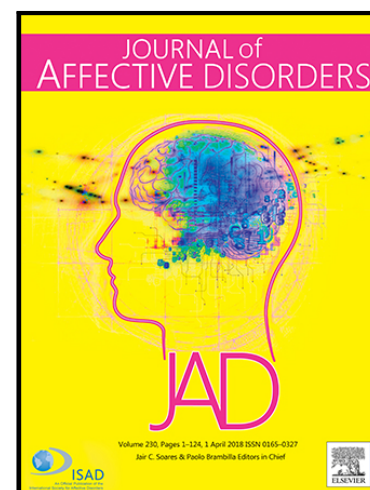


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## Highlights

- Anxiety turned out to be the most prevalent and serious issue for college students, especially for female students.
- A significantly higher percentage of male students endured depression than females, which persisted during the four academic years.
- Anxiety had a significant positive correlation with introversion. Female freshmen's anxiety levels were also associated with their body image, drinking habits, and academic performance.
- It is of great significance to adopt collegiate policies reflecting the gender differentials and offer female and male students more proper guidance in freshman and sophomore years in order to promote their psychological well-being.

# Gender differences in depression, anxiety, and stress among college students: A longitudinal study from China

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**Keywords:** Depression; Anxiety; Stress; Gender differences; College students

## Abstract

**Background:** The objective of this longitudinal study was to examine the gender differences in college students' depression, anxiety, and stress over the four academic years, and to explore possible anxiety-related factors among first year students.

**Methods:** The study analyzed 1892 undergraduate students from 15 universities in China, with 898 females and 994 males. The students have been followed for four years and completed a survey containing the Depression Anxiety Stress Scale-21 questionnaire, students' socio-demographic information, and their educational background, etc.

**Results:** 1) On average, both female and male college students suffered from mild anxiety in the first three years. Female students scored significantly higher in anxiety than males in the first and second years, and there was no significant gender difference in students' average depression and stress levels. 2) A significantly larger proportion of female students experienced anxiety above the normal threshold, whereas a higher percentage of male students endured different degrees of depression; no significant gender differences were found in stress problems. 3) Anxiety had a significant positive correlation with introversion. Female freshmen's anxiety levels were also associated with their body image, drinking habits, and academic performance.

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**Limitations:** Response bias may exist considering that self-reported data was used. Due to data unavailability, we only explored the anxiety-related factors in freshman year, which cannot sufficiently reflect the consistency of correlations over time.

**Conclusions:** Anxiety turned out to be the most prevalent and serious issue for college students, especially for female students; while a growing prevalence of depression was found among male students during college. It is of great significance to adopt collegiate policies reflecting the gender differentials.

**Keywords:** Depression; Anxiety; Stress; Gender differences; College students

## 1. Introduction

Mental health problems are becoming increasingly common among college students. Relevant research indicated that approximately half of the university students had moderate levels of stress-related mental health concerns, including anxiety and depression (Regehr, 2013). In the United States, almost half of college-aged individuals had a psychiatric disorder (Blanco et al., 2008). Likewise, more than 20 percent of Chinese college students suffered from depression and this ratio has kept growing over the past decade (Wei & Sang, 2017; Liu, Gao & Ping, 2019; Liu, Ping & Gao, 2019; Luo, 2018). In order to evaluate the mental states of students, the Depression Anxiety Stress Scales (DASS) has been widely acknowledged as a reliable research instrument in this field (Lovibond and Lovibond, 2004), and DASS was also validated to assess psychiatric symptoms in Asians and Chinese population (Quek et al., 2018; Ho et al., 2019). The three scales of depression, anxiety, and stress are considered as sub-dimensions of psychological distress (Lee, 2019).

Gender difference in psychological distress has long been a focus of relevant studies. Previous epidemiological research show that in general, females tend to suffer more from mental problems than males for two reasons. First, the physiological differences between females and males (such as genetic vulnerability, hormone and cortisol levels, etc.) may be reflected emotionally and behaviourally (Hankin & Abramson, 1999). For instance, females and males responded to stress differently as a consequence of their differential sensitivity to events (Afifi, 2007). Females were more vulnerable to stress and pain than males, so they might experience greater sadness and anxiety (Chaplin et al., 2008). Furthermore, self-concepts of traditional masculinity and femininity can affect their attitudes and behaviors towards life experiences. Masculinity exhibits traits such as individualism, and assertiveness, while femininity manifests in affection, compassion, and sensitivity to other's needs (Gibson et al., 2016). The prescribed gender role expectations, in turn, lead to their differential internalizing and externalizing problems. It has been evidenced that women were more likely to struggle with internalizing disorders such as depression and anxiety, while men exhibited more externalizing disorders like substance abuse (Horwitz & White, 1987; Seedat, et al., 2009; Rosenfield & Mouzon, 2013), alcohol abuse (Vu et al., 2019) and internet addiction (Zhang et al., 2018). In addition, females are more likely to develop borderline personality disorder which is characterized by unstable emotion (Keng et al., 2008).

