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ORIGINAL RESEARCH

Exploring the Correlation Between Psychological Stress, Anxiety, and Periodontitis Among University Students: A Cross-Sectional Investigation

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Objective: Periodontitis is a prevalent chronic inflammatory disease, with growing evidence suggesting a link to psychological factors such as stress and anxiety. University students, who frequently experience elevated psychological stress, may be particularly susceptible to periodontal issues. This study aimed to examine the relationship between stress levels, anxiety status, and periodontitis in university students, and to assess the potential influence of psychological factors on periodontal health.

Methods: The study sample comprised 240 university students. Participants were categorized post hoc according to their periodontal status and psychological assessment scores. Periodontal health was evaluated using the Community Periodontal Index (CPI), while stress and anxiety levels were measured with the Perceived Stress Scale-14 (PSS-14) and the Generalized Anxiety Disorder-7 (GAD-7), respectively. Statistical analyses included chi-square tests and multivariable logistic regression models to examine associations between psychological factors and periodontitis, adjusting for potential confounding variables.

Results: Among the participants (mean age: 21.70 ± 3.16 years), 43.3% were diagnosed with periodontitis. The mean age was 21.78 ± 3.32 years in the non-periodontitis group and 21.24 ± 2.06 years in the periodontitis group. Anxiety was prevalent: 33.8% had no anxiety, 30.8% had mild, 22.1% had moderate, and 13.3% had severe anxiety. Reported stress levels were 35.0% normal, 48.8% high, and 16.3% very high. Anxiety levels were significantly associated with an increased risk of periodontitis ($P < 0.001$). After adjusting for a range of potential confounders, including but not limited to gender, age, education level, smoking, and oral hygiene practices, individuals with mild, moderate, and severe anxiety had 8.391 (95% CI: 2.776–25.362), 11.423 (95% CI: 3.116–41.872), and 46.196 (95% CI: 10.414–204.921) times higher odds of developing periodontitis, respectively, compared to those without anxiety. In contrast, stress levels were not significantly associated with periodontitis after adjustment ($P > 0.05$).

Conclusion: Anxiety was significantly associated with periodontitis in university students, highlighting the importance of addressing anxiety as part of periodontal disease prevention and management strategies in this population.

Keywords: periodontitis, anxiety, stress, university students, oral health

Introduction

Periodontitis is one of the most common non-communicable diseases worldwide and is recognized as a significant public health issue affecting both oral and systemic health. As a complex inflammatory disease, periodontitis not only leads to the destruction of periodontal supporting tissues but is also closely associated with various systemic diseases.[1] Recent studies have shown that periodontitis may serve as an important risk factor for cardiovascular diseases, diabetes, chronic obstructive pulmonary disease, hypertension, and certain types of cancer, particularly in cases of severe periodontitis.[2,3] Essentially, periodontitis is a chronic inflammatory condition, with its primary pathological mechanism closely related to the host immune response triggered by microbial communities within dental plaque.[4,5] The persistent infection of pathogenic bacteria induces an inflammatory response in periodontal tissues, which, through host immune-mediated

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mechanisms, leads to the destruction of periodontal supporting structures, ultimately resulting in clinical attachment loss, periodontal pocket formation, and alveolar bone resorption. As the disease progresses, teeth gradually become loose, gingival recession occurs, and tooth loss may eventually follow.[6,7] To more precisely assess and classify the severity and progression of periodontitis, Tonetti et al proposed a classification system in 2018, jointly formulated by the European Federation of Periodontology and the American Academy of Periodontology.[8] This classification system, based on the clinical presentation of the disease and its impact on periodontal supporting structures, categorizes periodontitis into different stages and progression rates. Among these, clinical attachment loss, radiographic bone loss, and tooth loss due to disease serve as the primary indicators for staging.

Depression and anxiety are two common psychosocial disorders that frequently co-occur. In recent years, the global prevalence of these conditions has been rising, impacting not only overall health but also closely relating to oral and periodontal health.[9,10] Existing studies have suggested a potential association between psychological stress and the onset and progression of periodontitis.[11] Stress may influence the host response to periodontal pathogens through neuroendocrine and immune system regulation, thereby affecting periodontal health. Additionally, most individuals experience various negative life events, such as financial stress, excessive workload, changes in intimate relationships, major illnesses, and retirement. These factors can contribute to both short-term and long-term psychological stress.[12] Notably, as stress levels increase, both the prevalence and severity of periodontitis have been observed to rise significantly, suggesting that psychological stress may play a role in the pathogenesis of periodontitis. Further research has indicated that improving oral health may, in turn, enhance psychological well-being.[13] The association between mental health disorders and severe periodontal disease may be partially explained by behavioral changes induced by psychological conditions, such as poor oral hygiene practices, smoking, and alcohol consumption, all of which have been identified as major risk factors for periodontitis.[14] Thus, mental health issues may indirectly contribute to the progression of periodontitis through maladaptive behavioral patterns. Moreover, chronic psychological stress and certain mental health disorders are often accompanied by a state of low-grade chronic inflammation, which may be a key mechanism underlying their association with periodontitis. Conversely, chronic inflammation induced by periodontitis may affect neurotransmitter regulation, further exacerbating mental health conditions.[15] Therefore, in the clinical management of periodontitis and public health interventions, psychological health factors should be carefully considered to develop more comprehensive prevention and treatment strategies.

