RESEARCH PAPER

Association Of Stress With Oral Health Among The Population Of North Gujarat, India

Dr. Pranav R. Kurup [1], Dr. Gargi Rathod[2], Dr. Avani Patel[3], Dr. Dimpal Parmar[4], Dr. Ritu Randad Shah[5], Dr. Suraja R[6]

[1]Senior Lecturer, Department Of Public Health Dentistry, K.M. Shah Dental College and Hospital, Sumandeep Vidyapeeth, Deemed to be University, Vadodara, Gujarat, India.
[2]Assistant Professor, Department of Oral and Maxillofacial Pathology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University, Visnagar, Gujarat, India.
[3]Reader, Department of Oral & Maxillofacial Pathology & Radiology, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University Visnagar, Gujarat, India.
[4]Senior Lecturer, Department of Pediatric & Preventive Dentistry, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University Visnagar, Gujarat, India.
[5]Senior Lecturer, Department of Public Health Dentistry, Narsinhbhai Patel Dental College and Hospital, Sankalchand Patel University Visnagar, Gujarat, India.
[6]Senior Lecturer, Department Of Public Health Dentistry, K.M. Shah Dental College and Hospital, Sumandeep Vidyapeeth, Deemed to be University, Vadodara, Gujarat, India

ABSTRACT
Background: Psychological stress arises from an individual's interaction with their environment when perceived demands exceed coping capacity. It influences both systemic and oral health, contributing to anxiety, behavioural changes, and increased susceptibility to periodontal diseases.
Methods: This cross-sectional analytical study involved 400 randomly chosen adults aged 35–44 years from North Gujarat, India. Information was gathered through a predesigned structured questionnaire consisting of three parts: (1) demographic details including age, occupation, education, socioeconomic status, weight, height, and body mass index (BMI); (2) the Perceived Stress Scale (PSS) developed by Cohen et al. to assess stress over the past month; and (3) the WHO Oral Health Assessment Form (2013) for clinical evaluation. Data were analysed using SPSS version 20.0, employing Chi-square, ANOVA, and correlation tests.
Results: Stress levels showed a statistically significant positive correlation with gingival bleeding, periodontal pocket depth, and overall periodontal status ($p \leq 0.05$). Conversely, BMI showed a negative correlation with perceived stress levels.
Conclusion: Psychological stress significantly influences periodontal health. Although its precise biological mechanisms remain incompletely understood, integrating stress assessment and management into oral health promotion programs could enhance preventive care and improve population oral health outcomes.
Keywords: Anxiety, Body Mass Index, Periodontal Diseases, Subjective Stress.
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INTRODUCTION

Health is a universal concept shaped by cultural perspectives. The World Health Organization (WHO) defines health as a state of complete physical, mental, and social well-being & not merely the absence of disease or infirmity. Oral health constitutes a fundamental aspect of overall health, influencing nutrition, speech, quality of life, and overall well-being. Moreover, poor oral health can exacerbate or contribute to various chronic systemic conditions[1].

Psychological stress is an important contributing factor in the development and progression of oral diseases. During stress, stimulation of the hypothalamic–pituitary–adrenal axis and sympathetic nervous system promotes glucocorticoid secretion, which disrupts homeostasis and increases susceptibility to periodontal diseases, lichen planus, and aphthous ulcers. Stress delays the healing of connective tissue and bone and encourages apical migration of the junctional epithelium, and contributes to periodontal pocket formation. Furthermore, stress-related factors can trigger bruxism through neurotransmitter imbalances and behavioural changes[2].

Stress arises when environmental demands exceed an individual's adaptive capacity. While mild stress (eustress) can enhance performance, chronic unresolved stress (distress) often leads to anxiety and depressive symptoms. Anxiety, characterised by uneasiness and fear of perceived threats, can complicate the management of chronic oral conditions. Therefore, understanding the psychosocial

**Author for Correspondence: pranavkurup628@gmail.com*

determinants of oral health is essential for comprehensive dental care[3].

In this context, the study was designed to assess the relationship between stress level and oral health status among adults in North Gujarat, India.

