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The evaluation of depression, anxiety, and stress among undergraduate dental students in graduation year in Mainland China: a cross-sectional study

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Abstract

Background Mental health issue in dental students has emerged as a worldwide concern. This study aims evaluate the mental health status among undergraduate dental students in their final year in mainland China, and to investigate the association factors behind it, aiming for better understanding of current situation of dental education and provide some perspectives.

Methods An analytical cross-sectional study was conducted using an Internet-based survey platform to collect data from undergraduate dental students in their final year in mainland China. The DASS-21 instrument was used to evaluate mental health outcomes, while a supplementary questionnaire was designed to gather information on their university experience and satisfaction across various aspects. The relationship between socio-educational characteristics and mental health was then analyzed.

Results Varying levels of depression, anxiety, and stress were found among investigated participants. The mental problem was found related to gender ($p < 0.01$), school levels ($p < 0.001$), and regions ($p = 0.001$). Regression analysis identified several factors correlating with DASS-21 scores, with concerns about physical appearance being particularly prominent among students.

Conclusion Undergraduate dental students in final year in mainland China experience significant mental health challenges, including depression, anxiety, and stress. Factors including gender, school levels, and regions all showed significant difference in stress, depression, and anxiety. Besides, various academic and social reasons would contribute to that. Social support should pay more attention to mental health in dental students.

Keywords DASS-21, Mental problem, Dental education, Undergraduate

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Introduction

The World Health Organization stipulates that mental health conditions among young adults are becoming a growing concern, with suicide and depression, respectively, the second and third leading cause of death among individuals aged between 15 and 29 [1]. Compared to students in other majors, medical students suffer more pressures and seemed have more mental health issues. The mental health of medical students has also become the focus of global attention [2].

Medical students face pressures from many aspects. Study and clinical practice pressures faced by dental students are a vital factor leading to mental health problems [3–5]. The academic burden causes medical students worry about tests, GPA and the threat of academic failure [6]. The pressures of uncertainty about the future and high career expectations which also together lead to a higher incidence of mental health problems [1, 3–5]. Similar to general medical students, dental students also have to deal with pressures from patient care, peer competition, communication with faculties, and practical-clinical issues [5]. There is no doubt that dental students face great pressure. And these pressures have caused a huge psychological burden on dental students, which should also be concerned by dental educators [7]. In addition, with the popularization of advanced education, the number of college graduates has risen sharply in recent years, leading to a supply-demand imbalance in the job market. Meanwhile, dental students have many options to make when they graduate, such as pursuing higher education, or seeking jobs. These decisions are closely related to their initial willingness of major, expectations for the future, and their financial conditions [8, 9]. Therefore, understanding the sources of stress, depression, and anxiety among dental students and analyzing the factors that cause such psychological problems are of great importance for educators to better carry out dental education and alleviate students' psychological burden.

Depression, Anxiety and Stress scale 21-item (DASS-21) was a mental health assessment tool used all around the world. It is the sort version of DASS (42 items). The scale can help researchers analyze the stress, depression, and anxiety status of the subjects [10]. In mainland China, there have been several studies using the DASS-21 scale to assess the psychological status of college students [11–13]. However, there is still no data support for the psychological status analysis of dental students who are in their final year at their undergraduate.

The Chinese dental education system is unique. Chinese dental students complete five years of undergraduate education. In their final year they attend a residency program to improve their practical medical knowledge and train patient-care skills [14]. Dental students in mainland China enroll in dental school directly from high school via the College Entrance Examination, where they face tremendous competition [14, 15]. After entering dental school, Chinese dental students not only have to face the pressure of clinical practice but also cannot ignore the pressure of academic research. This is also a difference between Chinese dental education and that of other countries [14]. The classification of Chinese university is also different from that in other countries. According to China's educational policy, higher education institutions in China can be divided into two categories: Double First-Class universities and non-Double First-Class universities. Students in Double First-Class universities usually face more academical pressure. Moreover, economic development plays a significant role in shaping students' career choices and the pressure they face in job seeking. Due to the unique geographical characteristics of China, there is a substantial economic disparity between the eastern and western regions, resulting in differing levels of living and employment pressures. Generally, China's distinct national conditions and policies mean that the pressures dental students face in China differ from those experienced by their counterparts in other countries. Therefore, it is essential to conduct research on the psychological well-being of dental students within the specific context of China.

In this study, we conducted a questionnaire survey targeting undergraduate dental students in their final year of study in mainland China. Additionally, we assessed their psychological status via DASS-21 scale. We aim to provide preliminary data evidence in this field under the very special background of China's economy and education, and assist educators in reflecting on the application and reform of educational models, as well as in enhancing educational quality and will eventually benefit undergraduate dental student in the final year, assisting them with personal as well as professional development.

Materials and methods

Study population and procedures

A national cross-sectional study of undergraduate dental students in graduation year in Mainland China was conducted to assess the mental health of dental students and its associated causes. An online survey was developed using an Internet survey platform (https://www.wjx.cn/). The research was approved by the Ethics Committee of the Affiliated Stomatology Hospital of Guangzhou Medical University (Ethics Number: JXYJ2024001). Following the approval of universities, a link of the online survey was posted on numerous social network pages associated with dentistry, and invitations were sent to registered dental students from various universities in Mainland China. The survey's introduction explained the study and the voluntary and anonymous nature of the study introduced to the students before they filled

out the questionnaire. There are no conflicts of interest associated with this study. All participants involved in the research have provided their informed consent and are independent of any external influences. The research team has ensured that the study design, data collection, analysis, and reporting have been conducted with integrity and transparency, free from any financial or personal relationships that could potentially bias the results. All data collection was completed from March 2024 to May 2024.

