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Associations of Social Psychological Factors and OHRQoL in Periodontitis Patients: A Structural Equation Modeling Study

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Background and Purpose: Periodontitis is the leading cause of tooth loss in adults worldwide. The functional loss, nutritional deficiencies, and psychological barriers it causes, as well as its impact on overall health and quality of life, are all significant. The prevalence of periodontal disease is high in China. Our study aimed to determine the intricate relationship between periodontal disease status, dental anxiety, self-rated oral health (SROH), self-efficacy for oral care, perceived social support, socioeconomic status (SES), and the oral health-related quality of life (OHRQoL) among periodontitis patients.

Methods: This cross-sectional study used purposive sampling to identify 247 patients with periodontitis who entered the First Affiliated Hospital of Bengbu Medical University between October 2022 and October 2023. 247 participants underwent a periodontal clinical examination combined with imaging, adhering to the "2018 world new classification of periodontal and peri-implant diseases and conditions". Participants also completed a detailed questionnaire in paper format, which included OHRQoL, sociodemographic details, dental anxiety, SROH, self-efficacy in oral care, perceived social support, and subjective SES.

Results: Dental anxiety, self-efficacy for oral care, and SROH all had a direct and significant effect on OHRQoL. OHRQoL was indirectly related to SROH mediated by dental anxiety and subjective SES, perceived social support and self-efficacy for oral care, respectively. SROH was directly related to subjective SES, and at the same time, they had a direct effect on dental anxiety. Furthermore, patient's age, gender, annual household income, and education level were significantly associated with the degree of periodontal disease.

Conclusion: OHRQoL and periodontal status was influenced by socio-demographics characteristics, dental anxiety, SROH, self-efficacy for oral care, perceived social support, subjective SES in periodontitis patients. These insights underscore the importance of adopting a holistic approach in the management and treatment of periodontal diseases.

Keywords: periodontitis, oral health-related quality of life, self-rated oral health, structural equation modeling

Introduction

Periodontitis is an inflammatory and destructive condition affecting the periodontium, triggered by plaque that induces an immune-inflammatory response in the gingiva, ultimately leading to the loss of periodontal attachment. This severe condition can result in tooth loosening, displacement, and loss, making periodontitis the foremost cause of tooth loss globally.[1] Particularly severe in China, periodontal disease surpasses caries in prevalence across all age groups, highlighting a significant public health challenge.[2] This disease's impact extends beyond oral health, significantly affecting individuals' nutritional status, psychological well-being, overall health, and quality of life.

Initially, periodontitis can appear as a "silent infection" with subtle symptoms that become more pronounced and debilitating in its advanced stages, affecting chewing, speech, aesthetics, and even general health.[3] Traditionally, periodontal research has prioritized clinical indicators such as attachment loss, focusing on disease severity and treatment effectiveness. While these metrics are vital for assessing disease severity and treatment efficacy, they do not fully capture the subjective experiences of patients, like quality of life.[4]

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In addition to offering a thorough understanding of how individuals view their oral health, the subjective oral health measure enables evaluation of the functional, psychological, and social effects that oral diseases have on people's life.[5] Research has demonstrated a correlation between clinical, psychological, and socio-demographic characteristics and self-rated oral health (SROH).[6]

Oral health-related quality of life (OHRQoL) measurements are now important outcome indicators in the socio-psycho-biomedical model, reflecting a more holistic understanding of health.[7] Despite periodontitis' slow progression, its significant role in diminishing OHRQoL is increasingly recognized, challenging the notion that patients can adapt without consequence.[8]

Historically, research often relied on self-reported cases or inconsistent criteria for periodontal disease examination. The "2018 World New Classification of Periodontal and Peri-implant Diseases and Conditions" unified aggressive and chronic periodontitis into a singular diagnosis of periodontitis, offering detailed staging and grading. However, it is very rare in China to investigate and analyse the results of patients with different stages of periodontitis using the new international standard. This oversight limits our understanding of the disease's impact on patients' lives.

The assessment of OHRQoL is inherently subjective, influenced by a myriad of factors including social, psychological, socioeconomic, and demographic variables.[9] For example, the origin and maintenance of numerous inflammatory illnesses, including periodontal disease, are significantly influenced by stress.[10] A strong link has been established by some research between psychological stress and periodontitis.[11]

Dental anxiety (DA) presents as varying degrees of nervousness and fear during dental visits, contributing significantly to the avoidance of appointments,[12] with 41% of non-routine visits attributed to this fear.[13] Berggren described a cycle wherein DA leads to avoidance of treatment, resulting in worsened oral health, diminished overall well-being, diminished quality of life, social isolation, despair, and feelings of guilt and shame.[14]

In another study, Samin et al[15] discovered correlations between dental visit frequency, self-efficacy in brushing and flossing, and perceptions of oral health. Higher levels of self-efficacy was also linked to better compliance with oral hygiene instructions and reduced risk of non-compliance with periodontal treatments.[16,17] Self-efficacy for oral care reflects individuals' confidence in maintaining oral health. Studies across disciplines have linked higher self-efficacy levels to improved quality of life. In Chinese dental research, self-efficacy for oral care in periodontitis patients has been associated with OHRQoL.[18] The precise direct and indirect impacts of dental anxiety and self-efficacy on OHRQoL in people with periodontitis require more study.

For those with periodontitis, while treatment improves OHRQoL,[19] leveraging social and psychological resources is crucial for enhancing overall OHRQoL pre- and post-treatment. Social support involves perceiving and receiving care from one's network during times of need.[20] Prior studies show its impact on OHRQoL across various health conditions.[21–24] Consistent social support aids patients through treatment discomfort. After therapy, there is evidence that general self-efficacy mediates the association between perceived support and OHRQoL, according to Lei Miao et al[43] However, regarding this association in people with periodontitis before therapy, not much is known.