MATERIALS & METHODS

Study Design and Population

A cross-sectional analytical design was adopted involving 400 randomly selected adults aged 35–44 years residing in the Mehsana district, Gujarat, India. A multistage sampling technique was used to ensure representative selection. A pilot study with 100 participants was carried out to assess the feasibility and reliability of the research protocol.

Participant Selection Criteria

Participants aged 35–44 years who were cooperative and provided written informed consent were included. Individuals with systemic diseases (hypertension, diabetes, myocardial infarction, immunosuppressive conditions), pregnant or lactating women, those undergoing orthodontic treatment, chemotherapy, or radiotherapy, and persons with a history of alcohol/drug abuse or trauma/surgery of the head and neck region were excluded.

Ethical Considerations and Sampling Procedure

The study received clearance from the Institutional Ethics Committee before initiation. The North Gujarat district was divided into five zones (North-East, North-West, Central, South-East, and South-West), and four villages from each zone were randomly selected. All participants provided written informed consent before participation in the study. Information was gathered using a structured proforma through personal interviews.

Data Collection

The proforma consisted of three sections:

Part I: Demographic details including age, occupation, education, socioeconomic status, weight, height, and Body Mass Index (BMI)[4,5].

Part II: Assessment of stress level using the Perceived Stress Scale (PSS) developed by Cohen et al., which evaluates perceived stress over the past month[6].

Part III: The World Health Organization Oral Health Assessment Form for Adults (2013) was employed to assess oral health status[7].

Perceived Stress Assessment

The four-item Perceived Stress Scale (PSS-4) was employed, translated into the local language for participant comprehension. Each question was rated on a five-point Likert scale (0 = never to 4 = very often). The two negatively worded items were scored directly, and the two positively phrased items were reverse-scored. Total stress scores were obtained by summing responses across all items and categorised as:

Low stress: 0–4

Moderate stress: 5–10

High stress: 11–16

Oral Health Examination

The WHO Oral Health Assessment Form (Tooth) for Adults, 2013, was used to conduct oral examinations, which included assessment of extraoral findings, modified CPI periodontal status, loss of attachment, enamel fluorosis, dental erosion, dental trauma, and oral mucosal lesions. A single calibrated examiner conducted all examinations to ensure consistency, and data were recorded by trained assistants fluent in the local language.

Study Duration

The study was evaluated over a period of eight months, from January to August 2020.

Statistical Analysis

Data entry was performed in Microsoft Excel, and statistical analysis was conducted using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). Chi-square test, One-way ANOVA, Spearman's correlation, and Pearson's correlation. The level of Significance was kept at a p-value of ≤ 0.05.

RESULTS

Table 1: Stress Level and Gingival Bleeding among study subjects.

Stress	Bleeding			p-Value
	Absent N (%)	Present N (%)	Total N (%)	
Low	3 (100%)	0 (0%)	3 (100%)	≤ 0.05*
Moderate	152 (45.92%)	179 (54.08%)	331 (100%)	
High	5 (7.58%)	61 (92.42%)	66 (100%)	
Total	160 (40%)	240 (60%)	400 (100%)	

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Fig 1: Stress Level and Gingival Bleeding among study subjects.