Inclusion/exclusion criteria

In the population infiltration process, a strict Inclusion/Exclusion Criteria has been followed.

Inclusion criteria

1. Participants were undergraduate dental students in their final year at universities in mainland China.
2. Participants were able to understand and complete the Chinese-language DASS-21 Scale.
3. Participants voluntarily consented to participate in the study and signed the informed consent form.
4. Participants had no history of severe cognitive impairments or psychiatric disorders and were able to complete the psychological health assessment.

Exclusion criteria

1. Participants with severe psychiatric disorders, such as major depressive disorder, bipolar disorder, schizophrenia, etc., which could interfere with the study results, were excluded.
2. Participants who were undergoing treatment for depression, anxiety, or other related mental health issues (e.g., pharmacological or psychotherapeutic treatments) were excluded to prevent treatment-related biases from affecting the study results.
3. Pregnant or breastfeeding women were excluded, especially in studies involving potential pharmacological interventions or where physiological hormones might significantly influence study outcomes.
4. Participants who were unable to understand or complete the Chinese-language questionnaires due to language barriers were excluded.
5. Participants with serious physical health conditions, such as recent major surgery or acute episodes of chronic illness, were excluded due to the potential impact on their emotional and psychological states, which could distort the study results.
6. Participants with incomplete data or who failed to follow the study protocol (e.g., incomplete questionnaires) were excluded from the analysis.

Survey instruments

Depression Anxiety and Stress Scales (DASS-21) were used in this study to estimate depression, anxiety and stress among enrolled participants [11]. DASS-21 is an instrument that has 21 items with four response options in Likert format: "It has not happened to me" = 0, "It has happened a little" = 1, "It has happened quite a bit" = 2, and "It has happened a lot" = 3. The DASS-21 questionnaire comprises three distinct dimensions that assess different aspects of mental health. The severity of depression was categorized into five levels as: 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 Normal (0–14), Mild (15–18), Moderate (19–25), Severe (26–33), and Extremely Severe (34+) [16].

The validity and application in Chinese samples were also reported in many studies with confident validity as well as internal consistency and composite reliability [17]. The Chinese version of DASS-21 was used to assess undergraduate students' level of depression, anxiety and stress as well [18]. The DASS-21 questionnaire comprises three distinct dimensions that assess different aspects of mental health. Regarding the reliability analyses, for the Depression scale (0.72), anxiety (0.80), and stress (0.76) were identified. With internal consistency for the depression scale (0.77), anxiety (0.79), and stress (0.76),validated in Chinese population [10].

The questionnaire of university life and satisfaction survey

The questionnaire consisted of 17 socio-educational questions. In addition to gathering information about schools and districts of participants, the questionnaire included a total of 15 descriptive questions, which were described in detail in Supplementary Table 1. Briefly, the questionnaire was mainly to evaluate five aspects including self-evaluation, academic and professional evaluation, social interaction, family burdens and future plans. For the evaluation of satisfaction-related issues, we offer three options: "satisfied", "moderately satisfied" and "unsatisfied". For the other questions, "yes" and "no" were provided as options. Only one question on career switching were provided another option "Considering". Considered that GPA calculation in different schools varies, we made a uniform standard to evaluate the impact of GPA, and the explanations were also provided in the questionnaire before participants fill in this item.

The dependent variables were depression, anxiety, and stress, which were operationally defined, according to the DASS-21 scale. The independent variables were 17 socio-educational factors.

Statistical analysis

All outcomes were collected by an online-based survey instrument followed the standard work flow (Fig. 1). Outcomes were digitally recorded and analyzed afterwards by SPSS software (SPSS Statistic 25, IBM, Armonk, NY, USA). Descriptive analysis was completed and the normality of all data variables was tested by the Kol-mogorov and Shapiro–Wilk test. All the data used for scale analysis did not follow a normal distribution (Supplementary Table 2). Therefore, to further examine the relations between DASS-21 ratings and sociodemographic factors, univariate analyses (Kruskal–Wallis H test and Mann–Whitney U test) were applied. For significant statistical test outcomes post hoc, the Dunn–Bonferroni statistical test was further applied in single comparisons. Then multiple linear regression tests were executed on DASS-21 total and sub scores to distinguish the involvement of the earlier recognized, relevant factors. Statistical significance was set at $p < 0.05$.

Results

Sociodemographic characteristics of participants

A total of 596 questionnaires were collected, after inclusion and exclusion infiltration, 514 questionnaires were finally involved for following statistical analysis (Fig. 2; Table 1). In summary, 189 male participants and 325 female participants from 18 universities in Mainland China are included in the study. Among 18 universities, 7 were Double First-class universities, 11 were defined as Non double First-Class universities. Among the Double First-Class universities, there were 2 from the western region, 2 from the central region and 3 from the eastern region; among the Non double First-Class universities, there were 4 from the western region, 4 from the central region and 3 from the eastern region. (Fig. 3). 201 participants are from double first-class universities, and the other 313 are from non-double first-class universities. Considered the region distribution of these participants, 123 are for the East China, 225 are from Central region, and 166 are from West China (Table 1).

Scores of DASS-21 scales and associated factors

Table 2 shows the overall DASS-21 scores among participants. The total score according to DASS-21 among 514 participants is 10.87 ± 10.821, and the interquartile range (IQR) is 14. In terms of the subscale, the scores of depression, anxiety, and stress are 3.31 ± 3.812, 3.12 ± 3.534, and 4.44 ± 4.071, respectively. And the IQR of these three items are 5, 5, and 6, respectively.