Mounting research have focused on the gender difference in mental health among college students, but no consistent conclusion was drawn in this respect. Some studies concluded that female undergraduates exhibited mental problems more overtly (Adlaf et al., 2001). Especially, female students significantly suffered more from stress and anxiety (Bayram & Bilgel, 2008; Eisenberg et al., 2007; Mahmoud et al., 2012). As for the depression scale, some researchers found a higher prevalence rate of depression among female students (Liu et al., 2019; Sun, et al., 2017; Tung et al., 2018). By contrast, other researchers insisted that male students were more likely to experience depressive disorders than female students (Al-Qaisy, 2011; Wong et al., 2006), which corresponded with the statement that femininity appeared to be protective against depression symptoms for college educated people (Gibson et al., 2016). There were also studies which

found no substantial gender effects concerning their mental health states (Grant et al. 2002). With regard to the attitudes toward seeking psychological help, some researchers pointed out that female students who suffered from mental disorders were proved to have more positive help-seeking attitudes, and this led to their favorable intentions to seek help from mental health professionals; on the other hand, males were more likely to underutilize the mental services due to their negative attitude towards psychological openness (Chandra & Minkovitz, 2006; Komiya et al., 2000; Mackenzie et al., 2006; Rith-Najarian et al., 2019). Moreover, depression, anxiety, and stress often lead to suicide, which is common among college students (Davis et al., 2019). Gender plays a role in suicide attempts as males tend to use lethal methods (Choo et al., 2017), and females tend to attempt suicide by drug overdose (Ho et al., 2016).

Given that mental disorders may pose grave threats to students' academic performance on campus and predict their professional development in the future, it is of great significance to identify the influencing factors of college students' psychological distress. Existing literature identified several sources of anxiety, stress and depression commonly seen among college students in various contexts. They can be categorized into four major aspects, i.e., students' personality, lifestyle, family background, and academic performance. First, students' personality determines their attitudes towards difficulties, as well as their willingness to express negative feelings. Extroverts were more likely to be optimistic and confident of their ability, whereas students with introverted personalities seemed to be at risk of physical and psychological health problems (Buckworth et al., 2002). Second, college students' lifestyles play a vital role in their emotions. It was recognized that students' levels of anxiety and depression had a significant correlation with their body image, particularly associated with overweight and obesity (Tao et al., 2002; Wahed & Hassan, 2017). Apart from that, substance use behaviors were usually associated with mental health problems, such as alcohol use disorders (Blanco et al., 2008), cigarette smoking (Halperin, 2009), and internet addiction (Yen et al., 2009), etc. Sleeping quantity and quality and psychological health issues also showed clear connections. Students who were poor sleepers experienced mental difficulties such as depression and anxiety (Orzech et al., 2011). Third, there was a significant relationship between psychological distress of college students and their family background, including their monthly household income (Wahed & Hassan, 2017), parental occupations and education (Tao et al., 2002), and their relationship with families (Zuckerman, 1989). Financial pressure, particularly, was considered as a significant negative predictor of their physical and psychological health (Andrews & Wilding, 2004; Jessop et al., 2005; Roberts et al., 2000). In addition, academic pressure was the top source of concern for college students regarding their depression, anxiety, and stress (Beiter et al., 2015; Misra & Castillo, 2004).

The review of literature indicated that although gender difference in mental health has been recognized for the general population, it was inconclusive among college students in this respect. Furthermore, most relevant studies employed cross-sectional designs. Considering college students of different years may be confronted with varying circumstances regarding their study and lives, there may be some distinctions in their psychological status over the four-year span. For example, aside from academic pressure,

freshman students face stressful tasks of separation from their family (Pedrelli et al., 2015). Therefore, they may experience higher levels of anxiety than students of other years. Considering these research gaps, this study addressed three primary questions: 1) what are average levels of depression, anxiety, and stress among college students by gender during the four academic years? 2) what is the prevalence of mental problems in college students by gender, and does the prevalence vary by years? 3) how are students' personality, lifestyle, family background and academic pressure associated with mental health problems for freshman students?

## 2. Methods

### 2.1. Participants and procedures

Our study used data collected from the Beijing College Students Panel Survey (BCSPS) in China. This survey adopted a probability proportional to size (PPS) sampling method and a three-stage sampling design was followed. The first stage of the sampling unit was universities; in this step, altogether 15 universities were chosen from 6 groups based on their rankings and administrative affiliation. The second sampling unit was majors, with 25 majors randomly selected from three elite universities (Peking University, Tsinghua University, and Renmin University of China) and 15 majors from other universities. In the third sampling unit, 20 students were randomly chosen from each major. This survey followed two cohorts of students who were enrolled in 2006 (Juniors) and 2008 (Freshman) for five consecutive years, and the survey collected their information involving mental states, demographic characteristics, family background, and academic performance, etc. The follow-up rate of this panel data was over 90% (Liu, Gao & Ping, 2019; Cai & Wang, 2018). The first three rounds of survey were conducted on-site, while the final round was organized online, with students being invited to log in the questionnaire website with a specific code assigned through text messages and e-mails (Liu, Ping & Gao, 2019). In order to focus on the changes in mental health of students during college, we selected the cohort of students admitted in 2008 as our sample and analyzed their data in the four academic years. After excluding invalid questionnaires, the final sample size for analysis was 1892, with 898 females and 994 males. The universities of this study were categorized into three tiers. The top tier referred to five "985" project universities, accounting for 41.86 percent of the total sample; to be more specific, the top tier comprised Peking University (8.77%), Tsinghua University (9.78%), Renmin University of China (10.04%), Beihang University (6.4%), and Beijing Institute of Technology (6.87%). The second tier was mainly "211" project universities, including Beijing University of Chemical Technology (6.34%), Beijing University of Posts and Telecommunications (5.34%), Communication University of China (4.7%), China University of Mining and Technology (6.08%), and Minzu University of China (5.92%); and the third tier consisted of five other universities, with one non-211 project university under the Ministry of Education, i.e. Beijing Language and Culture University (5.87%), and four universities under the Beijing municipal government, i.e. North China University of Technology (6.71%), Beijing Institute of Petroleum and Chemical Technology (5.76%), Beijing University of Agriculture (5.6%), and Capital University of Economics and Trade (5.81%).