The high incidence of periodontal disease in China is influenced by multiple factors, including underdeveloped dental healthcare infrastructure[25] and traditional beliefs minimizing the significance of toothache and tooth loss in old age. SES also contributes, affecting knowledge gaps.[26–28] SES encompasses objective factors like income, education, and occupation, shaping individuals' social standings, as well as subjective perceptions of one's position in society.[29] Research in developed countries links low SES with poorer oral health due to limited access to health information.[30–32] While our prior research indicates a positive correlation between SES and OHRQoL,[33] the direct and indirect relationships between SES, periodontitis severity, and OHRQoL in Chinese periodontitis patients require further investigation. Given social, cultural, and racial differences, understanding the interplay between SES and OHRQoL in this population is essential.

DA, self-efficacy for oral care, perceived social support, and OHRQoL are complex variables to measure directly. Traditional statistical methods cannot fully capture their intricate causal pathways. Structural Equation Modeling (SEM) addresses this by analyzing direct and indirect effects, including mediating effects.[30] SEM overcomes the limitations of traditional methods, providing a more comprehensive understanding of relationships.[34]

Our investigation aims to elucidate the multifaceted relationship between periodontal disease status, DA, SROH, self-efficacy for oral care, perceived social support, SES, and OHRQoL among periodontitis patients, in order to propose effective interventions to enhance periodontal health and the quality of life in this population.

Methods

Participants and Data Gathering

This cross-sectional study used purposive sampling to identify 247 patients with periodontitis who entered the stomatology department of the First Affiliated Hospital of Bengbu Medical University between October 2022 and October 2023.

The formula for population proportion was utilized to determine the sample size.[35] ($N = Z^2P(1 - P)/d^2$), with Z = 1.96 (critical value for 95% confidence level), P = 9.1% (proportion of periodontal health rate in China), and d = 0.05. The minimal sample size was 127, with a 20% non-response rate necessitating 152 participants. However, our study included 247 participants, surpassing the minimum requirement and ensuring research credibility.

Participants were recruited from patients attending the stomatology department of the First Affiliated Hospital of Bengbu Medical University, which is a large general hospital located in eastern China. Among the patients we identified patients with periodontitis using clinical diagnostic criteria from "the 2018 World New Classification of Periodontal and Peri-implant Diseases and Conditions". Next, we provided a detailed explanation of the purpose and content of the study to the patients with periodontitis, after obtaining their written informed consent, we conducted clinical periodontal examinations and oral imaging examinations, recording the results in the periodontal examination form.

Clinical examinations were conducted by experienced dentists who passed the Kappa consistency test with the cooperation of the participant, covering periodontal indices such as gingival recession (GR), probing depth (PD), bleeding on probing (BOP), furcation involvement (FI), and clinical attachment loss (CAL), tooth mobility (TM), using ball-ended WHO Community Periodontal Index (CPI) probes. Oral imaging examinations were also performed to assess radiology bone loss (RBL) and vertical bone resorption.

Then we distributed printed paper questionnaires and participants were instructed to complete the questionnaire independently after giving their consent, with the experiences they had had during the previous six months. Completed questionnaires were collected promptly, allowing for immediate on-site checks to address any omissions or errors, with participants encouraged to make necessary corrections promptly.

Inclusion criteria: (1) meeting diagnostic criteria for periodontitis according to the 2018 world classification; (2) no periodontal treatment in the previous six months.

Exclusion criteria: (1) age < 18; (2) < 20 remaining natural teeth (excluding third molars), untreated deep caries, or endodontically diseased teeth; (3) ongoing orthodontic treatment; (4) pregnancy or nursing; (5) mental illness or cognitive disability; (6) refusal to participate.

Initially, 256 patients in total were enrolled, with 9 excluded for not meeting the diagnostic criteria for periodontitis or due to logical errors. In the end, 247 trustworthy and comprehensive questionnaires were collected, achieving a 96.5% effective response rate. This study adheres to ethical principles, ensuring participant well-being and avoiding psychological harm. The Ethics Committee of Bengbu Medical University gave their approval to the study. (2023366).

To explore correlations between measured variables, we formulated hypotheses (Figure 1).

Hypotheses

H1: DA, SROH and self-efficacy for oral care influence OHRQoL significantly.

H2: SROH significantly affect subjective SES, meanwhile, SROH and subjective SES both have an effect on DA.

H3: Periodontitis staging and perceived social support are influenced by subjective SES.

H4: Perceived social support affects self-efficacy for oral care, and periodontitis staging affect SROH.

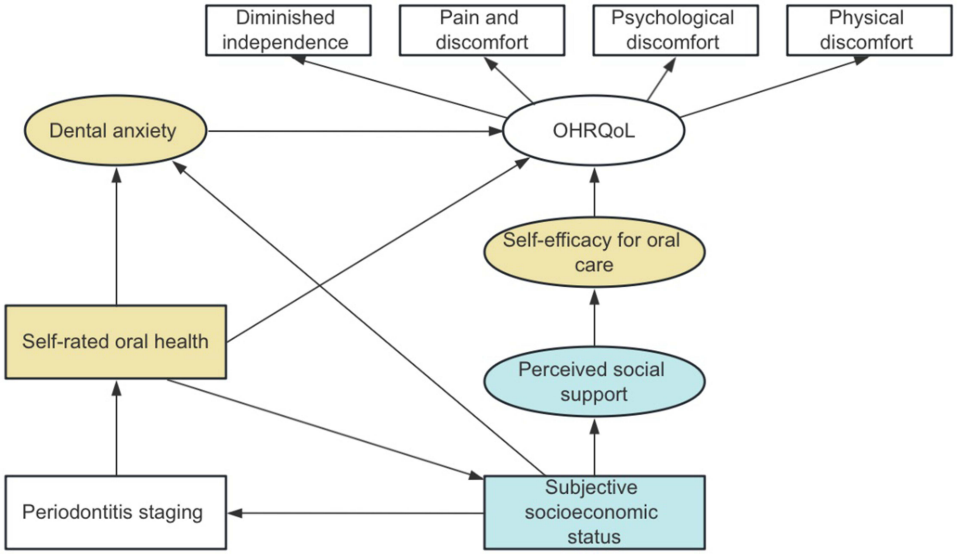

Figure 1 The ideal SEM. Ellipses represent latent variables, rectangles represent observed variables. Yellow represents oral-related psychological factors, blue represents social-related psychological factors.
Abbreviations: OHRQoL, oral health-related quality of life.