The severity of depression, anxiety, and stress in undergraduate dental students in graduation year

In order to further analyze the degree of depression, anxiety, and stress in stomatology students, the number and proportion of the severity of each subcategory in the scale were counted respectively, and the gender was classified and compared (Table 3; Fig. 4). The results showed that 28.8% of all participants reported symptoms of depression, of which 4.4% reported severe or very severe symptoms of depression. 32.9% showed symptoms of anxiety,

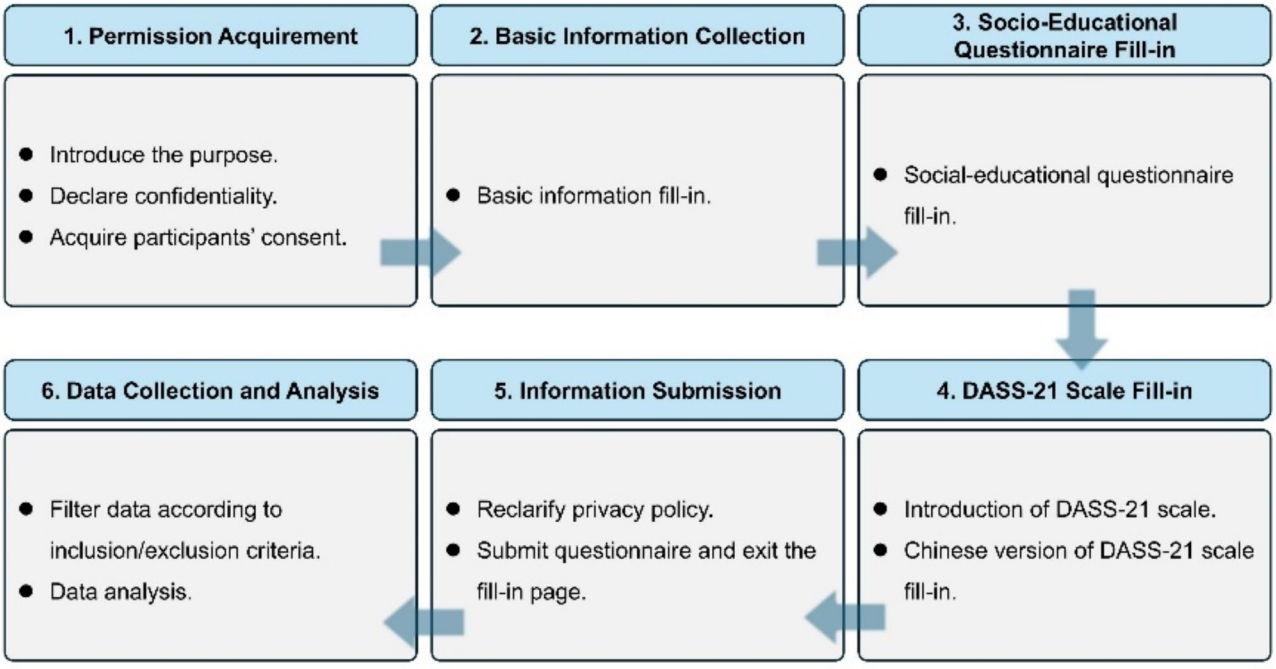

Fig. 1 Flow diagram of research process

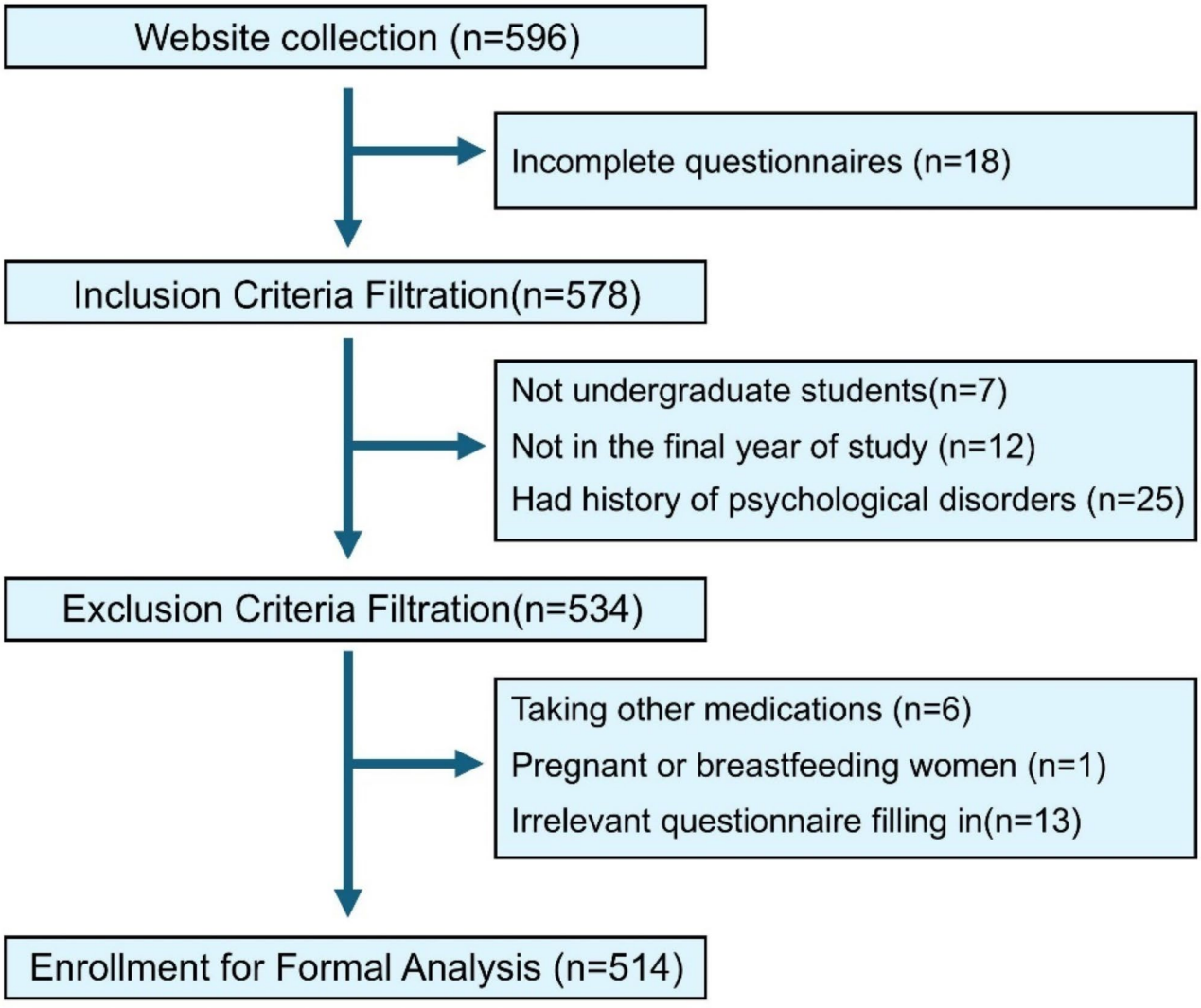

Fig. 2 Flow diagram for inclusion and exclusion of participants

Table 1 Characteristics of involved participants

Sociodemographic factors		*N* (%)
Gender	Male	189 (36.8)
	Female	325 (63.2)
University Level	Double First-class	201 (39.1)
	Non double First-class	313 (60.9)
Area	East	123 (23.9)
	Central	225 (43.8)
	West	166 (32.3)

with 9.9% of participants reporting symptoms as "severe" or "very severe." 17.9% of participants had symptoms of stress, of which 4.9% reported symptoms as "severe" or "very severe".