Although numerous studies have demonstrated associations between psychological stress and periodontal health in general adult populations,[11] there remains a notable gap in research specifically targeting university students—a group particularly susceptible to both mental health challenges and early-stage periodontitis. University students occupy a transitional life stage marked by high academic demands, social pressures, and uncertainty about future careers. These stressors contribute to elevated levels of stress and anxiety, yet their potential effects on periodontal health remain underexplored. Most existing studies either overlook this demographic or lack standardized assessments for both psychological and periodontal evaluation, limiting the ability to draw targeted, evidence-based conclusions.

This study aimed to examine the association between stress levels, anxiety severity, and periodontal status among university students diagnosed with periodontitis. The central hypothesis was that higher levels of stress and anxiety would be significantly associated with worse periodontal parameters in this population. The rationale for this study lies in addressing a gap in the existing literature regarding psychosocial determinants of periodontal health in young adults. The findings are expected to provide a scientific basis for targeted oral health management strategies and inform universities and public health authorities in developing integrated mental and oral health promotion programs for university students.

Materials and Methods

Study Sample

This study was approved by the Ethics Committee of the Affiliated Stomatology Hospital of Tongji University (Approval No. [2023]-SR-26) and was conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki.[16] Written informed consent was voluntarily obtained from all participants prior to enrollment. This was a cross-sectional study conducted among university students. Participants were recruited using a convenience sampling method

from university. From March 2023 to February 2025, undergraduate, master's, and doctoral students from various academic disciplines were recruited to ensure respect for individual differences and enhance the representativeness of the data. Periodontal health examinations were conducted by professionally trained researchers, while demographic characteristics, stress levels, and anxiety status were collected through a questionnaire survey.[17]

Inclusion criteria: (1) University students aged 18–29 years; (2) In self-reported good general health with no history or current diagnosis of systemic diseases; (3) Willing to participate in the study and providing signed written informed consent. Exclusion criteria: (1) Diagnosed with systemic diseases such as cardiovascular disease, immune system disorders, or diabetes; (2) Use of medications that could affect periodontal or psychological status, including immunosuppressants, antibiotics, antioxidants, or anti-inflammatory drugs within the past six months; (3) Pregnancy or current menstruation at the time of examination, due to the potential hormonal influence on periodontal and psychological parameters.

Methods

Periodontal Examination

This study followed the basic methods for oral health surveys established by the World Health Organization (WHO) and adopted the Community Periodontal Index (CPI) probe (Majestic™, China) recommended by WHO, along with a dental mirror, to assess participants' periodontal health under artificial lighting through visual inspection and probing. Periodontal health evaluation included CPI and attachment loss (AL) measurements.

The CPI probe (features a 0.5 mm stainless steel ball tip, with a black band at 3.5–5.5 mm from the tip and additional markings at 8.5 mm and 11.5 mm, ensuring standardized and reproducible measurements (Figure 1A). Periodontal examinations were conducted by two calibrated periodontists, with intra- and inter-examiner reliability assessments performed prior to the formal examination. Ten participants underwent five repeated assessments. The intra-examiner Kappa coefficients were 0.86 and 0.92, indicating high consistency, while the inter-examiner Kappa coefficients were 0.67, reflecting good agreement between the two examiners. During the examination, the CPI probe was gently inserted along the long axis of the tooth into the gingival sulcus or periodontal pocket, at an angulation of approximately 20 to 25 degrees to the tooth surface, ensuring that the probe remained in contact with the root surface. The probe was then moved from the distal to the central area along the sulcus with slight vertical oscillation to detect subgingival calculus. Gingival bleeding upon probing and periodontal pocket depth were also observed and recorded (Figure 1B–D).

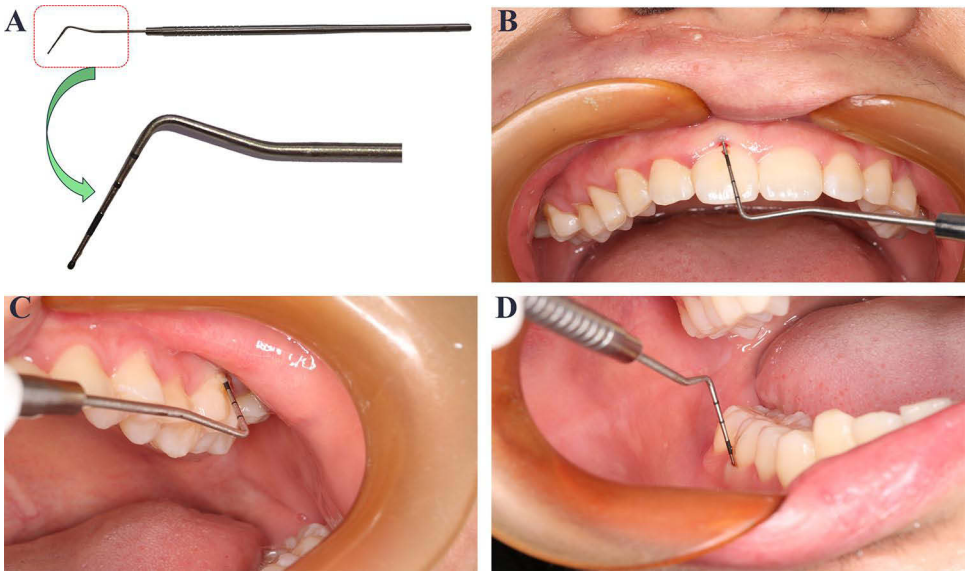

Figure 1 CPI probe(**A**) and periodontal examination process (**B–D**).