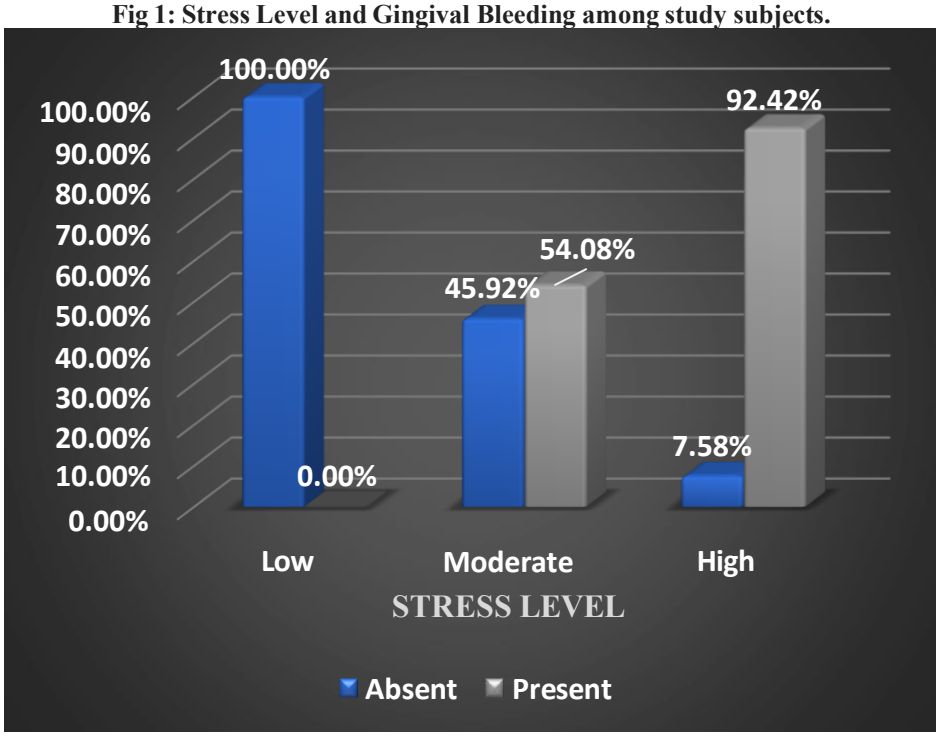

Table 1 and Figure 1 present the Stress Level and Gingival Bleeding on probing distribution of study subjects. Among the total study population, three participants exhibited low stress, and none demonstrated gingival bleeding upon probing. In the moderate stress group (n = 331), 179 subjects (54.08%) exhibited gingival bleeding, while 152 (45.92%) did not. Within the high-stress group (n = 66), 61 participants (92.42%) demonstrated gingival bleeding upon probing, whereas only 5 (7.58%) showed no bleeding.

Stress level showed a significant association with gingival bleeding ($p \leq 0.05$), with higher stress corresponding to increased gingival inflammation.

Table 2: Stress Level and Periodontal Pocket among study subjects

Stress	**Periodontal Pocket N (%)**				**p-Value**
	Absent N (%)	**4-5 mm N (%)**	**6 mm or More N (%)**	**Total N (%)**	
Low	3 (100%)	0 (0%)	0 (0%)	3 (100%)	≤ 0.05*
Moderate	152 (45.92%)	151 (45.62%)	28 (8.46%)	331 (100%)	
High	5 (7.58%)	30 (45.45%)	31 (46.97%)	66 (100%)	
Total	164 (41%)	177 (44.25%)	59 (14.75%)	400 (100%)	

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Fig 2: Stress Level and Periodontal Pocket among study subjects.