Variable analysis for DASS-21 and subscale scores in undergraduate dental students in graduation year

Furthermore, we conducted comparisons based on the characteristics of the study participants to assess the impact of different factors on participants' total DASS-21 scores and scores in each subcategory (Table 3). In terms of gender, there were significant differences in DASS-21 scores between male and female participants ($p < 0.01$). Females presented more severe conditions than me. Moreover, there were significant differences in the scores for depression, anxiety, and stress between the two groups ($p < 0.01$, $p < 0.01$, and $p < 0.05$, respectively), females got higher scores in all three subtypes. At the university level, students from Double First-Class universities and those from non-Double First-Class universities also exhibited statistically significant differences in total scores ($p < 0.001$) and scores in each subcategory (Depression $p < 0.001$, Anxiety $p < 0.001$, and

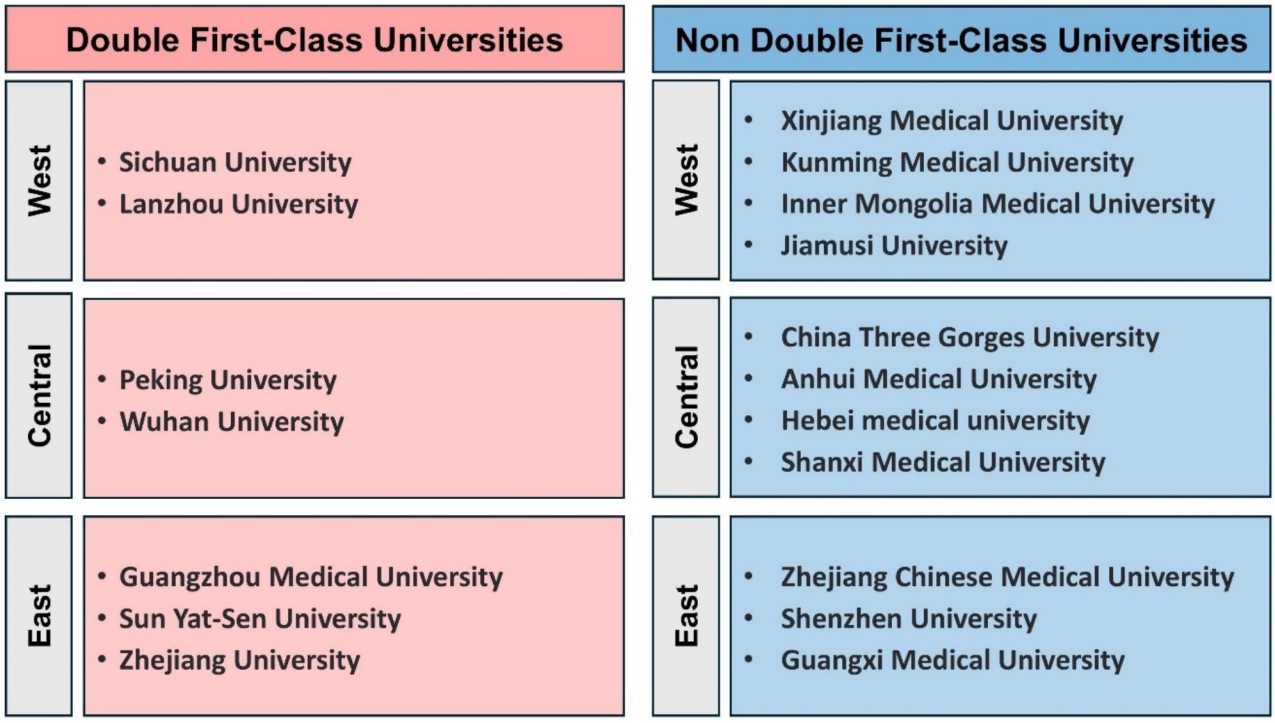

Fig. 3 The distribution of the universities participating in the research at the school level and the region divisions