Instruments

After reviewing a large amount of literature and consulting with various experts, the initial edition of the questionnaire was created, 50 randomly chosen patients with periodontal disease were presurveyed prior to the formal survey. Based on the opinions of experts and the findings of a preliminary investigation, the questionnaire was revised. Socio-demographic traits, OHRQoL, SROH, DA, self-efficacy for oral care, perceived social support, subjective SES were all covered by the questionnaire.

"In general, how do you perceive your present oral health status?" was the query used to evaluate the SROH. To evaluate it, we used a five-point Likert scale, with "1" indicating "very poor" and "5" indicating "very good".[36,37] Higher scores indicate better oral health self-assessment.

The Chinese version of the Oral Health Impact Profile-14 (OHIP-14), a simplified version of the OHIP-49 created by Slade, was used to assess OHRQoL.[38] Four dimensions—diminished independence, pain and discomfort, psychological discomfort, and physical discomfort—are represented by the 14 items that make up the OHIP-14. It was graded on a five-point Likert scale, with "0" denoting "never" and "4" denoting "very often". The total score ranged from 0 to 56. Better oral health was reflected by a lower OHIP-14 score. The OHIP-14 CHN demonstrated strong validity and reliability (Cronbach's $\alpha = 0.926$).[39,40]

The Chinese version of the Modified Dental Anxiety Scale (CMDAS) was utilized to quantify DA.[41] Comprising five questions rated on a five-point Likert scale from "0" for "anxiety-free" to "4" for "extreme anxiety". Higher scores indicated greater levels of DA, with strong internal consistency (Cronbach's $\alpha = 0.927$).

Three components of self-efficacy were measured using the Chinese version of the self-efficacy scale for oral care (SESS): oral consultation, correct brushing, and balanced diet, with a total of 15 items.[16,42] Higher scores indicate better oral care self-efficacy. In our study, SESS CHN has a strong internal consistency in our study (Cronbach's $\alpha = 0.930$).

The Multi-dimensional Scale of Perceived Social Support (MSPSS) in Chinese was used to measure perceived social support.[43,44] A total of 12 questions covering three dimensions: family support, friend support, and other support. From "completely disagree" to "completely agree", a seven-point rating system was employed. The "Total Social Support Score" is cumulative of all items. The higher the total score, the more social support the individual feels. The study's MSPSS CHN has a Cronbach's α of 0.936.

The Chinese version of the Subjective Socioeconomic Status Scale (CSSS) was used to measure subjective SES,[45] derived from the adult version of the MacArthur Scale of Subjective Social Status.[46] The CSSS comprised two items: one assessing social status and the other assessing community status. On a scale of 1 to 10, each item is given a score; the

total is 20. Greater numbers denote a greater subjective socioeconomic level, whereas lower scores reflect a lower subjective SES.

In this study, the questionnaire's *p*-value of Bartlett's test was 0.000, Cronbach's alpha was 0.866, and KMO (Kaiser-Meyer-Olkin) was 0.782.

Statistical Analyses

We applied IBM® SPSS® Statistics version 26.0 for data analysis. To characterize the demographic factors and self-rated oral health, we used mean ± standard deviation, frequency, and percentage. For every data analysis, a p value of less than 0.05 denotes statistical significance. To assess the differences in OHRQoL and periodontitis staging among socio-demographic factors and SROH, the Mann–Whitney *U*-test and the Kruskal–Wallis H-test were used.

The associations between OHRQoL, SROH, DA, self-efficacy for oral care, subjective SES, periodontitis stage, and perceived social support were examined using structural equation modeling, and OHRQoL, DA, self-efficacy for oral care, perceived social support were latent variables, SROH, subjective SES and periodontitis stage were observed variables. The normality of the research variables was evaluated using the Skewness-Kurtosis test.

In line with our hypothesis, the measurement model's quality was rated using confirmatory factor analysis (CFA). We used the bootstrap approach to examine the strength and significance of mediating effects among variables in the final model. Additionally, we assessed the strength and significance of direct and indirect effects using the bias-corrected bootstrap 95% confidence interval (CI). To estimate the parameters, we used the maximum likelihood estimate (MLE) approach. The model's fitness was assessed using a variety of indices, including goodness of fit index (GFI), root mean square error of approximation (RMSEA), chi-square/degrees of freedom ($\chi 2$/df), and more.

Results

Characteristics of the Participants

A total of 247 periodontal patients, ranging in age from 18 to 80 years old, were examined, comprising 95 men and 152 women. In the univariate analyses, SROH and OHRQoL were significantly correlated and periodontitis staging was highly correlated with gender, age, annual household income, and educational achievement. Other demographic characteristics are shown in Table 1.

Table 1 Demographic Characteristics and Univariate Analyses of Factors Associated with OHRQoL and Periodontitis

	Total (n=247)		**OHIP-14 (M ± SD)**		**Periodontitis Staging**								
	n	**%**		**Test *P*-value**	**Stage I**		**Stage II**		**Stage III**		**Stage IV**		**Test *P*-value**
					n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
Gender													
Male	95	38	1.01±0.72	*Z*=−0.45	7	7	17	18	33	35	38	40	*Z*=−2.60
Female	152	62	1.04±0.70	*P*=0.654	23	15	36	24	52	34	41	27	*P*=0.009
Age group													
18-	45	18	0.92±0.53	*H*=4.94	18	40	17	38	7	16	3	6	*H*=60.93
30-	55	22	1.10±0.75	*P*=0.423	8	15	17	31	15	27	15	27	*P*=0.000
40-	43	18	1.19±0.75		4	9	5	12	19	44	15	35	
50-	72	29	0.92±0.69		0	0	9	12	30	42	33	46	
60-	23	9	1.13±0.90		0	0	4	17	11	48	8	35	
70–80	9	4	0.94±0.48		0	0	1	11	3	33	5	56	
Annual household income													
<50,000 CNY	88	36	1.06±0.84	*Z*=−0.11	7	8	16	18	37	42	28	32	*Z*=−1.16
≥50,000 CNY	159	64	1.01±0.62	*P*=0.91	23	15	37	23	48	30	51	32	*P*=0.000

(*Continued*)

Table 1 (Continued).