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CPI measurements were conducted in accordance with WHO recommendations across six sextants: Upper right posterior region (teeth 17–14); Upper anterior region (teeth 13–23); Upper left posterior region (teeth 24–27); Lower left posterior region (teeth 37–34); Lower anterior region (teeth 33–43); Lower right posterior region (teeth 44–47). Within each region, the examination was performed on the 10 index teeth designated by WHO (teeth 17, 16, 11, 26, 27, 47, 46, 31, 36, 37) (Figure 2). If an index tooth was missing or unexaminable, all teeth within that region were assessed. Each tooth was examined at six sites (buccal, mesio-buccal, disto-buccal, lingual, mesio-lingual, and disto-lingual), and the highest CPI score and AL value were recorded to characterize the periodontal status of that tooth. The examination sequence started from the upper right posterior region, proceeding clockwise.

AL measurement was based on the distance from the cementoenamel junction (CEJ) to the base of the periodontal pocket and was assessed concurrently with the CPI index. The AL value for each index tooth was recorded, with the highest attachment loss value of that tooth representing the individual's AL level. If no index teeth were present in a given region, all remaining teeth within that region were examined to ensure data completeness. Finally, for each participant, the highest CPI score and AL value from the examined teeth were used as the final assessment.

According to the WHO periodontal health assessment criteria, CPI scores are classified into five levels to reflect the severity of periodontal conditions: CPI 0: Healthy gums, no bleeding or calculus; CPI 1: Gingival bleeding upon probing; CPI 2: Presence of dental plaque (calculus) or subgingival plaque; CPI 3: Periodontal pocket depth of 3–6 mm; CPI 4:

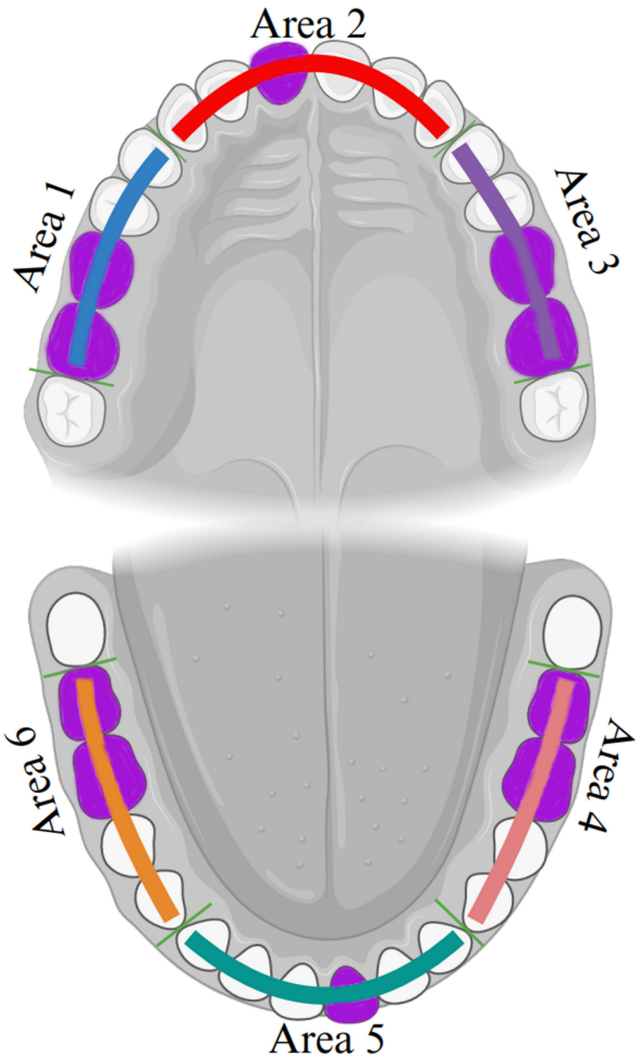

Figure 2 The six areas and the teeth coded (highlighted in purple) by the Community Periodontal Index of Treatment Needs.