Table 2 Overall DASS-21 scores of the study participants

DASS-21	Mean ± SD	IQR
Total	10.87 ± 10.821	14
Depression	3.31 ± 3.812	5
Anxiety	3.12 ± 3.534	5
Stress	4.44 ± 4.071	6

Table 3 Number of total population and gender percentage for each DASS-21 category

Subscale	Severity	Participant number *N* (%)	Gender *N* (%)	
			Male	Female
Depression	Normal	366(71.2)	137(72.5)	229(70.5)
	Mild	50(9.7)	22(11.6)	28(8.6)
	Moderate	75(14.6)	22(11.6)	53(16.3)
	Severe	10(1.9)	3(1.6)	7(2.2)
	Extremely Severe	13(2.5)	5(2.6)	8(2.5)
Anxiety	Normal	345(67.1)	137(72.5)	208(64)
	Mild	68(13.2)	18(9.5)	50(15.4)
	Moderate	50(9.7)	15(7.9)	35(10.8)
	Severe	23(4.5)	10(5.3)	13(4)
	Extremely Severe	28(5.4)	9(4.8)	19(5.8)
Stress	Normal	422(82.1)	156(82.5)	266(81.8)
	Mild	36(7.0)	15(7.9)	21(6.5)
	Moderate	31(6.0)	8(4.2)	23(7.1)
	Severe	16(3.1)	7(3.7)	9(2.8)
	Extremely Severe	9(1.8)	3(1.6)	6(1.8)

Stress $p < 0.001$). Generally, the statistics showed that enrolled students in Double First-Class universities have been facing more depression, anxiety, and stress conditions. This trend was similarly observed across different regions. Comparing regions revealed significant differences in total DASS-21 scores ($p = 0.001$) and subscale scores (Depression $p < 0.01$, Anxiety $p < 0.05$, and Stress $p < 0.001$) between the eastern and central regions, with the eastern region scoring significantly higher than the central region. There were significant differences in total DASS-21 scores ($p < 0.05$) and depression scores ($p < 0.05$) between the central and western regions, with the western region scoring significantly higher than the central region. However, there were no significant differences between the eastern and western regions.

Multiple regression analysis of DASS-21 total and subscale scores in undergraduate dental students in graduation year

In order to further study the correlation between symptoms of depression, anxiety and stress and life of stomatology students, we analyzed the correlation between the survey items in the questionnaire and the score of DASS-21 scale (Table 5). After analyzing the 15 questions in the questionnaire, it is found that 7 items including Satisfaction with appearance, Satisfaction with university life, Classmate relationship/friendship, Over-demanding, Satisfaction with employment prospects, Satisfaction with internship arrangements, Average GPA, and Profession

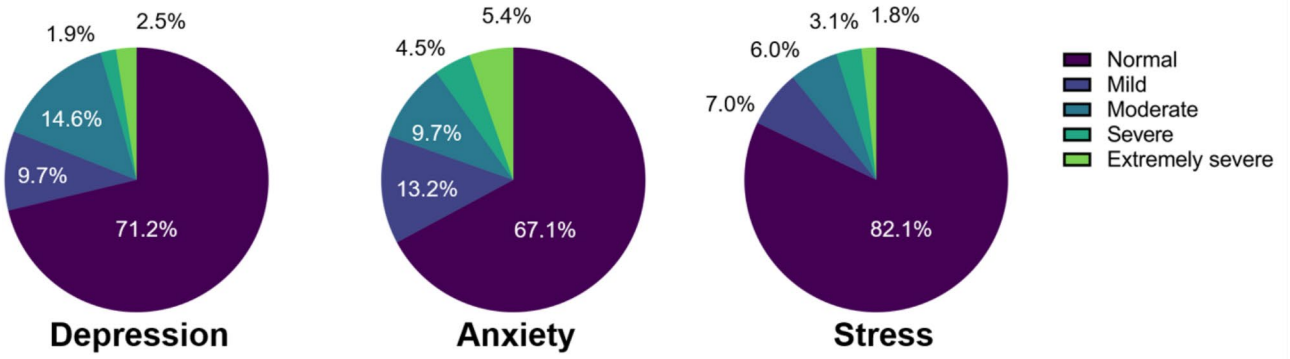

Fig. 4 The distribution of undergraduate dental students in graduation year in Mainland China on depression, anxiety, and stress. The levels were divided into normal, mild, moderate, severe, and extremely severe

change consideration were statistically related with total scores of DASS-21. Expect for the item Over-demanding (β= -0.119), other items performed positive correlation with total DASS-21 scores, among which Satisfaction with appearance performed the largest standardized coefficient (β = 0.218, $p < 0.001$).

Moreover, we analyzed the survey in each subscale. For Depression subscale analysis, 8 items were statistically related to scores of depression. For Anxiety subscale analysis, 8 items showed statistical relations with anxiety scores. For Stress subscale analysis, there were also 8 items found related to the scores. Among three subscale analysis, Satisfaction with appearance was identified the most related item (Depression β = 0.21, $p < 0.001$, Anxiety β = 0.202, $p < 0.001$, Stress β = 0.202, $p < 0.001$).