## 2.2. Measures

Depression, Anxiety, and Stress Scales 21 (DASS-21) was adopted to measure mental health in three self-report scales. In order to understand the subjects' emotional states, they were required to answer 7 items for each scale (depression, anxiety, and stress). Each item comprised a statement and the answers were reported on a four-point scale, with the score 0 representing "did not apply to me at all", and score 3 "applied to me very much, or most of the time". By summing the scores for relevant items, the values of depression, anxiety, and stress revealed the degrees of severity of the three scales in question (Lovibond and Lovibond, 2004). In addition, the DASS-21 is a short version of the original 42-item DASS form; thus, in order to characterize the severity levels relative to the population, the scores on DASS-21 were multiplied by two and compared with the cutoff values of conventional severity labels (normal, mild, moderate, severe, and extremely severe). The severity of depression was categorized into five scales, i.e. normal (0-9), mild (10-13), moderate (14-20), severe (21-27), and extremely severe (28+). Similarly, the five scales of anxiety were normal (0-7), mild (8-9), moderate (10-14), severe (15-19) and extremely severe (20+). The score ranges of stress were 0-14 for normal, 15-18 for mild, 19-25 for moderate, 26-33 for severe and 34+ for extremely severe. (Lovibond and Lovibond, 2004). It should be noted that DASS scores do not necessarily define clinical interventions, but they indeed reflect mental problems to certain extent. For this study, the Cronbach's coefficients alpha ranged from 0.67 to 0.87 (see Table 1), which displayed good internal reliability of DASS measurement for a large sample size ( $n=1892$ ).

Moreover, this paper explored the correlations between anxiety and a series of variables from the survey in accordance with the literature, including students' personality, lifestyle, family background and academic performance. Specifically, students reported their personality on a nine-point scale (1-9), ranging from quite introverted to quite extroverted, so we took this variable as ordinal, with students scoring higher as more outgoing and sociable. Later in order to explore the severity distribution for students with introverted/extroverted personality, we adopted a dichotomic classification with a cutting score of 4.5 based on the data form so as to categorize students into either introverts or extroverts. The lifestyle of college students was measured by their body mass index (BMI, in  $\text{kg/m}^2$ ), whether they drank in the past year, and the hours of sleeping. BMI was computed based on students' self-reported height and weight data; a BMI value lower than 18.5 was considered underweight, while a BMI higher than 24 meant overweight and obesity (Gallagher et al., 2000). In this study, we treated students with BMI between 18.5 and 24 as healthy ( $=1$ ) and those below 18.5 or above 24 as unhealthy ( $=0$ ). Furthermore, students' family background was assessed mainly through three aspects, i.e., their parental educational levels, total household income in the past year (CNY), and whether students come from rural or urban areas. The variables paternal and maternal educational levels were reported on an ordinal scale (Not officially educated=1, Elementary education=2, Junior secondary education =3, Senior Secondary Education=4, Vocational/technical high school=5, Technical secondary school=6, Associate's degree=7, Bachelor's degree=8, Master's degree and above=9). In addition, university tiers and class rank were two indicators for students' academic performance. The universities of this study were divided into three tiers, i.e., top "985"



project universities (=1, the top tier), “211” project universities (=2, the second tier) and other universities (=3, the third tier). As for class rank, we first calculated students’ percentile rank via dividing their self-reported rankings by the class size, multiplying by 100, and then subtracting that number from 100. At this stage, if a student was in the 70<sup>th</sup> percentile, then it meant he or she scored higher than 70% of his or her classmates, or in other words, this student was among the top 30 percent of the class. However, considering there might exist some minor inaccuracy in the original self-reported rankings, we further measured the class percentile on a scale of 1 to 10. In this way, if a student’s rank equaled 10, it meant his or her percentile ranged from 90 to 100, or the student was among the top 10 percent of the class. This newly generated class rank can be understood as a decile version of the percentile rank. The higher students’ decile rank is, the better students’ performance is.

### 3. Results

#### 3.1. Gender differences in mean scores of depression, anxiety, and stress

Table 1 presents the mean scores, standard deviations, skewness and kurtosis of the three DASS scales (depression, anxiety, and stress) for both female and male students in college. Specifically, the mean scores of anxiety scale for female students varied from 3.34 to 3.86 during the four years, while male students scored between 3.35 and 3.60. By utilizing a two-way analysis of variance (gender and year) with one factor repetition (year) considering the same cohort was followed during college, we found that on average, students suffered from different anxiety levels across the four academic years (Pillai’s Trace=0.013,  $p<0.01$ ), and the average anxiety levels female and male students experienced were statistically significant (Pillai’s Trace=0.004,  $p<0.1$ ). Results of a two-sample t-test further indicated that there existed statistically significant differences in anxiety problems between female and male students mainly in the freshman and sophomore years ( $p < 0.01$ ); and the effect size estimates also conformed to this conclusion (Cohen’s  $d=0.122$  in year one and Cohen’s  $d=0.123$  in year two). As for the scale of depression, students struggled with different depressive situations in the four years (Pillai’s Trace =0.011,  $p<0.01$ ), but the gender differences were not statistically significant (Pillai’s Trace =0.002,  $p=0.344$ ). In addition, college students encountered different stress levels during college (Pillai’s Trace=0.064,  $p<0.01$ ), but the stress female and male students suffered from on average were also not statistically significant (Pillai’s Trace=0.002,  $p=0.197$ ). Overall, female students encountered significantly higher levels of anxiety than male students on average in the first two years of college, while there were no significant gender differences in students’ depression and stress levels.