	Total (n=247)		OHIP-14 (M ± SD)		Periodontitis Staging								
	n	%		Test *P*-value	Stage I		Stage II		Stage III		Stage IV		Test *P*-value
					n	%	n	%	n	%	n	%	
Educational level													
<6 years of education	13	5	0.78±0.84	*H*=3.475	0	0	3	23	6	46	4	31	*H*=10.90
6–12 years of education	99	40	1.00±0.74	*P*=0.176	7	7	17	17	34	35	41	41	*P*=0.004
≥12 years of education	135	55	1.07±0.67		23	17	33	24	45	33	34	25	
Self-rated oral health													
Very poor	34	14	1.55±0.87	*H*=41.96	2	6	7	21	9	26	16	47	*H*=6.54
Poor	89	36	1.19±0.65	*P*=0.000	8	9	17	19	34	38	30	34	*P*=0.162
Fair	102	41	0.80±0.49		18	18	24	24	31	30	29	28	
Good	19	8	0.61±0.89		2	11	4	21	9	47	4	21	
Very good	3	1	0.45±0.44		0	0	1	33	2	67	0	0	

Abbreviations: n, number; M, Mean; SD, Standard Deviation; Z, Mann–Whitney *U*-test; H, Kruskal–Wallis *H*-test; CNY, Chinese Yuan; OHIP-14, Oral Health Impact Profile-14.

Correlation Analysis Among Variables

The bar chart (Figure 2) clearly shows the disparities in periodontitis stagings among different ages, educational levels, genders and annual household income. Figure 2a shows that the proportion of severe periodontitis increases with age.

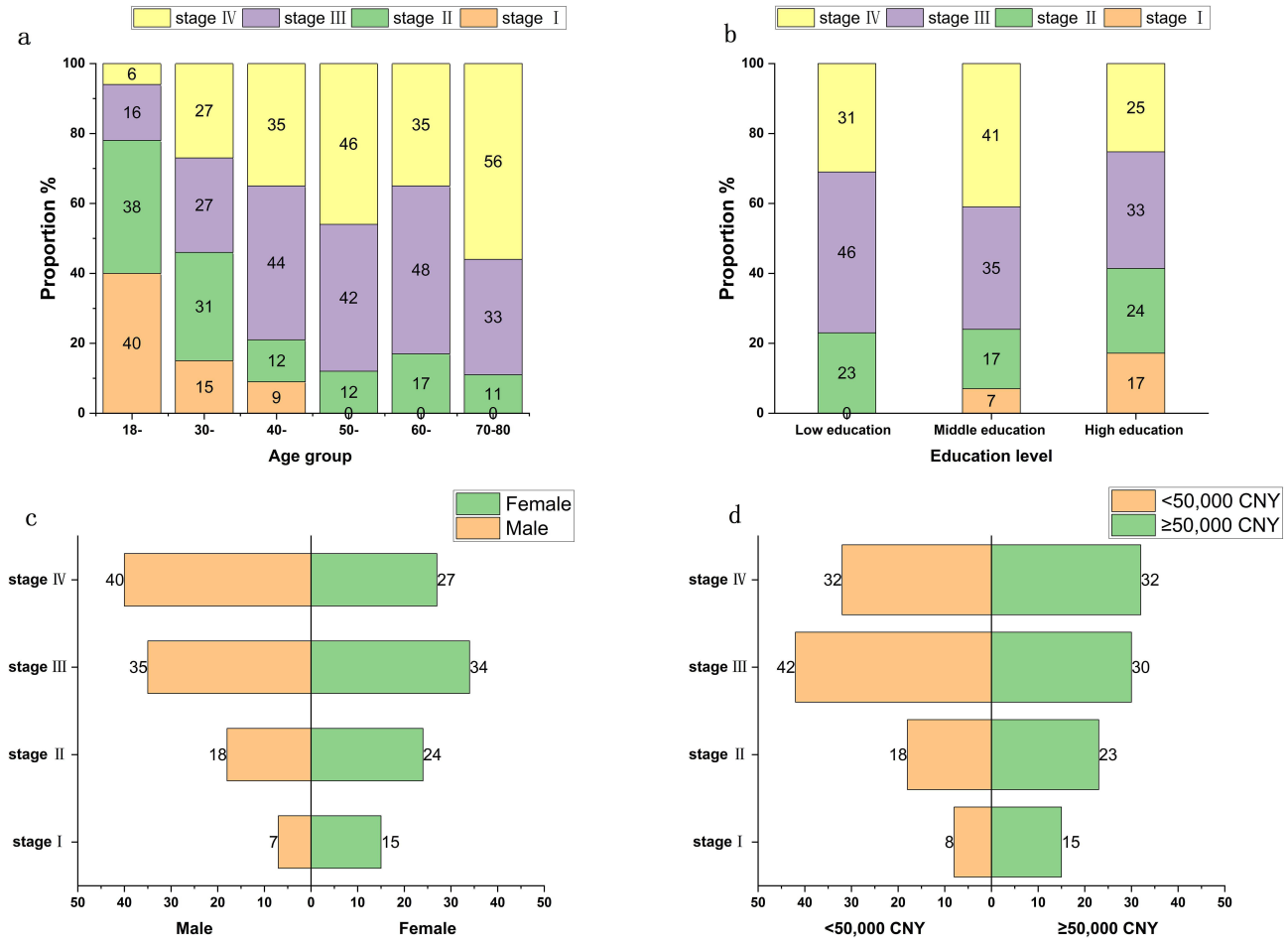

Figure 2 Disparities in periodontitis stagings among different ages (**a**), educational levels (**b**), genders (**c**) and annual household income (**d**).
Abbreviations: CNY, Chinese Yuan.