According to the subscale analysis results, Average GPA, Satisfaction with internship arrangements and career prospects showed positive correlation with all three scores. Classmate relationship/friendship also showed positive correlation with all three scores. Besides, Over-demanding showed statistically negative impact on scores of depression, anxiety, and stress.

Discussion

With the increasing pressure of further education and employment in Chinese society, college students are under increasing pressure and have a higher incidence of psychological problems. A study showed that the prevalence of depression, anxiety and stress among college students was 18.4%, 23.6% and 34.5% respectively [19]. This indicates that symptoms of depression, anxiety, and stress have become common among college students. Among all of the students, medical students seem to be under the most pressure [20–22]. Therefore, focusing on the mental health of medical students and analyzing the underlying causes of their stress is crucial to improving their well-being and fostering the positive advancement of medical education. In our survey, based on the results of DASS-21 scale, the percentages of patients with depression, anxiety, and stress among recent graduate-year dental students were 28.8%, 32.9%, and 17.9%, respectively. The majority of the affected students were found with symptoms of moderate or higher degrees (Table 3; Fig. 4). There were similar research results in other studies. A study investigated the students from the Bachelor of Dental Science program at The University of Queensland of their levels of depression, anxiety and stress. Their results showed that 24%, 44% and 11% of students had moderate or above levels of depression, anxiety and stress, respectively [31]. Same research at the College of Dentistry of KSU in Riyadh City found an abnormal levels of depression, anxiety and stress were identified in 55.9%, 66.8% and 54.7% of the study participants, respectively [32]. This study appears to report higher levels of stress, depression and anxiety problems compared to our findings. However, this may have something to do with the fact that the study included more grade groups, while we only focused on the students in the final year at their undergraduate.

Understanding the mental state of students at different grades is very important because it will prompt educators to make more targeted educational programs. In a survey based on GHQ-12 questionnaire, researchers found that the stress levels in dental students increased year by year and reached the upmost in the final year [23]. Fifth-year students face greater pressure as they are subject to multiple pressures from society, work and study [23–25]. It could be explained under our social background as well. In mainland China, undergraduate dental students mainly face two options: find a job or pursue graduate study. However, due to China's large population and descending economic growth, it has become more difficult to pursue graduate school and work. But interestingly, in our study, neither of these points showed significant depression, anxiety, and stress. But considering a career change significantly increased participants'

depression and stress levels. While in other research, there was reports showed that the pressure level in freshmen was higher than it in fifth grade students. They explained that it may be attributed to their adaptation to the university environment and the development of coping strategies for stress. Although they enrolled medical students in their study, they didn't separate medical students from the whole group [26].

Gender was found to be a significant factor affecting mental health in the undergraduate dental student in their final year. According to our analyzed data, Female students showed more depression, anxiety and stress because less proportional ratio in severity "Normal" has been noticed (Table 3). Also, the DASS-21 total and subscale scores for males were significantly lower than that for females (Table 4), which was consistent with some similar studies [27, 28]. It has been shown that female students care more about their body image and academic performance, which led to a higher anxiety level [18]. This may be related to the fact that female students have a higher sensitivity in dealing with interpersonal relationships, which is important throughout dental education, as a high level of interpersonal skills is often required in this field [28]. Another possible reason behind this difference may be that female students were more likely to express their feeling, while male students tended to hide it [23].

We also found that students in double first-class universities bear a greater psychological burden than students in non-double first-class universities. Education could impact mental health in different ways. Educational attainment has previously been shown to be positively associated with levels of depression [29]. People with less education may have fewer economic and social resources to cope with a depressive episode. However, studies on student population may have reached the opposite conclusion. In better research institutions, students are more concerned about their GPA and their daily performance, so there may be more severe anxiety and stress situations [30, 31]. This psychological characteristic may also be the reason why medical students generally show higher rates of depression and anxiety [32]. Another multicenter study found that medical students' depression and anxiety symptoms were associated with school location and tuition scholarship. Though there were seldom discussed the role of school levels to this result, it also warned us that educational institutes may also impact students' mental health [33]. Besides, In China, there is an invisible relationship between the location of schools and the level of economic development. For example, Beijing and Shanghai are among the most developed regions in China, and most of the schools here are top-tier universities. This is because the development of schools in China is partly linked to the financial resources of the region,

Table 4 Differences in participants' characteristics regarding DASS-21 total score and subscale scores

Variables	DASS-21 Total			DASS-21 Depression			DASS-21 Anxiety			DASS-21 Stress		
	Mean ± SD	Test Statistic	*p*	Mean ± SD	Test Statistic	*p*	Mean ± SD	Test Statistic	*p*	Mean ± SD	Test Statistic	*p*
Gender												
Male	9.67 ± 10.898	U = 25,935	< 0.01	2.87 ± 3.734	U = 26109.5	< 0.01	2.71 ± 3.498	U = 25639.5	< 0.01	4.09 ± 4.173	U = 27,335	< 0.05
Female	11.58 ± 10.731			3.57 ± 3.838			3.36 ± 3.539			4.65 ± 4.003		
University Level												
Double First-Class	14.67 ± 11.665	U = 16813.5	< 0.001	4.58 ± 4.268	U = 17,390	< 0.001	4.07 ± 3.912	U = 18,297	< 0.001	6.03 ± 4.243	U = 16,463	< 0.001
Non-Double First-Class	9.68 ± 10.270			2.91 ± 3.570			2.82 ± 3.358			3.94 ± 3.889		
Area												
East	12.49 ± 11.216	H = 13.720	0.001	3.79 ± 4.102	H = 10.966	< 0.01	3.34 ± 3.640	H = 8.406	< 0.05	5.35 ± 4.236	H = 16.515	< 0.001
Central	9.32 ± 10.731			2.81 ± 3.697			2.75 ± 3.524			3.76 ± 3.971		
West	11.29 ± 10.221			3.48 ± 3.596			3.33 ± 3.347			4.49 ± 3.886		
Post hoc test												
East-Central		57.029	0.001	-	48.090	< 0.01	-	40.704	< 0.05	-	64.742	< 0.001
East-West		18.065	0.862	-	9.753	1.000	-	5.067	1.000	-	29.991	0.228
Central-West		-38.964	< 0.05	-	-38.336	< 0.05	-	35.637	0.058	-	-34.750	0.071