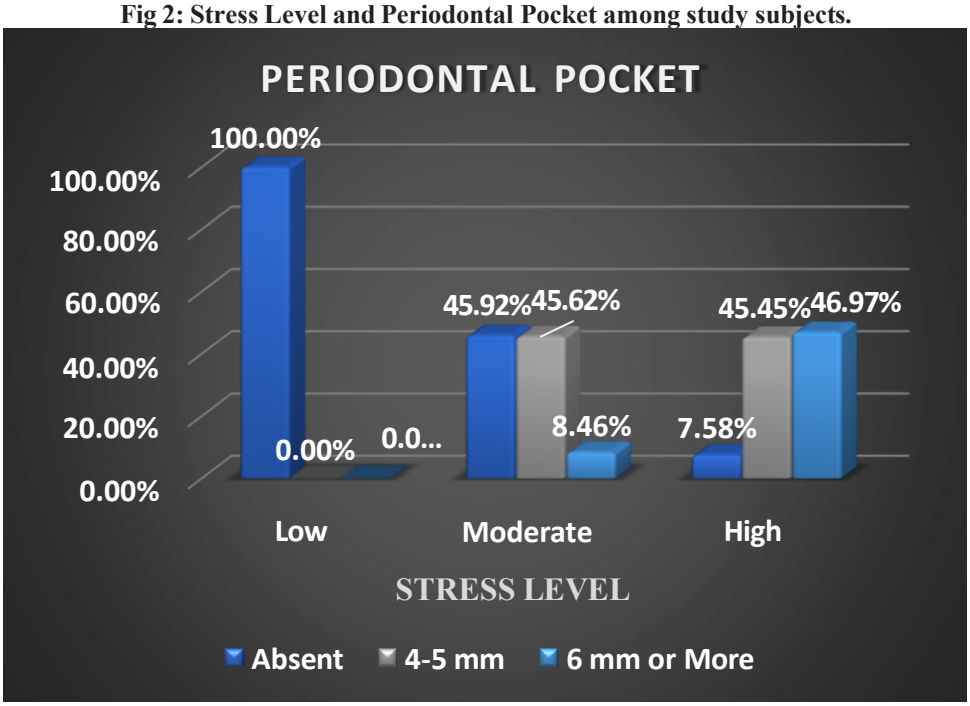

Table 2 and Figure 2 present the Stress Level and Periodontal Pocket distribution of study subjects. Among the total study population, three participants exhibited low stress, and none demonstrated the presence of periodontal pockets. In the moderate stress group (n = 331), 152 subjects (45.92%) showed no periodontal pocketing, 151 (45.62%) had pockets measuring 4–5 mm, and 28 (8.46%) exhibited pockets ≥6 mm in depth. Within the high-stress group (n = 66), 5 participants (13.64%) exhibited no periodontal pockets, 30 (39.39%) had pockets measuring 4–5 mm, and 31 (46.97%) demonstrated pockets ≥6 mm.

Stress level showed a significant association with gingival bleeding ($p \leq 0.05$), with higher stress corresponding to deeper Periodontal Pocket.

Table 3: Stress Level and Loss of Attachment among study subjects.

Stress	Loss of Attachment N (%)						p-Value
	0-3 mm N (%)	4-5 mm N (%)	6-8 mm N (%)	9-11 mm N (%)	12 mm or More N (%)	Total N (%)	
Low	3 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)	≤ 0.05*
Moderate	152 (45.92%)	151 (45.62%)	28 (8.46%)	0 (0%)	0 (0%)	331 (100%)	
High	5 (7.58%)	30 (45.45%)	29 (43.94%)	2 (3.03%)	0 (0%)	66 (100%)	
Total	160 (40%)	181 (45.25%)	57 (14.25%)	2 (0.5%)	0 (0%)	400 (100%)	

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Fig 3: Stress Level and Loss of Attachment among study subjects.