[ Table 1 about here. ]

In order to compare the scores on DASS-21 with the cutoff values of conventional severity ratings, all the mean scores have been multiplied by two and the results are shown in Figure 1. On average, the depression scores of females and males during college were below the normal threshold at 9, and the corresponding stress scores were also below the cutoff at 14, indicating that the average depression and stress levels of both

female and male students were within a normal range. Nevertheless, the average anxiety scores of female students surpassed the cutoff at 7 in the first three years, though the scores gradually fell down over time. This also applied to male students in the first and third years. Therefore, on average, female students suffered from mild anxiety from the freshman to the junior year in college, while male students reported having mild anxiety in the freshman and junior years.

[ Fig 1 about here. ]

### 3.2. Gender differences in severity degrees of depression, anxiety, and stress

Figure 2 demonstrates the proportions of female and male students with degrees of depression, anxiety, and stress above the normal levels. In general, over 45 percent of female students and around 40 percent of male students reported experiencing anxiety above the normal threshold in the freshman year. These percentages both decreased to approximately 38 percent in the senior year. It is worth noting that a significantly larger proportion of female students faced intense struggles against anxiety than males ( $\chi^2(1)=11.61$ ,  $p<0.01$ , Cramer's  $V=0.04$ ). By contrast, a significantly higher ratio of male students than females experienced different degrees of depression during college ( $\chi^2(1)=4.26$ ,  $p<0.05$ , Cramer's  $V=0.02$ ), which rose from about 32 percent in the first year to over 37 percent in the third year before declining by 2 percent in the last year. Moreover, there was no significant gender difference in proportions of students above the normal levels of stress in college ( $\chi^2(1)=0.11$ ,  $p=0.74$ , Cramer's  $V=0.004$ ).

[ Fig 2 about here. ]

In order to further explore the severity degrees of depression, anxiety, and stress for female and male students, Table 2 shows the proportions of participants whose answers on the DASS-21 indicated a normal, mild, moderate, severe or extremely severe levels of depression, anxiety, and stress across grades in college. With regard to the depression scale, either female or male students who suffered from mild depression represented about 15 percent of the total in the freshman year, which dropped slightly to roughly 13 percent and 11 percent, respectively in the senior year. However, both male and female students who struggled with moderate depression increased steadily from 13.68 percent to 18.71 percent, and from 12.81 percent to 15.26 percent, respectively during the four years in college. Therefore, the changes possibly implied that students, particularly male students who previously reported having mild depression experienced a deteriorating situation during the four years in college, given that the proportions of other severity degrees mainly remained constant. As for the anxiety scale, over 22 percent of female students in the freshman year grappled with moderate anxiety, and their male counterparts constituted nearly 19 percent. The ratio of moderately anxious female students decreased gradually to approximately 20 percent in the senior year, while the

proportion of male students declined in the first three years, and then jumped to more than 20 percent in the senior year. A Pearson's chi-squared test indicated that in the junior year, there were significant gender differences in the severity distribution of depression ( $\chi^2(4)=8.76$ ,  $p<0.1$ , Cramer's  $V=0.07$ ) and anxiety ( $\chi^2(4)=18.04$ ,  $p<0.01$ , Cramer's  $V=0.10$ ). Moreover, the proportions of students who struggled with different degrees of stress fell over time for both females and males, with significant gender differences merely in the freshman year ( $\chi^2(4)=8.13$ ,  $p<0.1$ , Cramer's  $V=0.07$ ).

[ Table 2 about here. ]

Overall, anxiety problems turned out to be the most prevalent and serious mental health issue for college students. On average, both female and male students suffered from mild anxiety in the first three years, and the mean anxiety score of female students significantly overtook that of the males in the first and second years. Furthermore, a significantly higher proportion of female students struggled with anxiety above the normal levels; whereas a significantly higher percentage of male students endured different degrees of depression. Particularly in the junior year, there were significant gender differences in the severity distribution of anxiety and depression.

### *3.3. Correlation between anxiety and students' personality, lifestyle, family background, and academic performance*

From the above analysis, we concluded that the freshman year was a time of heightened anxiety for college students. In order to better understand the relevant factors of this issue, this section investigated the correlation between anxiety and a series of variables in accordance with the literature, including students' personality, lifestyle, family background and academic performance (see Table 3). Specifically, there was statistically significant correlation between anxiety and personality for both female and male college students ( $p<0.01$ ). More introverted personality appeared to be associated with more severe anxiety problems. As for students' lifestyle, BMI had statistically significant effects on the levels of anxiety for only females ( $p<0.05$ ). Female students with unhealthy BMI were more likely to endure anxiety compared to their normal weight equivalents. Moreover, increasing probability of drinking corresponded to increasing levels of anxiety among female freshmen ( $p<0.01$ ). Family background, in general, had no significant correlation with students' anxiety. Regarding the academic performance, there were also no significant differences among students from different tiers of universities, but worse performance was significantly correlated with more anxious mental states among female students ( $p<0.1$ ). In addition, it was worth noting that students' anxiety levels were tightly related to the stress and depression scales. Overall, the anxiety problems of freshman students were significantly correlated with their personality, while the anxiety levels of female students were also linked to their body image, drinking habits and academic performance.