and the more developed a city is, the more it can attract outstanding talents. Additionally, the economic level of a city also becomes a factor for students when choosing universities. Therefore, the location of a school may involve more complex factors that need to be explored when evaluating related issues.

Apart from school factor, region factors were also found statistically significant with the total DASS-21 score. In our research, the DASS-21 score and its subscale scores were significantly higher in the eastern region compared to that in the central region. It could be explained by high-speed life in eastern regions was more likely to cause people feel anxious, depressive, and stressful. Besides, western China maintains more traditional social structures and values of collectivism. The social support systems are more developed and mutual aid among community members is more common, individual psychological stress in such circumstances may be reduced [2, 34]. This is also in line with our finding that students' psychological states are correlated with good relationships with family, teachers, and classmates as well as satisfaction with life and internship experiences.

Social support can be beneficial for mental health in many ways [35]. Study has shown that students with low quality social support were more likely to experience mental health problems, including a sixfold risk of depressive symptoms relative to students with high quality social support [36]. The results were consistent with our findings. Students who shared a good relationship with classmates/friends, or felt satisfied with communications with college teachers showed lower rates of depression, anxiety, and stress. As a dental educator, in addition to imparting professional knowledge and skills to students, caring for students' physical and mental health is also an important part of education. Especially dental education itself was of highly pressure, educators should pay more attention on students' mental health development. To our acknowledge, there were few researches were in the assessment of psychological problems of dental students. Therefore, the implementation and analysis of this study has opened up this link to a certain extent. It also brings thoughts for subsequent related research. This also indicated that college and other related administrative departments should pay more attention on that and showed more social support to mental health problems among college students [37, 38].

However, our study has several limitations. Firstly, the sample size may not be sufficient to fully support our conclusions, and further validation is necessary. Given that psychological surveys targeting this group have not been conducted in mainland China, we lacked a substantial reference dataset. This study was based on an online questionnaire administered after confirming sample target, and we did not strictly control the sample acquisition process. Our goal was to gather a large sample to support our conclusions and provide data for future research. Additionally, dental students from vocational schools were not included in our survey, which is another limitation. Students from vocational institutions may have different views on career choices and professional awareness, and including this group could have provided more comprehensive data. Lastly, our questionnaire did not collect opinions from students on how they expect from school, or on assisting them with their mental issues. Addressing this could have helped guide educators in designing targeted psychological counseling services, which should have been one of the primary objectives of our research — to help students manage depression, anxiety, and stress more effectively.

In general, to our acknowledge, this is the first study on evaluating mental health among undergraduate dental students in the final year in mainland China. By comprehensively analyzing age, school level, regions, and other socioeconomic factors related to dental students, we provided statistical estimations on their depression, anxiety, and stress for the first time. This study provides valuable insights and data to support future related research and offers guidance for dental educators.

Conclusion

Many dental undergraduates in mainland China having shown significant symptoms of depression, anxiety, or stress in their final year. Moderate and higher levels of stress, depression and anxiety were reported in our study. Female population, students in eastern area, and those who are from double-first class university showed higher scores according to DASS-21. Socio-educational factors contributed to the high occurrence of stress, depression and anxiety. Among all factors in all subscale analysis, appearance worry was the top reason in graduate dental students. Social support also had a significant effect on their mental health status. We should provide appropriate mental health support for students throughout their dental education by providing practical advice and emotional support during their learning process.

Table 5 Multiple regression analysis of DASS-21 total and subscale scores and associated factors