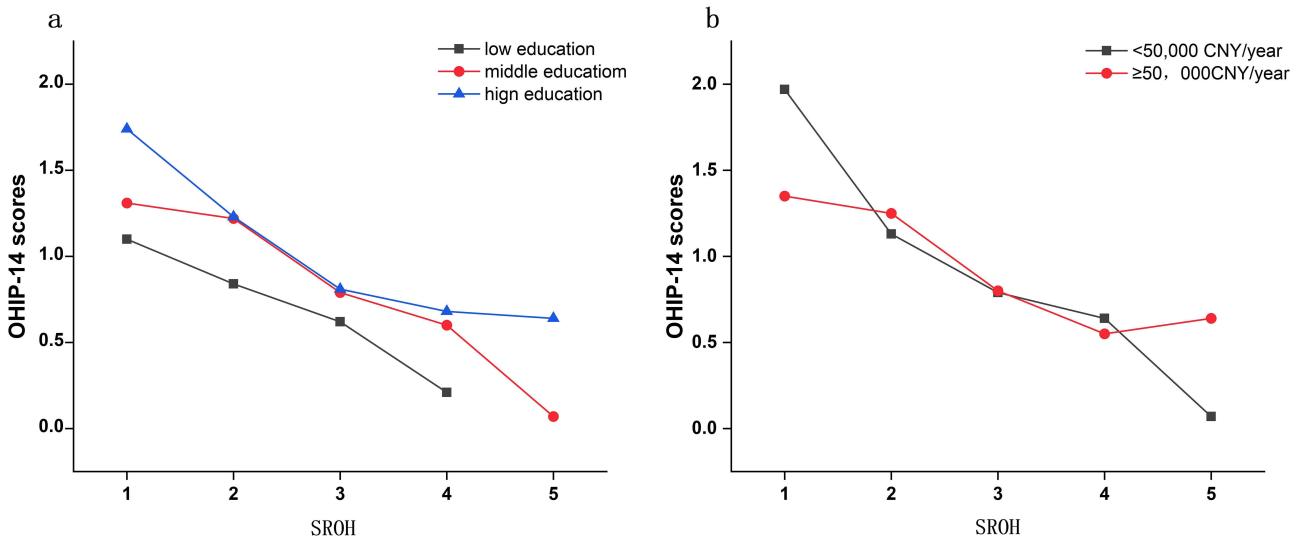

Figure 3 The correlation between SROH and OHIP-14 scores at various education (**a**) and income levels (**b**).
Abbreviations: SROH, self-rated oral health; CNY, Chinese Yuan; OHIP-14, Oral Health Impact Profile-14.

Figure 2b shows that patients with a high level of education have the lowest proportion of severe periodontitis. Figure 2c and d demonstrates that of the patients with severe periodontitis, the proportion of males is higher than that of females, and the proportion is higher among those with low annual household income.

Figure 3 displays graphs of OHRQoL versus SROH at different income and education levels. The figure demonstrate that at the same level of SROH, the better educated patients had higher OHIP-14 scores and worse OHRQoL (3a). As SROH changed, OHRQoL changed to a greater extent for patients with lower annual household income (3b).

Hypothetical Model Testing

All of the variables in the results were regarded as normal (skewness <3 and kurtosis <8). Given that there was no statistical significance in the pathway coefficient ($p > 0.05$), we eliminated the path from "periodontitis staging" and "subjective socialeconomic status". Additionally, since the initial model was unable to adequately match the sample data, modification indices (AMOS) were utilized to connect numerous error terms of the essential variables. Ultimately, following model modification, the standardized path coefficients of the final model demonstrated statistical significance (all $p<0.05$) (Figures 4 and 5).

Additionally, at the end, every SEM model fitness indicator satisfied the required levels.[47–49] The recommended criteria were applied to the fitness indicators of the initial model and the final model (Table 2).

Analysis of the Final Model

Figures 4 and 5 show a significant and direct relationship between OHRQoL and DA ($\beta = 0.232$), SROH ($\beta = -0.377$) and self-efficacy for oral care ($\beta = -0.147$).

SROH ($\beta = -0.177$) and subjective SES ($\beta = 0.135$) were directly predicted by DA. Meanwhile, subjective SES was directly related with SROH ($\beta = 0.181$) and perceived social support ($\beta = 0.214$). Self-efficacy for oral care had a significant association with perceived social support ($\beta = 0.271$). Periodontitis staging was directly linked to SROH ($\beta = -0.154$).

Furthermore, it was discovered that OHRQoL and SROH were indirectly correlated ($\beta = -0.0425$), with two mediating effect pathways. Table 3 displays the mediation effect test findings: SROH indirectly affected OHRQoL through DA ($\beta = -0.041$), and this indirect effect accounts for 9.76% of the total effect; OHRQoL was indirectly related to SROH mediated by subjective SES, perceived social support and self-efficacy for oral care, and this indirect effect accounts for 0.37% of the total effect. Table 4 shows the standardized direct, indirect, and total effects for the final model.

Additionally, the greatest influencing factor on OHRQoL was found to be SROH, followed by DA and self-efficacy for oral care, with respective total effective values of −0.377, 0.232, and −0.147.