Presence of dental plaque (calculus) or subgingival plaque, with periodontal pocket depth ≥ 6 mm. Similarly, AL scores are classified into five levels to quantify the destruction of periodontal supporting tissues: AL 0: 0–3 mm; AL 1: 4–5 mm; AL 2: 6–8 mm; AL 3: 9–11 mm; AL 4: ≥12 mm. Based on periodontal status, participants were categorized into a non-periodontitis group (CPI 0–CPI 2), including healthy gingiva and gingivitis, and a periodontitis group (CPI 3 or CPI 4).[8,18] Participants with CPI scores of 3–4 or AL scores ≥1 were diagnosed with periodontitis and were advised to seek periodontal treatment.[19]

The sample size calculation was based on the prevalence of periodontitis among Chinese university students. According to previous studies, the prevalence of periodontitis in this population is 57.3%.[18] With a 95% confidence level and a 5% margin of error, the minimum required sample size was determined to be 94. To mitigate the potential impact of non-response or missing data, a total of 240 university students were ultimately included in the study.

General demographic information was collected using a standardized questionnaire, including age, gender, height, weight, education level, parental education level, and only-child status. Lifestyle-related variables included smoking status, alcohol consumption habits, average daily sleep duration, oral hygiene practices and frequency, and gingival bleeding during tooth brushing. The body mass index (BMI) was calculated using the standard formula, which is the ratio of weight in kilograms to the square of height in meters.[20] All data collection was conducted during the middle of the academic semester, when there were no scheduled midterm or final examinations.

Psychological Stress Assessment

This study employed the 14-item Perceived Stress Scale (PSS-14) to assess participants' psychological stress levels.[21] The PSS-14 is primarily used to measure an individual's perceived psychological stress over the past month within a specific life context. The scale consists of 14 items, each rated on a five-point Likert scale, ranging from 0 ("never") to 4 ("very often"), with a total score ranging from 0 to 56. Based on the PSS-14 score, participants' stress levels were categorized into three groups: Normal stress: 0–28 points; High stress: 29–42 points; Very high stress: >42 points. PSS-14 has demonstrated good reliability and validity, with an internal consistency reliability coefficient at an acceptable level.[22] In addition, the Chinese version of the scale has been validated in previous studies, proving to be an effective tool for assessing psychological stress levels in the Chinese population.[23]

In this study, the PSS-14 was administered online and completed anonymously and independently by participants during the mid-semester period, outside of examination weeks. No time limit was imposed, and instructions were provided at the beginning of the questionnaire. Participants were encouraged to complete the survey in a quiet environment without external assistance.

Anxiety Level Assessment

This study employed the Generalized Anxiety Disorder 7-item scale (GAD-7) to assess participants' anxiety levels. GAD-7 is a widely used anxiety screening tool consisting of seven items, primarily designed to evaluate anxiety symptoms experienced by individuals over the past two weeks.[24] The scale follows a four-point Likert scoring system, with each item rated as follows: 0 points: "Not at all"; 1 point: "Several days"; 2 points: "More than half the days"; 3 points: "Nearly every day"; The total score ranges from 0 to 21, and anxiety levels are classified into four categories based on the scores: No anxiety: 0–4 points; Mild anxiety: 5–9 points; Moderate anxiety: 10–14 points; Severe anxiety: 15–21 points. GAD-7 has demonstrated good reliability and validity, and its Chinese version has been validated in previous studies, proving to be an effective tool for assessing anxiety levels in the Chinese population.[25]

The GAD-7 was administered concurrently with the PSS-14 through the same online platform. Participants completed the scale independently and anonymously, with clear instructions provided. The survey occurred in the middle of the academic semester and not during the examination period, which helped to avoid potential bias due to acute test-related anxiety.

Statistical Analysis

Periodontal examination data were initially recorded on paper by members of the research team and subsequently transcribed into an electronic format. Questionnaire data were directly exported from the online survey platform, and CPI

scores were calculated based on these data. All data were entered and organized using Microsoft Excel, while statistical analyses were performed using SPSS 27.0 software (IBM Corp., Armonk, NY, USA) and GraphPad Prism 8.0.2 software (San Diego, CA, USA). Descriptive statistical analysis (frequency and percentage) was used to summarize the characteristics of categorical variables. Chi-square tests were conducted to analyze associations between categorical variables, aiming to determine the relationships among anxiety, stress levels, and periodontal health status.

Additionally, multivariable logistic regression models were employed to evaluate the association between anxiety/stress levels and periodontal health status. To reduce potential confounding effects, the regression models were adjusted for gender, age, only-child status, educational, parental education, smoking, drinking, BMI index, tooth brushing frequency, toothpick use, and dental floss use. All statistical analyses were conducted using two-sided tests, with $P < 0.05$ considered statistically significant.

Result

Baseline Characteristics and Their Association with Periodontitis

A total of 240 participants were included in this study (Figure 3). Based on the CPI index, participants were categorized into two groups: non-periodontitis group (CPI 0–2) and periodontitis group (CPI 3–4). In the comparison of demographic characteristics and periodontal disease status/severity, no statistically significant differences ($P > 0.050$) were observed between the two groups regarding gender, age, only-child status, education level, parental education level, smoking status, alcohol consumption, sleep duration, BMI, toothbrushing frequency, and the use of toothpicks (Table 1).

Regarding dental flossing frequency, a marginally significant difference was observed between the two groups ($P = 0.050$). A higher proportion of individuals in the periodontitis group reported infrequent flossing, with 54.1% rarely or never using dental floss, compared to 41.4% in the non-periodontitis group. Additionally, the proportion of individuals who used dental floss at least once per day was 29.6% in the non-periodontitis group, whereas it was only 10.8% in the periodontitis group.