Survey items	Scores	B	SE	β	T	*P*	95%CI
Gender	DASS-21	-0.691	0.811	-0.031	-0.852	0.395	-2.284; 0.902
	D	-0.101	0.294	-0.013	-0.344	0.731	-0.679; 0.477
	A	-0.164	0.274	-0.022	-0.599	0.55	-0.701; 0.374
	S	-0.426	0.314	-0.05	-1.354	0.176	-1.043; 0.192
Marital Status	DASS-21	-1.259	0.809	-0.054	-1.557	0.12	-2.847; 0.330
	D	-0.305	0.293	-0.037	-1.038	0.3	-0.881; 0.272
	A	-0.385	0.273	-0.051	-1.413	0.158	-0.921; 0.151
	S	-0.569	0.313	-0.065	-1.815	0.07	-1.185; 0.047
Average GPA	DASS-21	1.541	0.507	0.109	3.039	**< 0.01**	0.545; 2.538
	D	0.38	0.184	0.076	2.066	**< 0.05**	0.019; 0.742
	A	0.507	0.171	0.109	2.963	**< 0.05**	0.171; 0.843
	S	0.654	0.197	0.122	3.327	**0.001**	0.268; 1.040
Willingness	DASS-21	0.622	0.882	0.025	0.706	0.481	-1.111; 2.355
	D	0.158	0.32	0.018	0.494	0.622	-0.471; 0.787
	A	0.398	0.298	0.049	1.338	0.181	-0.186; 0.983
	S	0.066	0.342	0.007	0.193	0.847	-0.606; 0.738
Satisfaction With Appearance	DASS-21	3.475	0.607	0.218	5.721	**< 0.001**	2.281; 4.668
	D	1.177	0.22	0.21	5.343	**< 0.001**	0.744; 1.610
	A	1.051	0.205	0.202	5.127	**< 0.001**	0.648; 1.453
	S	1.247	0.235	0.208	5.296	**< 0.001**	0.784; 1.709
Satisfaction With University Life	DASS-21	2.627	0.79	0.155	3.326	**0.001**	1.075; 4.179
	D	0.897	0.287	0.15	3.13	**< 0.05**	0.334; 1.460
	A	0.588	0.267	0.106	2.207	**< 0.05**	0.065; 1.112
	S	1.142	0.306	0.179	3.73	**< 0.001**	0.540; 1.744
Classmate Relationship / Friendship	DASS-21	3.2	0.861	0.149	3.714	**< 0.001**	1.507; 4.892
	D	1.23	0.313	0.162	3.936	**< 0.001**	0.616; 1.844
	A	1.135	0.291	0.161	3.904	**< 0.001**	0.564; 1.706
	S	0.835	0.334	0.103	2.499	**< 0.05**	0.179; 1.491
Communication With University Teachers	DASS-21	1.619	0.89	0.079	1.819	0.07	-0.130; 3.367
	D	0.609	0.323	0.084	1.887	0.06	-0.025; 1.244
	A	0.846	0.3	0.126	2.818	**< 0.01**	0.256; 1.436
	S	0.163	0.345	0.021	0.473	0.637	-0.515; 0.841
Satisfaction With Employment Prospects	DASS-21	2.04	0.727	0.118	2.806	**< 0.01**	0.612; 3.467
	D	0.527	0.264	0.086	1.998	**< 0.05**	0.009; 1.045
	A	0.631	0.245	0.111	2.573	**< 0.05**	0.149; 1.113
	S	0.882	0.282	0.135	3.131	**< 0.01**	0.328; 1.435
Satisfaction With Internship Arrangements	DASS-21	1.947	0.743	0.116	2.62	**< 0.01**	0.487; 3.407
	D	0.63	0.27	0.107	2.338	**< 0.05**	0.101; 1.160
	A	0.502	0.251	0.092	2.003	**< 0.05**	0.010; 0.995
	S	0.814	0.288	0.129	2.827	**< 0.01**	0.248; 1.380
Profession Change Consideration	DASS-21	1.409	0.582	0.098	2.42	**< 0.05**	0.265; 2.554
	D	0.533	0.211	0.105	2.523	**< 0.05**	0.118; 0.948
	A	0.325	0.196	0.069	1.652	0.099	-0.061; 0.711
	S	0.552	0.226	0.102	2.444	**< 0.05**	0.108; 0.995
Future Work Plan	DASS-21	-1.151	0.791	-0.053	-1.454	0.147	-2.706; 0.404
	D	-0.205	0.287	-0.027	-0.712	0.477	-0.769; 0.360
	A	-0.512	0.267	-0.072	-1.917	0.056	-1.037; 0.013
	S	-0.434	0.307	-0.053	-1.416	0.158	-1.037; 0.168
Future Study Plan	DASS-21	-1.214	0.842	-0.052	-1.441	0.15	-2.870; 0.441
	D	-0.414	0.306	-0.05	-1.353	0.177	-1.014; 0.187
	A	-0.317	0.284	-0.042	-1.116	0.265	-0.876; 0.241
	S	-0.483	0.327	-0.055	-1.48	0.139	-1.125; 0.158

Table 5 (continued)

Survey items	Scores	B	SE	β	T	*P*	95%CI
Financial Responsibility	DASS-21	0.81	0.941	0.031	0.861	0.389	-1.038; 2.659
	D	0.115	0.341	0.012	0.337	0.736	-0.556; 0.786
	A	0.272	0.317	0.032	0.857	0.392	-0.352; 0.896
	S	0.423	0.365	0.043	1.16	0.247	-0.293; 1.140
Over-Demanding	DASS-21	-3.402	1.015	-0.119	-3.351	**0.001**	-5.397; -1.408
	D	-0.928	0.368	-0.092	-2.52	**< 0.05**	-1.652; -0.204
	A	-1.252	0.343	-0.134	-3.655	**< 0.001**	-1.925; -0.579
	S	-1.222	0.394	-0.114	-3.105	**< 0.01**	-1.995; -0.449

Abbreviation: B unstandardized beta coefficient, SE standard error, β standardized beta coefficient, T Statistic value, P *p*-value, CI confidence interval

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Not applicable.

Author contributions
Y. F., M. Y., and S. Z. designed the whole experiment. Y. F., M. Y., and W. H. collected data in this study. Y. Z. and Y. F. analyzed the data. Y. F. and X. G. designed the questionnaire. Y. F. and M. Y. wrote the manuscript, Y. F., M. Y., and Y. C. revised the manuscript. S. M. and S. Z. supervised the whole project.

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Data availability
Data used to support the findings of this study are available from the corresponding author upon request.

Declarations

Ethics approval and consent to participate
The research adhered to the Declaration of Helsinki. The research was approved by the Ethics Committee of the Affiliated Stomatology Hospital of Guangzhou Medical University. All participants involved in the research have provided their informed consent and are independent of any external influences.

Consent of publication
Not applicable.

Competing interests
The authors declare no competing interests.

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