mental health problems.

Our results also suggested that economic stress was positively correlated with MDD, which was consistent with previous studies across different demographics and geographical locations.[35–37] A study on doctoral students in the United States found that financial stress, due to inadequate stipends and high living costs, was linked to increased depression symptoms.[36] Another study in seven countries showed that economic pressure can lead to parental depression, which in turn affects adolescent mental health.[37] A study on junior high school students showed that economic stress was significantly and positively associated with depression.[35] Economic stress could lead to depression in adolescents, possibly because they cannot properly express their negative emotions when they experience economic stress from families. However, few studies have found that poverty was not associated with depression.[38,39] The difference may be attributed to different social environments and age of the study population. Our study population was freshmen, 63.44%

of them were from rural areas, and 61.54% were not from one-child family. These students were more likely to develop psychological stress than those from urban areas and who were from one-child family. Compared with those students from wealthier families, students from poor families have different lifestyles and behavior habits, and some of them often show the psychological tendency of inferiority and isolation. Therefore, schools and all aspects of society should not only provide the necessary economic help, such as improving the funding system, adding awards, increasing the amount of grants, widening the channels of work-study, but also pay more attention to the mental health of economically disadvantaged students.

In Chinese culture, mental health issues often carry a stigma, which may discourage students from acknowledging their stress or seeking help.[40] This cultural context could influence how students experience and cope with psychological stress, possibly affecting the development of MDD. Given the current situation of high level psychological stress among college students and the findings of this study, several intervention strategies may be considered, including: (1) universities should establish a psychological counseling program to help students establish effective self-regulation and coping mechanisms; (2) teachers should improve the consciousness of psychological education, which is of great help to prevent students' psychological problems and do a good job in mental health care; (3) parents should strengthen communication with the students, guide them to talk about difficulties encountered, and give appropriate help and comfort. The results of this study have significant implications for general undergraduate training strategies and specific interventions for MDD.

Limitations

This study has several limitations. First, as this research employed self-reporting measures, reporting and recall biases are possible. Secondly, this study did not include severe physical illnesses, social-economic factors, mental disorders, etc. The effects of these important confounding factors were not controlled in the analysis. Thirdly, this study was conducted in two medical universities in Shandong province in China. Therefore, it should be interpreted with caution when applied to other regions and countries.

Implications for Future Research

We found that psychological stress is prevalent in Chinese university students, and that learning stress and economic stress are linked to MDD risk. However, additional longitudinal investigations involving university students are necessary to reproduce these results, and further clarify the connection between psychological stress and MDD. This will enable us to enhance our comprehension of the causes of MDD and develop efficient interventions and suitable support services for this specific group.

Baseline depressive symptoms and baseline anxiety symptoms were included in our study, but not other mental disorders. Future studies should consider including more baseline mental health assessments to better understand the interaction between existing mental health conditions and stress-related MDD onset.

Conclusions

This study addressed associations between psychological stress and the risk of first onset of MDD in a sample of Chinese first-year students in a 1-year longitudinal study. Two significant outcomes of the analysis are (a) psychological stressful events in the past year were positively associated with MDD incidence in first-year college students and (b) two dimensions of psychological stress, namely learning stress and economic stress, were identified as independent risks for MDD occurrence. In addition, this study exploits this recent progress to propose a new route to reduce the risks of MDD in college students, with very important applications for mental health prevention and intervention at universities.

Data Sharing Statement

The datasets used in this study are available from the corresponding author.

Ethics Statement and Informed Consent

This study was approved by the Medical Research Ethics Committee in Jining Medical University, Jining, China. This study complies with Declaration of Helsinki. All participants provided informed consent.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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