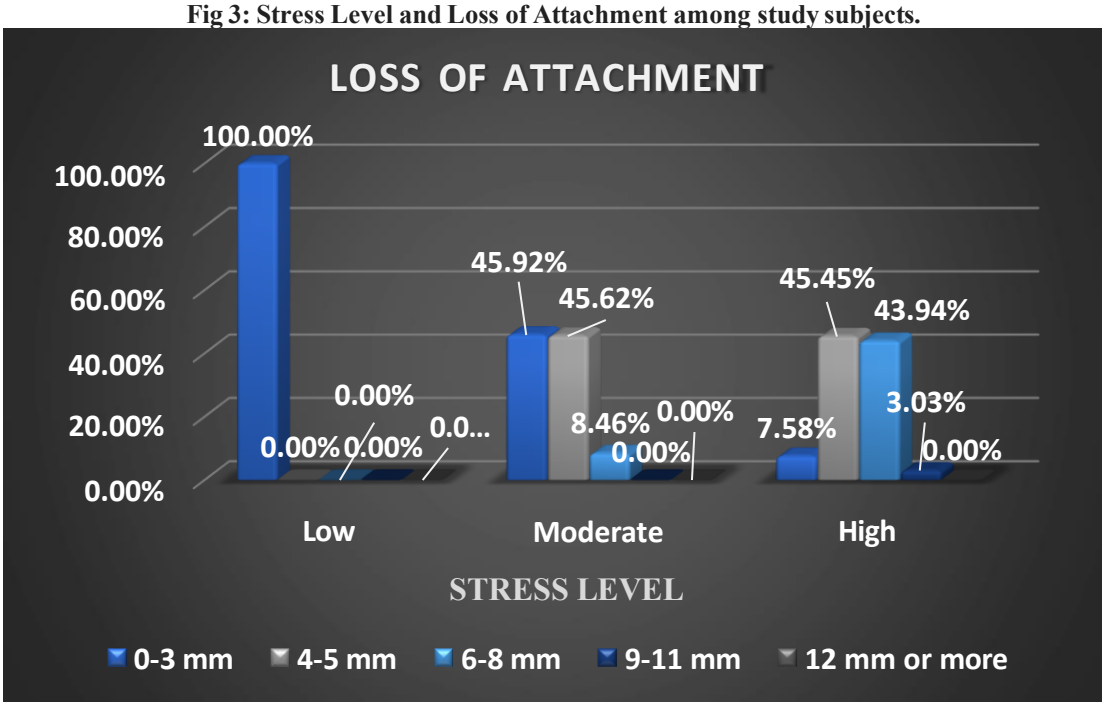

Table 3 and Figure 3 illustrate the distribution of clinical attachment loss (CAL) among participants according to their stress levels. All participants with low stress (n = 3; 100%) exhibited CAL within the 0–3 mm range. Among those with moderate stress (n = 331), 45.92% demonstrated CAL of 0–3 mm, 45.62% had CAL of 4–5 mm, and 8.46% presented with CAL of 6–8 mm. In contrast, participants categorised under high stress (n = 66) showed a greater severity of attachment loss, with 7.58% exhibiting CAL of 0–3 mm, 45.45% with 4–5 mm, 43.94% with 6–8 mm, and 3.03% with 9–11 mm.
A statistically significant association was identified between stress levels, as measured by the Perceived Stress Scale (PSS), and the extent of clinical attachment loss ($p \leq 0.05$), indicating that higher stress levels were correlated with greater periodontal tissue destruction.

Table 4: Socio-economic status and dentition status distribution among participants.

	SES	No	Mean Value		CI		p-Value
			Mean	SD	Lower	Upper	
DT	Upper	3	0.00	0.00	0.00	0.00	> 0.05**
	Upper Middle	240	1.09	1.414	0.91	1.27	
	Lower Middle	145	0.75	1.362	0.53	0.98	
	Upper Lower	12	0.67	1.231	-0.12	1.45	
	Lower	0	0	0	0	0	
MT	Upper	3	1.67	1.528	-2.13	5.46	> 0.05**
	Upper Middle	240	1.37	1.654	1.16	1.58	
	Lower Middle	145	1.74	2.983	1.26	2.23	
	Upper Lower	12	1.17	2.443	-0.39	2.72	
	Lower	0	0	0	0	0	
FT	Upper	3	3.33	4.041	-6.71	13.37	≤ 0.05*
	Upper Middle	240	0.53	1.319	0.36	0.70	
	Lower Middle	145	0.51	1.021	0.34	0.68	

	Upper Lower	12	0.08	0.289	-0.10	0.27	
	Lower	0	0	0	0	0	
DMFT	**Upper**	3	5.00	5.292	-8.14	18.14	> 0.05**
	Upper Middle	240	2.98	2.727	2.63	3.32	
	Lower Middle	145	2.97	3.742	2.36	3.59	
	Upper Lower	12	1.92	2.503	0.33	3.51	
	Lower	0	0	0	0	0	

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Fig 4: Socio-economic status and dentition status distribution among participants.