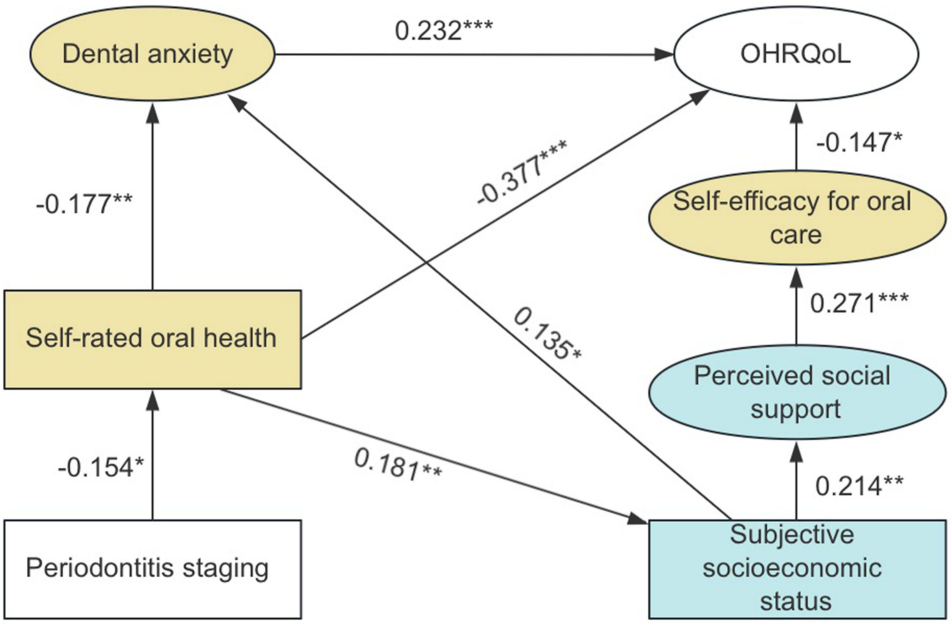

Figure 4 Direct effects in the final model (bootstrapped standardized estimates). Solid lines represent direct effects. Ellipses represent latent variables, rectangles represent observed variables. Yellow represents oral-related psychological factors, blue represents social-related psychological factors. *p<0.05; **p < 0.01; ***p < 0.001.
Abbreviation: OHRQoL, oral health-related quality of life.

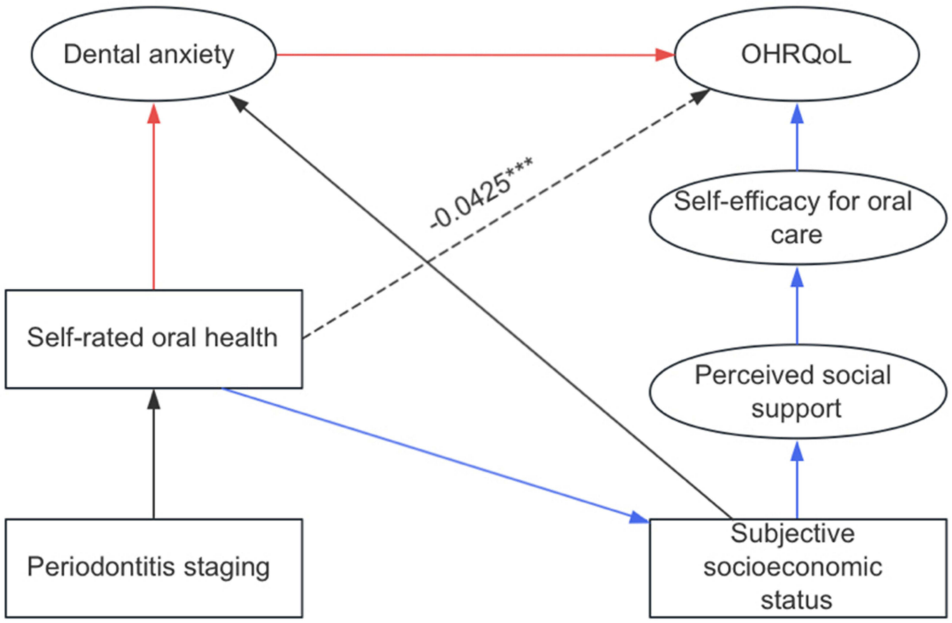

Figure 5 Indirect effects in the final model (bootstrapped standardized estimates). Dashed lines represent indirect impacts. The red and blue solid lines represent two different indirect paths respectively. Ellipses represent latent variables, rectangles represent observed variables. *p<0.05; **p < 0.01; ***p < 0.001.
Abbreviation: OHRQoL, oral health-related quality of life.

Discussion

The purpose of the study was to investigate the relationship between periodontal disease status, oral-related psychological factors, social-related psychological factors, and OHRQoL among periodontal patients. Findings revealed that DA, self-efficacy for oral care, and SROH significantly impacted OHRQoL, with SROH exerting the strongest influence. SROH directly correlated with subjective SES and influenced DA. Subjective SES had a positive effect on perceived

Table 2 The Fitness Indicators of SEM Models

Fitness Indicators	Recommended Criteria	Initial Model	Final Model
Absolute fit indicators			
χ2/df	<5	1.855	1.420
RMSEA	<0.05–0.08	0.059	0.041
GFI	>0.90	0.904	0.928
RMR	<0.05	0.053	0.048
Incremental fit indicators			
NFI	>0.90	0.910	0.935
CFI	>0.90	0.956	0.980
RFI	>0.90	0.891	0.916
IFI	>0.90	0.957	0.980
TLI	>0.90	0.947	0.974
Goodness of fit indicators			
PNFI	>0.50	0.750	0.727
PGFI	>0.50	0.666	0.646

Abbreviations: df, degrees of freedom; χ^2, chi-square; CFI, comparative fit index; GFI, goodness of fit index; NFI, normed fit index; IFI, incremental fit index; PNFI, parsimonious normed fit index; PGFI, parsimony goodness of fit index; TLI, Tucker–Lewis index; RFI, relative fit index; RMR, root mean square residual; RMSEA, root-mean square error of approximation.