[ Table 3 about here. ]

Figure 3 further demonstrates the correlations between anxiety and personality, BMI, drinking habits and academic rankings. We divided students mainly into two groups based on each of the four factors respectively. To be more specific, we characterized freshman students whose personality scored below 4.5 as introverts and those with scores equal or higher than 4.5 as extroverts, and then compared their anxiety state across gender. It turned out that among students with normal level of anxiety, 19.7 percent of females and 33.6 percent of males were introverted. However, these ratios amounted to 35.9 percent and 53.8 percent for those who suffered from extremely severe anxiety. This indicated that for both female and male freshmen, higher degrees of severity in anxiety was consistent with larger proportions of introverts. Similarly, we defined students as two groups according to whether their BMI fell into the normal range or whether they drank in the past year. Results showed that the more severe anxiety female freshmen experienced, the more possible students were at unhealthy weight or were drinkers. As for students' rankings, among female freshmen who felt normal degrees of anxiety, 32.6 percent ranked in the bottom half; but for those who struggled with extremely severe anxiety, up to 46.2 percent were in the bottom half. These results further corroborated the above analysis that personality might affect both male and female freshmen's anxiety state, while female students felt different degrees of anxiety as their body image, drinking habits and academic performance differed. Furthermore, there were significant differences in the proportions of introverts ( $\chi^2(4)=13.72$ ,  $p<0.01$ , Cramer's  $V=0.16$ ) and the percentage of drinkers ( $\chi^2(4)=11.46$ ,  $p<0.05$ , Cramer's  $V=0.09$ ) between female and male students with different levels of anxiety problems; while the severity distribution for the students with unhealthy BMI and the students in bottom half indicated no significant gender differences.

[ Fig 3 about here. ]

#### 4. Discussion

Through a descriptive analysis of gender differences in mental health of students during college, female students suffered from significantly higher levels of anxiety than their male counterparts on average, especially in the freshman and sophomore years; while male students experienced more depressive problems. The results were congruent with some previous studies in different contexts (Al-Qaisy, 2011; Wong et al., 2006). We also found that the mean scores of depression, anxiety, and stress all experienced downward trends during college, which may be attributable to issues of adjustment when prospective students first enter university, which later improve as students learn to cope better (Puthran et al., 2016; Liu, Ping & Gao, 2019). However, there was an alarming high degree of persistence for students who have suffered from depressive disorders as well as anxiety problems. This may be due to a lack of perceived need for help, or a lack of services use (Zivin et al., 2009). As for the further deterioration of male students' depression problems, it may be partly attributed to their negative attitude towards emotional openness, which meant that they might be reluctant to utilize the mental services during college (Komiya et al., 2000; Rith-Najarian et al., 2019). Therefore, colleges

should pay special attention to male students' mental states and encourage them to express their emotions and seek professional help if needed.

Furthermore, the present study added further support to the emerging consensus on the correlation between psychological distress and introversion (Buckworth et al., 2002). As for the substance use behaviors, we concluded that female drinkers tended to be more anxious than those who did not drink. This conformed with past research that although a higher percentage of college men were likely to drink and smoke than women, the associations between substance use behaviours and mental health problems were stronger for females (Breslau, 1995; Cranford et al., 2009). It should also be mentioned that female drinkers belong to Cloninger's Type I alcoholism, which is characterized by female gender, anxiety and better prognosis (Puri et al., 2013). The correlation between anxiety problems and body shape also parallels the gender stereotypes prevailing in the society that females show more concern about their appearance. Previous study found that female gender and higher BMI were associated with lower body esteem and low body esteem could be a predisposing factor for anxiety in Chinese females (Mak et al., 2013). In addition, given that female students may be more sensitive under stressful life circumstances, pressure from academics may exacerbate their worries.

To sum up, it is of great significance for colleges to adopt collegiate policies reflecting the gender differentials and offer female and male students more proper guidance in freshman and sophomore years in order to promote their psychological well-being. More specifically, one possible way is to make use of smartphone mental health applications properly. Previous study found that smartphone mental health applications have high acceptance rate by female (Fealy et al., 2019) and young people (Do et al., 2018). Thus, smartphone mental health applications will be useful to reduce prevalence of depression, anxiety, and stress in Chinese college students.

## 5. Limitations

First, since our study involved a self-administered questionnaire survey, response bias may exist considering that students may have underreported their negative emotions or overreported their academic performance. Second, in the process of data collection, questions about the anxiety-related factors were only asked in the freshman year. Due to the limitations of data, we explored the correlation between anxiety and a series of variables merely in the first academic year, which can not sufficiently reflect the consistency of correlations over time. In addition, because we selected the indicators of those anxiety-related factors based on the information collected from the questionnaire for convenience, some of them may not be representative and further explorations of other indicators may be still in need.

## 6. Conclusions

First, both female and male students suffered from mild anxiety in the first three years, and the mean anxiety score of female students significantly overtook that of the males in the first and second years. There were no significant gender differences in students' average depression and stress levels.

Second, a significantly higher proportion of female students struggled with anxiety above the normal levels; whereas a significantly higher percentage of male students endured different degrees of depression. Particularly in the junior year, there were significant gender differences in the severity distribution of anxiety and depression.

Third, the anxiety problems of freshman students were positively correlated with their introverted personality, while the anxiety levels of female students were also associated with their body image, drinking habits and academic performance.