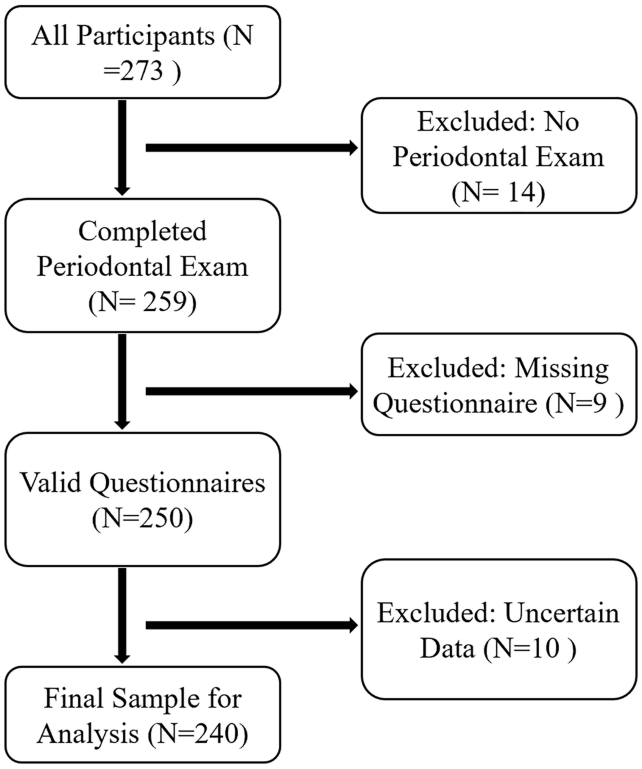

Figure 3 Flowchart of the study.

Table 1 Comparison of Demographic Data Among Covariates and the Status and Severity of Periodontal Disease

Characteristic	All (n = 240) (Weighted Column %)	No Periodontitis (CPI 0–2) N (%)	Periodontitis (CPI 3–4) N (%)	*P*
Gender				0.859
Male	133(55.4)	112(55.2)	21(56.8)	
Female	107(44.6)	91(44.8)	16(43.2)	
Age (years)	21.70±3.16	21.78±3.32	21.24±2.06	0.341
Only child				0.331
No	115(47.9)	100(49.3)	15(40.5)	
Yes	125(52.1)	103(50.7)	22(59.5)	
Education				0.508
Undergraduate	189(78.8)	159(78.3)	30(81.1)	
Master	45(18.8)	38(18.7)	7(18.9)	
PhD	6(2.5)	6(3.0)	0(0.0)	
Parents' education				0.295
Undergraduate degree and below	157(65.4)	130(64.0)	27(73.0)	
Bachelor's degree or above	83(34.6)	73(36.0)	10(27.0)	
Smoking				0.708
No	218(90.8)	185(91.1)	33(89.2)	
Yes	22(9.2)	18(8.9)	4(10.8)	
Drinking				0.665
No	148(61.7)	124(61.1)	24(64.9)	
Yes	92(38.3)	79(38.9)	13(35.1)	
Sleep duration (hours)				0.783
<6	30(12.5)	25(12.3)	5(13.5)	
6–8	191(79.6)	163(80.3)	28(75.5)	
>8	19(7.9)	15(7.4)	4(10.8)	
BMI index				0.839
<18.5	33(13.8)	27(13.3)	6(16.2)	
18.5–24	152(63.3)	130(64.0)	22(59.5)	
24–28	46(19.2)	38(18.7)	8(21.6)	
>28	9(3.8)	8(3.9)	1(2.7)	
Brushing frequency				0.176
Seldom/Never	2(0.8)	2(1.0)	0(0.0)	
1–3 times a month	4(1.7)	2(1.0)	2(5.4)	
1 time a week	3(1.3)	3(1.5)	0(0.0)	
2–6 times a week	8(3.3)	5(2.5)	3(8.1)	
1 time a day	49(20.4)	41(20.2)	8(21.6)	
≥2 times a day	174(72.5)	150(73.9)	24(64.9)	
Toothpick				0.330
Seldom/Never	168(70.0)	142(70.7)	26(70.3)	
1–3 times a month	16(6.7)	10(4.9)	6(16.2)	
1 time a week	17(7.1)	15(7.4)	2(5.4)	
2–6 times a week	15(6.3)	14(6.9)	1(2.7)	
1 time a day	13(5.4)	13(6.4)	0(0.0)	
≥2 times a day	11(4.6)	9(4.4)	2(5.4)	
Dental floss				0.050
Seldom/Never	104(43.3)	84(41.4)	20(54.1)	
1–3 times a month	21(8.8)	18(8.9)	3(8.1)	
1 time a week	22(9.2)	17(8.4)	5(13.5)	
2–6 times a week	29(12.1)	24(11.8)	5(13.5)	
1 time a day	31(12.9)	30(14.8)	1(2.7)	
≥2 times a day	33(13.8)	30(14.8)	3(8.1)	

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For toothbrushing frequency, although the overall distribution did not show a statistically significant difference (P = 0.176), the proportion of individuals brushing their teeth at least twice daily was lower in the periodontitis group (64.9%) compared to the non-periodontitis group (73.9%). Furthermore, the percentage of participants brushing their teeth 2–6 times per week was higher in the periodontitis group (8.1%) than in the non-periodontitis group (2.5%). To further investigate the impact of psychological factors on periodontal health, subsequent multivariable regression analyses adjusted for potential confounding factors to explore the association between stress, anxiety levels, and periodontal health status.