Table 3 Results of the Multiple Mediation Effect Test

Model Path	Effects	95% CI	
		LLCI	ULCI
Ind 1	−0.0410**	−0.1032	−0.0102
Ind 2	−0.0015**	−0.0058	−0.0002
SROH →OHRQoL (total effect)	−0.4197***	−0.5468	−0.2692
SROH →OHRQoL (total direct effect)	−0.3772***	−0.5125	−0.2288
SROH → OHRQoL (total indirect effect)	−0.0425**	−0.1058	−0.0120
Ind 1/total effect	0.0976**	0.0241	0.2641
Ind 2/total effect	0.0037*	0.0005	0.0166

Notes: *p<0.05, **p<0.01, ***p<0.001; Ind1:SROH→MDAS→OHRQoL; Ind2: SROH→CSSS→MSPSS→SESS→OHRQoL; OHRQoL, oral health-related quality of life; SROH, self-rated oal health;

Table 4 Standardized Direct, Indirect, and Total Effects for the Final Model

Model Path	Total Effects	95% CI		Direct Effects	95% CI		Indirect Effects	95% CI	
		LLCI	ULCI		LLCI	ULCI		LLCI	ULCI
Dental anxiety→ OHRQoL	0.2319***	0.0638	0.4166	0.2319**	0.0638	0.4166	–	–	–
SROH→ OHRQoL	−0.4197***	−0.5406	−0.2628	−0.3772***	−0.5125	−0.2288	−0.0425**	−0.1058	−0.0120
SROH → Dental anxiety	−0.1523*	−0.2791	−0.0236	−0.1766**	−0.3037	−0.0468	0.0244*	0.0002	0.0625
Periodontitis staging →SROH	−0.1538**	−0.2613	−0.0428	−0.1538**	−0.2613	−0.0428	–	–	–
SROH→ Subjective SES	0.1807**	0.0588	0.2987	0.1807**	0.0588	0.2987	–	–	–
Subjective SES →Perceived social support	0.2138**	0.0829	0.3352	0.2138**	0.0829	0.3352	–	–	–
Perceived social support → Self-efficacy for oral care	0.2706***	0.1277	0.4028	0.2706***	0.1277	0.4028	-	-	-
Self-efficacy for oral care → OHRQoL	−0.1467*	−0.2830	−0.0162	−0.1467*	−0.2830	−0.0162	-	-	-
Subjective SES → Dental anxiety	0.1348*	−0.0209	0.2850	0.1348*	−0.0209	0.2850	-	-	-

Notes: *p<0.05, **p<0.01, ***p<0.001.
Abbreviations: OHRQoL, oral health-related quality of life; SROH, self-rated oal health.

social support, which in turn influenced self-efficacy for oral care. Moreover, periodontitis status was positively associated with SROH. Patients' demographic factors, including age, gender, annual household income, and education level, were also found to be highly correlated with the severity of periodontal disease. This study represents the first comprehensive exploration of these relationships among periodontal patients.

In China, with a large population and numerous periodontal disease cases, the government has prioritized national oral health, particularly focusing on early detection and treatment of periodontitis. Our study found periodontitis patients had an OHIP-14 score of 14.36 ± 9.885, compared to 6.6 in healthy individuals and 12.9–16.5 in a previous study in London.[50] Given the diverse population and adoption of a new classification system, further research in China is warranted.

In our study, we discovered that as people aged, severe periodontitis became more common, consistent with findings by Nazir et al[51] using World Health Organization data. This highlights the susceptibility of the elderly to severe periodontitis, possibly due to challenges in oral hygiene maintenance. Given China's aging population, there's an urgent need for enhanced nationwide periodontal health promotion efforts. Moreover, research suggests that periodontal destruction in the elderly may result from untreated disease over time rather than solely age-related factors, warranting further investigation.[52]

According to our research, men are more prone than women to develop severe periodontitis, while more women exhibited mild to moderate periodontitis. This aligns with previous studies showing a strong link between males and severe periodontitis.[53] However, research on the relationship between gender and mild-to-moderate periodontitis is limited. In a US study, it was noted that males with periodontitis often use mouthwash, which can alleviate surface inflammation but does not address underlying periodontal issues.[54] This may obscure initial periodontal discomfort in male patients, potentially leading to the progression of severe periodontitis.

SES encompasses both objective (eg, education level, annual household income) and subjective components.[33] In our study, patients with high levels of education had the lowest incidence of periodontitis in stage IV, and with the same level of SROH, higher OHIP-14 scores were found with higher levels of education, suggesting a decrease in OHRQoL, which may indicate that patients with high levels of education place more importance on their oral health, and thus their self-perception has a greater influence on life quality. As stated in a previous study via Bado FMR et al,[55] higher education is linked to worse OHRQoL. A cross-sectional survey in China by Songlin He et al[26] also showed that one of the key factors influencing OHRQoL in individuals with chronic periodontitis is education level. However, unlike our prior study, those with middle education levels exhibited the poorest OHRQoL, possibly due to differences in oral health perceptions compared to the general population.

In our investigation, people with lower annual household incomes were more likely to suffer from severe periodontitis, aligning with research findings from Brazil.[56] This suggests that socioeconomic disparities influence periodontal health. Additionally, we found that individuals with less financial resources experienced a higher influence from changes in SROH on OHRQoL. There is a direct relationship between socioeconomic level and oral health attitudes and practices, as our earlier study demonstrated,[33] therefore, individuals with lower socioeconomic position have weaker attitudes and convictions regarding oral health and thus poorer oral health care behaviours, and are more susceptible to periodontal disease, which affects quality of life. Addressing these disparities through targeted policies and interventions is crucial to improving periodontal health and reducing socioeconomic inequalities nationwide.

Our structural equation modeling found that positive SROH was linked with better OHRQoL. Subjective evaluations of oral health provide information on how people view oral health and its broader implications. This is in line with our earlier research of an oral health survey of residents in eastern China,[33] however, given that periodontitis patients were the subjects of this investigation, two mediation pathways were discovered to imply an indirect relationship between the two. Firstly, we find SROH indirectly affected OHRQoL through dental anxiety. The findings match those observed in earlier studies. Qingying et al[57] in southwestern China showed that among patients with tooth extraction, those with poor SROH had significant DA. A previous study with a single-centre sample also showed that the more severe the DA, the worse the OHRQoL in patients with chronic periodontitis.[58] Addressing DA among periodontitis patients with poor SROH could enhance OHRQoL by providing psychological support or clear communication regarding periodontal treatment, thereby fostering treatment cooperation and overall well-being.