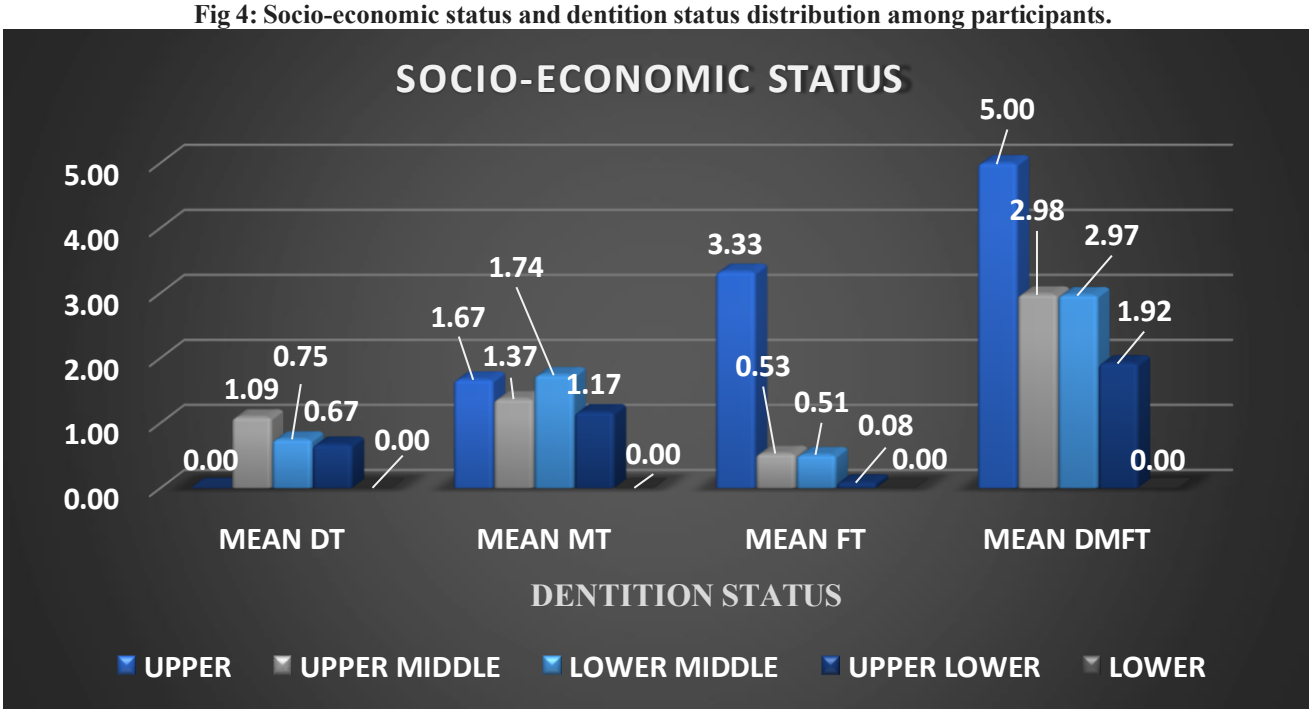

Table 4 and Figure 4 present the mean values of the decayed, missing, and filled teeth (DMFT) components across different socio-economic status (SES) categories. The average number of Decayed Teeth (DT) was highest among participants in the upper middle class (1.09), followed by the lower middle class (0.75) and the upper lower class (0.67), whereas participants in the upper and lower classes recorded no decay. The difference in mean DT across SES groups was not significant statistically ($p > 0.05$).

The average number of missing teeth (MT) was highest among participants in the lower middle class (1.74), followed by the upper class (1.67), upper middle class (1.37), and upper lower class (1.17), with no missing teeth reported among the lower class. These differences were not significant statistically ($p > 0.05$).

The mean number of filled teeth (FT) was greatest among the upper class (3.33), followed by the upper middle class (0.53), lower middle class (0.51), upper lower class (0.08), and lower class (0). A statistically significant difference was observed in the mean FT among the different SES categories ($p \leq 0.05$), suggesting that participants with higher SES had greater access to restorative dental care.

The overall DMFT index was highest among the upper class (5.00), followed by the upper middle class (2.98), lower middle class (2.97), and lower class (0). However, the variation in mean DMFT values across SES categories was not statistically significant ($p > 0.05$).