Association Between Stress Levels, Anxiety Status, and Periodontitis

The results in Table 2 indicate a significant association between stress levels and the prevalence and severity of periodontitis. Among individuals in the normal stress group, the majority did not have periodontitis (69.0%). However, in the high-stress group, this proportion significantly decreased to 29.1%, while the prevalence of periodontitis increased substantially to 54.1% (P = 0.010). Although the very high-stress group comprised a small sample (2.1%), the proportion of individuals with periodontitis still showed an increasing trend.

Additionally, changes in anxiety levels also had a significant impact on the risk of periodontitis ($P < 0.001$). In the no anxiety group, 68.0% of participants did not have periodontitis. However, this proportion declined to 43.2% in the mild anxiety group and further dropped to 18.9% in the moderate anxiety group. Notably, in the severe anxiety group, the prevalence of periodontitis increased significantly to 24.3%.

Multivariable Logistic Regression Analysis of Stress and Anxiety Levels on Periodontitis Risk

A multivariable logistic regression model was employed to evaluate the impact of stress and anxiety levels on the risk of periodontitis, with adjustments made for potential confounders, including but not limited to gender, age, education level, smoking, and oral hygiene practices. (Table 3).

In the unadjusted model, compared to the normal stress group, the odds ratio (OR) for periodontitis in the high-stress group was 1.867 (CI: 0.814–4.279), while the very high-stress group had an OR of 0.635 (CI: 0.054–7.526). However, neither association reached statistical significance ($P > 0.05$). In the adjusted model, this trend remained consistent, with the high-stress group showing an OR of 1.802 (CI: 0.753–4.315) and the very high-stress group an OR of 0.686 (CI: 0.052–9.115), again without statistical significance ($P > 0.05$) (Table 3 and Figure 4).

In contrast, the relationship between anxiety levels and periodontitis demonstrated statistical significance ($P < 0.001$). In the unadjusted model, compared to the no anxiety group, the OR for the mild anxiety group was 8.398 (CI: 2.829–24.928), for the moderate anxiety group was 11.396 (CI: 3.163–41.062), and for the severe anxiety group was 47.470 (CI: 11.274–199.885), all showing significant positive associations.

Table 2 The Impact of Stress Levels and Anxiety on the Incidence of Periodontal Disease

Characteristic	All (n = 120) (Weighted Column %)	No Periodontitis (CPI 0–2) N (%)	Periodontitis (CPI 3–4) N (%)	*P*
Stress				0.010
Normal pressure level	156(65.0)	140(69.0)	16(43.2)	
High pressure level	79(32.9)	59(29.1)	20(54.1)	
Super pressure	5(2.1)	4(2.0)	1(2.7)	
Anxiety				<0.001
No anxiety	143(59.6)	138(68.0)	5(13.5)	
Mild anxiety	60(25.0)	44(21.7)	16(43.2)	
Moderate anxiety	23(9.6)	16(7.9)	7(18.9)	
Severe anxiety	14(5.8)	5(2.5)	9(24.3)	

Table 3 Multivariable Logistic Regression Determining the Odds of Periodontal Disease Occurrence by Strss or Anxiety

Characteristic	Unadjusted Model		Adjusted Model	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Stress		0.275		0.361
Normal pressure level	1 (Ref)		1 (Ref)	
High pressure level	1.867 (0.814–4.279)		1.802(0.753–4.315)	
Super pressure	0.635 (0.054–7.526)		0.686(0.052–9.115)	
Anxiety		<0.001		<0.001
No anxiety	1 (Ref)		1 (Ref)	
Mild anxiety	8.398(2.829–24.928)		8.391(2.776–25.362)	
Moderate anxiety	11.396(3.163–41.062)		11.423(3.116–41.872)	
Severe anxiety	47.470(11.274–199.885)		46.196 (10.414–204.921)	

Note: 1 (Ref) = reference; omitted for collinearity.
Abbreviations: OR: Odds Ratio, CI: Confidence Interval.

After adjusting for potential confounding factors, the association between anxiety levels and periodontitis remained significant. The OR for the mild anxiety group was 8.391 (CI: 2.776–25.362), for the moderate anxiety group was 11.423 (CI: 3.116–41.872), and for the severe anxiety group was 46.196 (CI: 10.414–204.921). These findings further suggest that higher anxiety levels are strongly associated with an increased risk of periodontitis (Table 3 and Figure 5).