Secondly, OHRQoL was indirectly impacted by SROH, which is mediated by subjective socioeconomic position, perceived social support, and self-efficacy for oral care. Similar to a study among Canadian adolescents,[15] self-efficacy plays a pivotal role in health promotion and disease prevention by shaping individuals' beliefs about their ability to improve their health. Consistent with research in northeastern China,[18] where low self-efficacy for oral care was associated with poor OHRQoL in chronic periodontitis patients, our study utilized the Self-Efficacy for Oral Care Scale to delve deeper into these factors within the periodontitis population. Given China's diverse cultural and regional landscape, our study focused on the eastern region, where variations in ethnic cultures, enforcement of oral health policies, and socio-psychological factors may influence patient experiences. For periodontitis patients, this underscores the importance of identifying and leveraging positive social and psychological resources to enhance their overall OHRQoL.

Research by Schwarzer et al[59] emphasized the impact of psychosocial factors on health behavior change, highlighting the importance of self-efficacy and self-regulation skills. Simple interventions can enhance oral self-monitoring, self-efficacy, and oral self-care, leading to improved flossing behavior. Moreover, a prospective cohort study in Japan indicated that assessing specific self-efficacy for oral care could predict long-term periodontal treatment follow-up.[17] Given the significance of "supportive periodontal therapy" (SPT) in post-treatment maintenance, healthcare providers can utilize self-efficacy for oral care and perceived social support theories to design tailored interventions. Strengthening periodontal health education and providing encouragement throughout treatment can enhance patient adherence and cooperation, thereby continuously improving the OHRQoL of periodontitis patients.

Furthermore, our study revealed a significant and positive association between SROH and subjective SES, emphasizing the importance of psychosocial factors in oral health perception. While previous research has highlighted the correlation between SROH, OHRQoL, and objective SES, our study focused on periodontitis patients and employed a subjective SES indicator. In our study, perceived social support reduced as subjective SES decreased. This is in line with the results of a previous study done on a sample of Canadian youths,[60] which revealed that teenagers from households with lower socioeconomic class were more likely to drink more high-sugar beverages and brush their teeth infrequently, and they were also less likely to receive assistance from peers and parents. However, this is in contrast to an earlier American study,[24] which found no change in perceived social support with reduced financial support. Different national conditions, cultural backgrounds, patient groups, and feelings of social support and socioeconomic position could all be contributing factors to the different results. Moreover, we uncovered a direct link between subjective SES and DA, echoing research in Iran.[61] This novel association underscores the need for policy interventions to address socioeconomic inequalities among high-risk populations. By mitigating DA, enhancing perceived social support, and ultimately improving OHRQoL, such initiatives can enhance general well-being and improve oral health results. Furthermore, the path from subjective socioeconomic position to periodontitis stage was not significant, according to the model and path analyses' results, so we removed it. A previous Brazilian study[6] using a structural equation modeling approach showed that adolescent family SES indirectly influences SROH through oral clinical symptoms. Different definitions of influencing factors, different sample groups, and different national circumstances may lead to different results. (Objective income-based SES vs subjective SES, adolescents aged 12–14 attending public schools in Brazil vs patients with periodontitis aged 18–80 in eastern China).

It can be seen that a single clinical indicator may not fully capture the essence of health and may not adequately reflect the holistic and comprehensive nature of individuals with biological, psychological, and social attributes. Therefore, while we continuously improve and refine clinical evaluation indicators and methods, it is necessary to consider incorporating patient-centered evaluation indicators that emphasize the treatment of functional and psychosocial factors. This will enhance patient compliance with treatment, foster the habit of regularly maintaining periodontal health, and ultimately achieve the goal of patient satisfaction and improved quality of patients' lives.

There are various limitations on this study. Firstly, the cross-sectional nature of our study precludes causal inferences, and longitudinal research is warranted to elucidate temporal relationships among variables. Secondly, self-reported questionnaire data are subject to bias, and future studies should incorporate objective measures where feasible. Additionally, our study sample was limited to periodontal patients in eastern China, necessitating caution in generalizing findings to broader populations. In order to get over these restrictions, future studies should diversify their samples

further and use longitudinal designs to determine causal correlations. Despite these limitations, our study contributes valuable insights that can inform Chinese authorities in their efforts to improve oral public health and develop effective periodontal health promotion policies and preventive interventions.

Conclusion

In conclusion, our study contributes to the existing literature by elucidating the complex relationships among periodontal disease status, psychosocial factors, and OHRQoL. We found that DA, self-efficacy for oral care, and SROH significantly influenced OHRQoL, with SROH exerting the greatest impact. Notably, SROH indirectly affected OHRQoL through DA, while OHRQoL was indirectly linked to SROH through subjective SES, perceived social support, and self-efficacy for oral care. Additionally, subjective SES positively influenced perceived social support, enhancing self-efficacy for oral care. Moreover, periodontitis status directly correlated with SROH. Patient demographics, including age, gender, annual household income, and education level, significantly correlated with periodontal disease severity. However, subjective SES did not significantly influence periodontitis staging in our structural equation modeling. This study helps in formulating targeted psychological and behavioral interventions and better periodontal health promotion strategies, aiming to improve periodontal health conditions in China and other countries.

Data Sharing Statement

On reasonable request, the corresponding author provides the datasets used and/or analyzed during the current study.

Ethics Approval and Consent to Participate

This study was approved by the Ethics Committee of Bengbu Medical University (2023366). The ethical guidelines established by the institutional and national research committees, the 1964 helsinki statement and its later amendments or similar ethical standards, were followed in all procedures carried out in studies involving human participants. All the patients gave the informed consent and signed the informed consent form.

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Disclosure

The author(s) report no conflicts of interest in this work.

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