Table 5 A: Multiple regression analysis of study variables. (Life Time Caries Experience)

Model	R Value	R square Value	Adjusted R Square Value	Standard Error of estimate	F-Value	p-value
DMFT	0.164	0.027	0.007	3.133	1.359	> 0.05**

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Table 5 B: Multiple regression analysis of study variables. (Life Time Caries Experience)

Variable	Unstandardized Coefficients		Standardized Coefficients	t-Value	p-Value	95% Confidence Interval	
	Odds Ratio	Std Error	Beta			Lower Bound	Upper Bound
Gender	0.31	0.32	0.04	0.96	> 0.05**	-0.32	0.94
SES	-0.19	0.28	-0.03	-0.69	> 0.05**	-0.75	0.36
BMI	1.07	0.93	0.15	1.15	> 0.05**	-0.76	2.92
PSS	0.95	0.56	0.11	1.69	> 0.05**	-0.15	2.05
Ethnic Group	-0.31	0.46	-0.03	-0.69	> 0.05**	-1.22	0.58
Community	0.09	0.11	0.04	0.83	> 0.05**	-0.12	0.31

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Tables 5a and 5b summarize the results of the multiple regression analysis performed to predict lifetime dental caries experience using selected independent variables, including gender, socio-economic status (SES), body mass index (BMI), Stress Level, ethnic group, and community.

The overall regression model was not statistically significant ($R = 0.164$, $F = 1.359$, $p > 0.05$), indicating that the combined influence of these predictors did not significantly explain the variance in lifetime dental caries experience. Similarly, none of the individual independent variables demonstrated a statistically significant relationship with caries experience in the study population.

Table 6 A: Multiple regression analysis of study variables. (Periodontal status)

Model	R Value	R square Value	Adjusted R Square Value	Standard Error of estimate	F-Value	p-value
Periodontal Status	0.454	0.206	0.190	0.638	12.696	≤ 0.05*

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Table 6 B: Multiple regression analysis of study variables. (Periodontal status)

Variable	Unstandardized Coefficients		Standardized Coefficients	t-Value	p-Value	95% Confidence Interval	
	Odds Ratio	Std Error	Beta			Lower Bound	Upper Bound
Gender	0.04	0.06	0.02	0.61	> 0.05**	-0.08	0.17
SES	0.14	0.05	0.11	2.48	≤ 0.05*	0.03	0.25
BMI	-0.18	0.19	-0.12	-0.99	> 0.05**	-0.56	0.18
PSS	0.87	0.11	0.47	7.62	≤ 0.05*	0.64	1.09
Ethnic Group	-0.31	0.46	-0.03	-0.69	> 0.05**	-1.22	0.58
Community	0.09	0.11	0.04	0.83	> 0.05**	-0.12	0.31

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Table 6a and 6b summarise the results of the multiple regression analysis performed to determine loss of attachment from gender, socio-economic status (SES), body mass index (BMI), Stress Level, ethnic group, and community. The overall regression model was statistically significant ($R = 0.454$, $F = 12.696$, $p \leq 0.05$), indicating that the combined effect of these variables significantly predicted periodontal status.

Among the independent variables, socio-economic status (SES) and Stress Level were found to be statistically significant predictors of loss of attachment ($p \leq 0.05$), suggesting that both lower SES and higher perceived stress levels were associated with greater periodontal breakdown. In contrast, gender, body mass index (BMI), ethnic group, and community were not significantly associated with periodontal status ($p > 0.05$).

Table 7: Distribution of study subjects based on multiple regression analysis. (Stress Level)

Variables	Stress Level	
	Co-relation Value	p-value
SES	0.079	> 0.05**
BMI	-0.255	≤ 0.05*
Total DMFT	0.049	> 0.05**
Bleeding	0.308	≤ 0.05*
Pocket	0.420	≤ 0.05*
Periodontal Status	0.428	≤ 0.05*

Statistical significance was set at $p \leq 0.05$ (*); results exceeding this threshold were considered non-significant (**).