In sum, anxiety turned out to be the most prevalent and serious mental issue for Chinese college students, especially for female students; while a growing prevalence of depression was found among male students during college.

### **Conflict of interest**

The authors declare no conflict of interests.

### **Contributors**

Author W.G and X.L. designed the study and wrote the protocol. Authors X.L. and S.P. undertook the statistical analysis, Author W.G. and S.P. managed the literature searches and analyses., and author W.G., X.L. and S.P. wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

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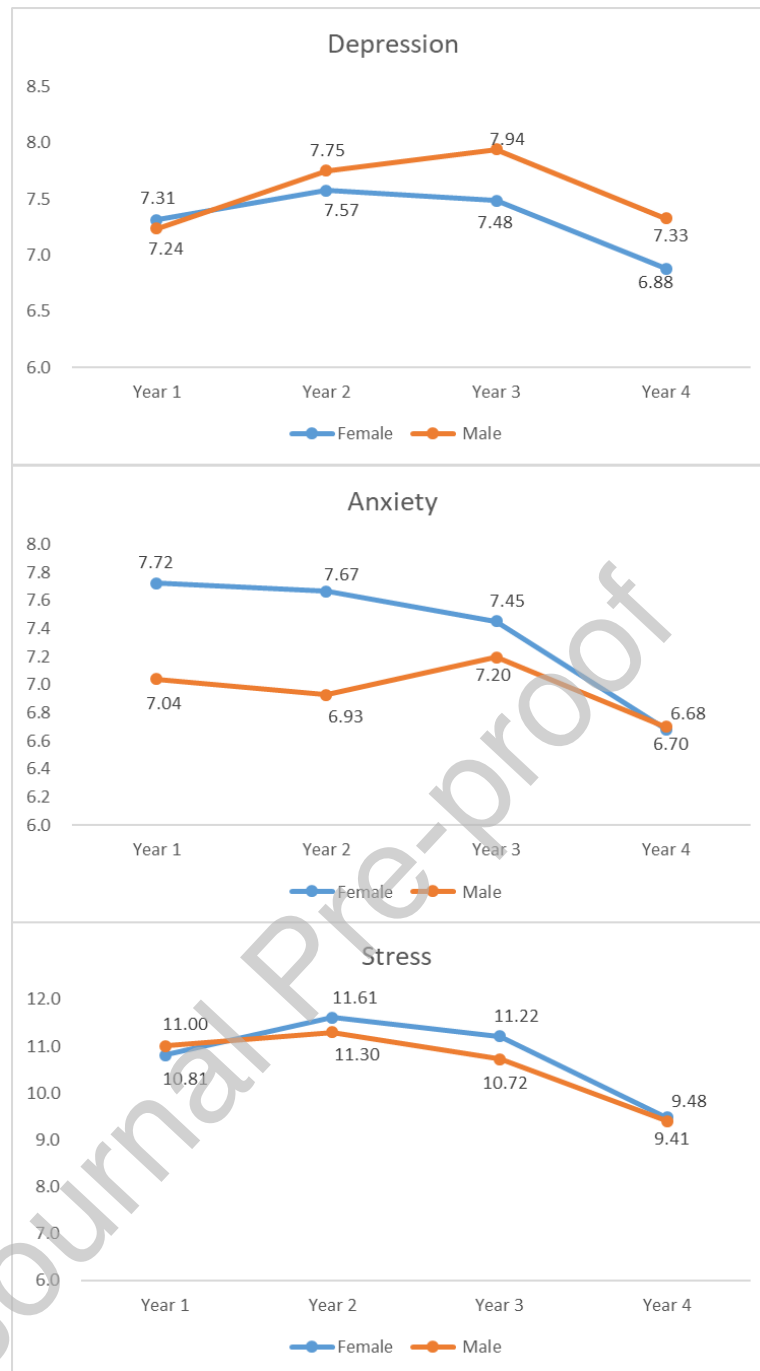
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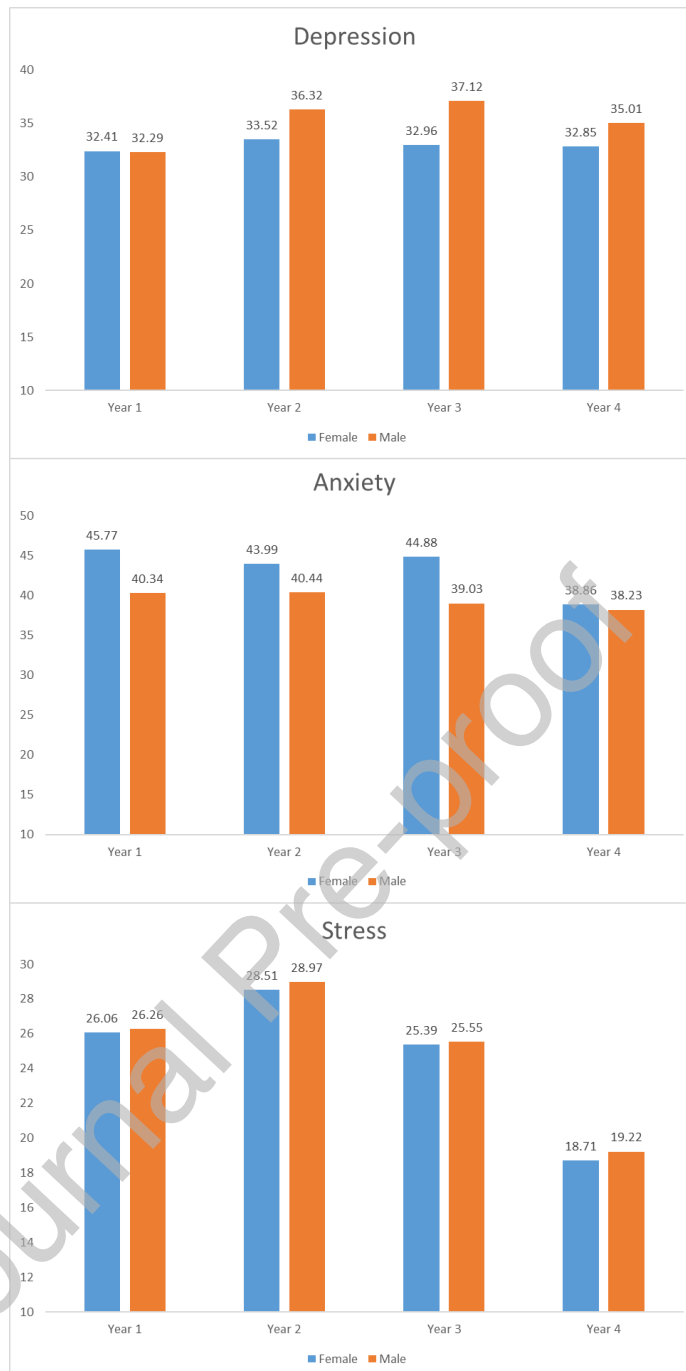