Discussion

This study investigated the relationship between stress levels, anxiety status, and periodontitis among university students. The results demonstrated a significant positive association between anxiety levels and the risk of periodontitis, whereas stress levels did not show statistical significance after adjusting for confounding factors. This finding suggests that anxiety may be a crucial psychological factor affecting periodontal health in university students, while the impact of stress appears to be more complex and warrants further investigation. The study data indicates that as anxiety levels increase, the risk of periodontitis progressively rises. Individuals with higher anxiety levels were more likely to develop

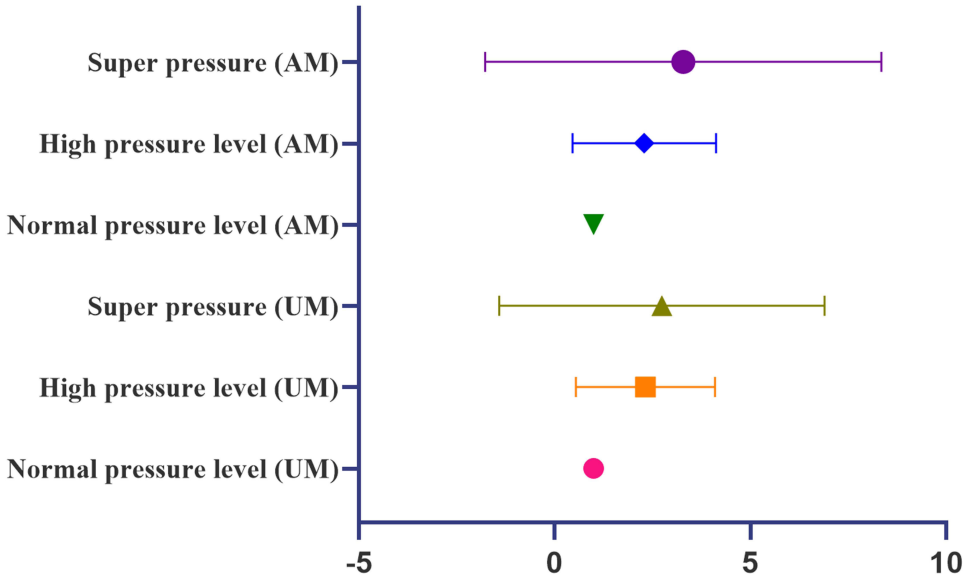

Figure 4 The effects of stress on periodontal disease.
Abbreviations: AM, adjusted model; UM, unadjusted model.

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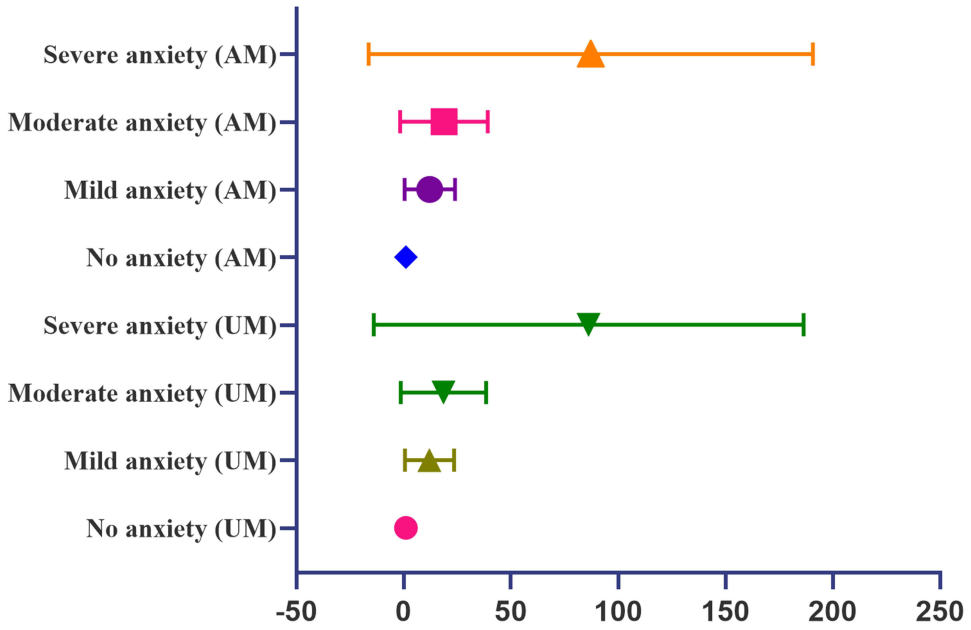

Figure 5 The effects of anxiety on periodontal disease.
Abbreviations: AM, adjusted model; UM, unadjusted model.

periodontitis, and this trend remained significant even after adjusting for confounding factors such as smoking, alcohol consumption, and oral hygiene habits. Furthermore, although stress levels were initially associated with periodontitis in the univariate analysis, the multivariable regression analysis did not reveal a significant effect. This may suggest that the impact of stress on periodontal health is more individualized or influenced by other regulatory factors. These findings clearly indicate that higher anxiety levels are associated with a significantly increased risk of periodontitis among university students, even after adjusting for major confounders such as smoking, oral hygiene behaviors, and socio-economic factors.