Table 7 presents the correlation between the Stress Level and selected clinical parameters. A significant positive correlation was observed between Stress Level and gingival bleeding, periodontal pocket depth, and overall periodontal status, indicating that higher stress levels were associated with greater periodontal inflammation and attachment loss ($p \leq 0.05$). Conversely, a significant negative relationship was identified between body mass index (BMI) and stress level ($p \leq 0.05$), suggesting that individuals with higher BMI reported lower stress levels.

DISCUSSION

The relationship between stress levels and oral health status among adults in North Gujarat was assessed in this investigation. Oral health reflects overall health and well-being, and conditions such as dental caries and periodontal diseases are multifactorial, influenced by systemic, behavioural, and environmental factors including stress, socioeconomic status (SES), and body mass index (BMI)[8]. Psychological stress has emerged as a main risk factor in both systemic and oral diseases. Individual stress perception and response vary across intrinsic and extrinsic factors. Stress may alter oral hygiene behaviours and immune responses, thereby affecting oral health. Although the relation between stress and oral health is well established, the underlying biological and behavioural mechanisms remain complex[9].

Stress is known to influence immune regulation and hormonal activity, which can lead to microbial dysbiosis in the oral cavity. Elevated cortisol levels can promote the growth of pathogens such as Fusobacterium nucleatum, aggravating periodontal inflammation and tissue destruction[10,11]. The present findings indicate that gingival bleeding was significantly more common among participants with high stress levels (92.42%) compared to those with moderate (54.08%) or low stress (0%). This strong association supports findings by Linden et al., Monteiro et al., and Grossi et al., who also noted a positive link between stress and gingival inflammation[12–14]. These effects may be attributed to stress-related neglect of oral hygiene, decreased motivation for self-care, and altered immune responses. Conversely, studies by Merchant et al., Marcenes et al., and Moss et al. found no significant association between stress and bleeding from the gingiva[15–17], possibly owing to methodological differences, population variations, or behavioural confounders such as smoking and oral hygiene habits.

Periodontal pocket depth was also significantly greater among individuals with high stress (86.36%), correlating with previous studies by Dienzer et al., Page et al., Monteira da Silva et al., and Kamma et al.[18–21]. Similarly, the observed association between stress and loss of attachment supports earlier findings by Axtelius et al., Breivik et al., and Refulio et al.[22–24]. Stress-related reductions in salivary flow, altered salivary composition, pH imbalance, and increased plaque retention further contribute to periodontal deterioration[25,26].

This study is among the first population-based studies from North Gujarat to evaluate the relationship between perceived stress, BMI, and SES and oral health. Its strengths include a randomized sampling design and use of the validated Perceived Stress Scale (PSS), which effectively captures recent stress perception compared with broader instruments like the Depression Anxiety Stress Scale.

However, the study has certain limitations that require consideration. Because of its cross-sectional design, causal relationships cannot be inferred, and reliance on self-reported stress data may have introduced recall and reporting bias. Confounders such as smoking, alcohol use, and physical inactivity were not controlled for. Additionally, the PSS-4, though concise, may not fully capture the complexity of stress compared to its 10- or 14-item versions.

Despite these limitations, the study emphasises the need to consider psychological stress as a modifiable risk factor in oral disease prevention and management. Future longitudinal and interventional studies are recommended to elucidate causal pathways between stress and oral health outcomes.

CONCLUSION

Considering the limitations inherent to this cross-sectional research, a significant correlation was seen between perceived stress levels and oral health indicators, particularly bleeding from the gingiva, periodontal pocket depth, and loss of attachment. Poorer periodontal health was observed among individuals with high stress levels compared with those experiencing moderate or low stress. These findings indicate a contributory role of psychological stress in the progression of periodontal disease, possibly through behavioural and biological mechanisms such as neglect of oral hygiene and altered immune response.

Although no causal relationships can be inferred from the present design, the results underscore the need to consider psychological well-being as an essential component of oral

health promotion and disease prevention programs. Future longitudinal and interventional studies are recommended to further elucidate the pathways linking stress and oral health and to develop holistic preventive strategies that integrate mental and dental health care.

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