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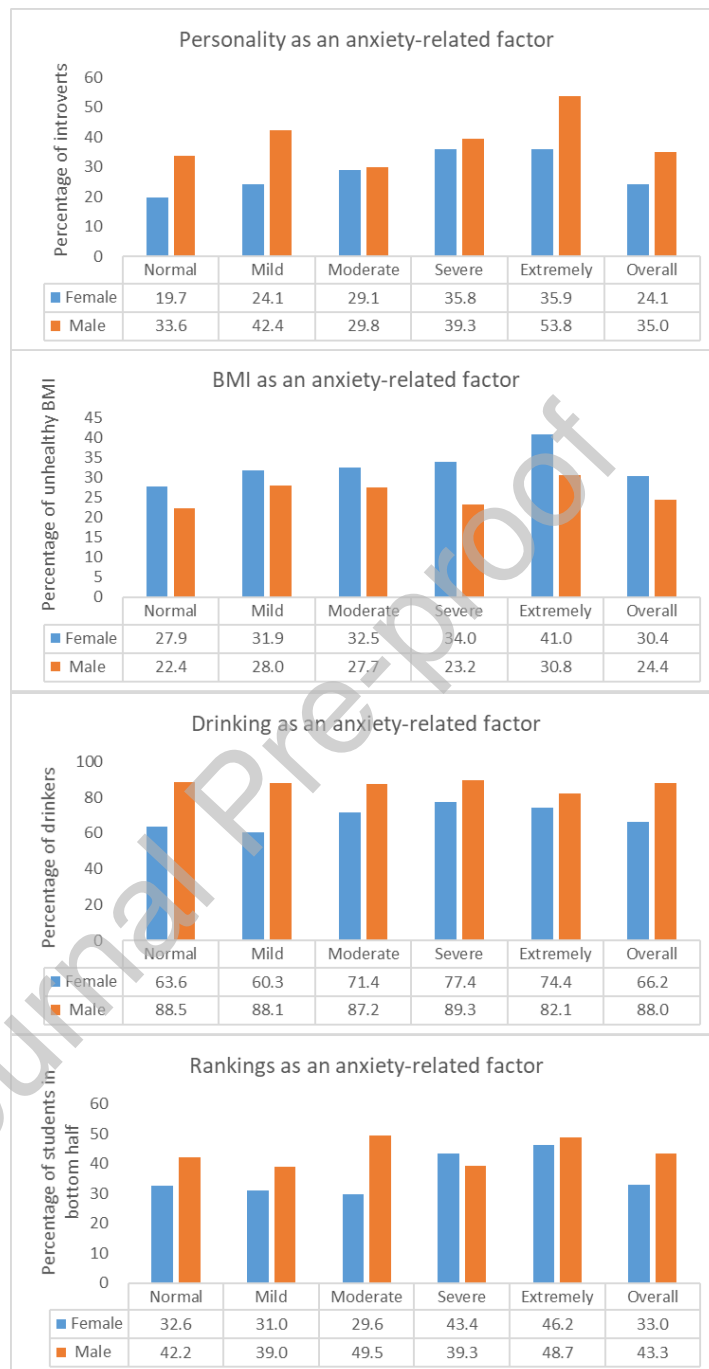
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**Fig 1. Gender differences in severity scores of depression, anxiety and stress across years**