Previous research has also reported a positive correlation between anxiety and periodontitis, suggesting that anxiety may increase the risk of periodontitis by influencing behavioral habits and physiological responses.[26] However, findings on the association between stress and periodontitis remain inconsistent. Some studies have indicated that high stress levels may increase the risk of periodontitis, while others have found no significant relationship.[27] These discrepancies may be attributed to factors such as individual coping mechanisms, social support systems, and the duration of stress exposure.[11,28] University students represent a unique population with distinct behavioral habits and psychological characteristics. Compared to other groups, they experience substantial academic pressure while also undergoing a critical stage of psychological development and self-identity formation, making them more susceptible to anxiety-related influences. Anxiety may lead to neglect of oral health management, such as reduced toothbrushing frequency, decreased flossing, and irregular eating habits, which in turn elevate the risk of periodontitis.

Additionally, anxiety may impair immune function, making periodontal tissues more susceptible to infection and inflammation. Anxiety triggers excessive activation of the hypothalamic-pituitary-adrenal axis, leading to elevated glucocorticoid levels, which suppress immune cell function and reduce host resistance to periodontal pathogens.[29] Moreover, anxiety overactivated the sympathetic nervous system, promoting the release of pro-inflammatory cytokines such as IL-6 and TNF-α, thereby exacerbating periodontal inflammation.[30] Anxiety is also frequently accompanied by a range of unhealthy behaviors, including poor oral hygiene, irregular eating habits, smoking, and alcohol consumption. This study found that individuals with higher anxiety levels exhibited poorer oral hygiene behaviors, such as less frequent flossing and reduced toothbrushing frequency, both of which have been strongly linked to periodontitis. Additionally, anxiety may lead to lifestyle changes such as staying up late and an unbalanced diet, which could indirectly affect periodontal health.

In addition to psychological factors, several established confounding variables, including smoking and oral hygiene practices, significantly influence periodontal health. Smoking is a well-known risk factor that impairs immune function, reduces vascularization of periodontal tissues, and alters subgingival microbial composition, thereby exacerbating inflammation.[31] Similarly, inadequate oral hygiene, such as infrequent toothbrushing and lack of flossing, promotes plaque accumulation and increases the risk of disease.[32] In this study, participants with periodontitis reported lower frequencies of flossing and suboptimal brushing habits, consistent with previous research. These behavioral patterns may mediate the link between psychological distress and periodontitis, as stress and anxiety are commonly associated with reduced self-care routines.

The findings of this study suggest that oral health management should be integrated with psychological health interventions in university student populations. Universities and public health institutions should enhance mental health education, raise awareness of the relationship between anxiety and oral health, and provide appropriate psychological support measures. For individuals with higher anxiety levels, personalized oral health management strategies should be implemented, including regular periodontal check-ups and tailored oral health guidance. Furthermore, students should be encouraged to develop good oral hygiene habits and have access to mental health counseling services to mitigate the negative impact of anxiety on periodontal health, thereby helping them establish a healthier lifestyle and reduce the incidence of periodontitis. In this regard, collaborative strategies that address both mental well-being and oral health may contribute not only to the prevention of periodontitis but also to the broader goal of promoting systemic health.[33]

This study has several limitations that should be acknowledged. First, the sample was drawn from universities in specific regions, which may limit the generalizability of the findings to the broader university student population. Future studies should include participants from diverse geographic and institutional backgrounds to enhance external validity. Second, the cross-sectional design precludes causal inferences; whether anxiety contributes to the development of periodontitis or vice versa remains unclear. Longitudinal studies are needed to clarify temporal and causal relationships. Third, the assessment of psychological status relied on self-reported instruments, which, despite their validated reliability, may still be subject to response bias. Similarly, periodontal status was evaluated using the CPI index, which provides limited detail; future research should employ more comprehensive periodontal assessments. Fourth, although the analysis adjusted for major confounders such as smoking, alcohol consumption, and oral hygiene behaviors, residual confounding from unmeasured variables—such as genetic predisposition, nutritional status, and systemic health—cannot be ruled out. Fifth, participants included university students at various educational levels, which may have introduced selection bias due to differences in stress perception, oral health knowledge, and health behaviors. Stratified sampling or adjustment for educational level in future analyses is recommended. Finally, to minimize the potential influence of hormonal fluctuations on periodontal and psychological status, menstruating women were excluded at the time of data collection. However, this exclusion may have introduced gender-related selection bias and reduced the representativeness of female participants. Future studies should consider including menstruating individuals and statistically controlling for menstrual cycle phases or hormonal status to better capture sex-specific effects.

Conclusion

This study found a significant positive association between anxiety levels and the risk of periodontitis, while stress levels were not statistically significant after adjusting for confounders. The findings underscore the importance of mental health in oral health promotion and suggest incorporating psychological interventions in periodontitis prevention. Given the cross-sectional design, longitudinal studies and intervention trials are needed to explore underlying mechanisms and validate comprehensive health management strategies.

Data Sharing Statement

Datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of the Affiliated Stomatology Hospital of Tongji University (Approval No. [2023]-SR-26) and was conducted in strict accordance with the ethical principles outlined in the Declaration of Helsinki.

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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