**Fig 2. Proportions of students above the normal levels of depression, anxiety, and stress**



**Fig 3. Personality, BMI, drinking and rankings as anxiety-related factors for freshman students**

**Table 1. Descriptive statistics of depression, anxiety, and stress for female and male college students**

	Female				Male				p value	Effect Size		
	Me an	S D	Skew ness	Kurt osis	Me an	S D	Skew ness	Kurt osis		Coh en's d	Point-Bi serial r	Cronb ach's $\alpha$
Depression Year1	3.66	3.19	1.30	5.16	3.62	3.23	1.14	4.35	0.802	0.012	0.006	0.752
Anxiety Year1	3.86	2.83	1.27	5.04	3.52	2.79	1.21	4.78	0.008	0.122	0.061	0.673
Stress Year1	5.41	3.60	0.70	3.22	5.50	3.70	0.73	3.28	0.570	0.026	0.013	0.764
Depression Year2	3.79	3.31	1.33	5.21	3.88	3.49	1.14	4.26	0.570	0.026	0.013	0.782
Anxiety Year2	3.83	3.04	1.51	6.28	3.46	2.97	1.19	4.35	0.008	0.123	0.061	0.720
Stress Year2	5.80	3.72	0.72	3.37	5.65	3.87	0.65	3.02	0.378	0.041	0.020	0.780
Depression Year3	3.74	3.43	1.26	4.63	3.97	3.74	1.05	3.73	0.166	0.064	0.032	0.842
Anxiety Year3	3.73	3.11	1.22	4.92	3.60	3.42	1.31	4.69	0.399	0.039	0.019	0.811
Stress Year3	5.61	3.61	0.63	3.48	5.36	3.91	0.73	3.33	0.153	0.066	0.033	0.829
Depression	3.44	3.38	1.15	4.13	3.66	3.69	1.11	4.12	0.170	0.063	0.032	0.873

Year4												
	3.3	3.	1.13	4.18	3.3	3.	1.32	5.03	0.9	0.00	0.002	0.860
Anxiet	4	10			5	46			45	3		
y												
Year4												
Stress	4.7	3.	0.74	3.36	4.7	3.	0.71	3.26	0.8	0.00	0.005	0.864
Year4	4	59			0	79			37	9		

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**Table 2. Severity distribution (%) of DASS-21 scores by gender across years**

Year	1		Pea rso n $\chi^2$	Cra mer' s V	2		Pea rso n $\chi^2$	Cra mer' s V	3		Pea rso n $\chi^2$	Cra mer' s V	4		Pea rso n $\chi^2$	Cra mer' s V
	Fe	M			Fe	M			Fe	M			Fe	M		
	ma le	al e			ma le	al e			ma le	al e			ma le	al e		
<b>Depression</b>																
Normal	67.	67			66.	63			67.	62			67.	64		
	59	.7			48	.6			04	.8			15	.9		
		1				8				8				9		
Mild	15.	15			16.	15			14.	13			13.	10		
	59	.1			04	.5			59	.4			14	.9		
		9				9				8				7		
Moderate	12.	13	1.7		12.	15	4.8		13.	16	8.7		15.	18	6.3	
	81	.6	1	0.03	25	.4	6	0.05	03	.3	*	0.07	26	.7	9	0.06
		8				9								1		
Severe	3.2	2.			4.0	3.			3.5	5.			3.1	3.		
	3	41			1	62			6	43			2	52		
Extremely Severe	0.7	1.			1.2	1.			1.7	1.			1.3	1.		
	8	01			2	61			8	91			4	81		
<b>Anxiety</b>																
Normal	54.	59			56.	59			55.	60			61.	61		
	23	.6			01	.5			12	.9			14	.7		
		6				6				7				7		
Mild	12.	11			11.	11			13.	8.			8.2	7.		
	92	.8			58	.4			03	05			4	24		
		7				7										
Moderate	22.	18	6.2		21.	18	3.0		20.	18	18.		20.	20	1.4	
	61	.9	2	0.06	38	.8	0	0.04	82	.6	04	0.10	71	.0	0	0.03
		1				1				1	***			2		
Severe	5.9	5.			5.2	5.			5.0	4.			5.4	5.		
		63			3	03			1	43			6	73		
Extremely Severe	4.3	3.			5.7	5.			6.0	7.			4.4	5.		
	4	92			9	13			1	95			5	23		
<b>Stress</b>																
Normal	73.	73			71.	71			74.	74			81.	80		
	94	.7	8.1		49	.0	0.8		61	.4	2.8		29	.7	1.8	
		4	3			3	2			5	6			8	0	
Mild	12.	10	*		12.	11			11.	10			8.1	7.		



	69	.9		47	.9		8	.2		3	14	
		7			7			6				
		10			11			10				
Moderate	8.6	.7	0.07	10.	.1	0.02	9.1	.8	0.04	7.3	8.	0.03
	9	6		91	7		3	7		5	75	
Severe	4.3	3.		4.3	4.		3.7	3.		2.7	2.	
	4	42		4	73		9	52		8	82	
Extremely	0.3	1.		0.7	1.		0.6	0.		0.4	0.	
Severe	3	11		8	11		7	91		5	5	

Note: \*\*\* 1% significance level, \*\*5% significance level, \*10% significance level.

**Table 3. Pearson correlation coefficients between anxiety and a series of variables for freshman students**

	stres s	depre ssion	perso nality	BMI	drink ing	slee ping	pater nal educ ation	mate rnal educ ation	house hold inco me	home town	unive rsity tier	ran kin g
all	0.63 3***	0.571 ***	-0.10 5***	-0.05 5**	-0.02 4	0.00 6	0.00 3	0.02 3	0.028	0.037 0	0.024 0	-0.0 35
fem ale	0.63 7***	0.588 ***	-0.12 4***	-0.06 7**	-0.09 5***	-0.0 33	-0.00 7	0.02 7	0.009	0.035 0	0.020 0	-0.0 61*
mal e	0.63 4***	0.557 ***	-0.10 7***	-0.03 6	0.029	0.04 2	0.00 3	0.00 9	0.044	0.030 0	0.002 00	-0.0 27

Note: \*\*\* 1% significance level, \*\*5% significance level, \*10% significance level.