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Effects of Chronic Stress on Oral Health Status in Correlation with Salivary Gland Secretions

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ABSTRACT

Background: This study investigates the impact of chronic stress on salivary gland function and oral health status, specifically analyzing salivary flow, pH, protein content, and oral health status indices such as xerostomia, dental caries, and gingival inflammation. The study aims to explore the correlations between varying levels of stress and deteriorating oral health status.

Methodology: A study was conducted from January 2023 to January 2024 at Sardar Begum Dental College and Hospital, Peshawar. This cross-sectional study involved 250 participants. Stress levels were assessed using validated questionnaires, while salivary flow rates, pH, and total protein levels were measured using standard biochemical assays. Oral health status was evaluated through the DMFT (Decayed, Missing, Filled Teeth) index, xerostomia scores, gingival index, and plaque accumulation. Data were analyzed using ANOVA to identify significant differences among stress groups.

Results: Significant reductions in both unstimulated (0.45 mL/min to 0.20 mL/min) and stimulated (1.15 mL/min to 0.55 mL/min) salivary flow rates were observed as stress levels increased ($p < 0.05$). Salivary pH dropped significantly ($p = 0.002$), while total protein levels increased ($p < 0.001$). Similarly, oral health status deteriorated with rising stress levels, with higher xerostomia scores, DMFT index, and plaque accumulation ($p < 0.001$).

Conclusion: Chronic stress is associated with decreased salivary gland function and worsening oral health status. Integrating stress management into oral health status protocols may help mitigate these effects, particularly in high-stress populations.

Keywords: Chronic stress, salivary gland function, oral health status status, xerostomia, DMFT index, gingival inflammation.

Introduction

Chronic stress has become an increasingly pervasive issue in modern life, exerting profound effects on various physiological systems, including the salivary glands [1]. The function of salivary glands is integral to maintaining oral health status, as saliva plays a crucial role in cleansing the mouth, neutralizing acids, and providing antibacterial action [2]. When salivary gland function is impaired, it leads to xerostomia (dry mouth), increasing the risk of dental caries, gingivitis, and other oral infections. Understanding the impact of chronic stress on salivary gland function is critical for improving oral health status outcomes in stressed populations [3].

Globally, stress-related health issues are on the rise. According to the World Health Organization (WHO), chronic stress affects approximately 30% of the global population [4], with the numbers expected to increase due to growing socio-political and economic pressures [5]. In developed countries such as the United States and Europe, studies have demonstrated a clear correlation between elevated stress levels and poor oral health status outcomes [6]. In Asia, particularly in densely populated countries like China, India, and Pakistan, the prevalence of stress-related health problems is growing rapidly due to factors such as urbanization, competitive lifestyles, and socio-economic challenges [7 8].

In Pakistan, chronic stress is a widespread issue, exacerbated by political instability, economic uncertainty, and rapid urbanization [9]. Studies conducted in Karachi and Lahore have highlighted the increasing prevalence of stress-related health issues, including their impact on oral health status[10 11]. The link between stress and oral diseases is well-documented internationally, but there is a need for more region-specific research in Pakistan. This study aims to contribute to the body of knowledge by exploring the correlation between chronic stress and oral health status deterioration in the Pakistani population.

The epidemiology of stress-related oral diseases shows a higher incidence of conditions like xerostomia, dental caries, and gingival inflammation in individuals experiencing high levels of stress [12]. Stress activates the hypothalamic-pituitary-adrenal (HPA) axis, resulting in elevated cortisol levels that impact salivary gland function. Cortisol has been shown to reduce salivary flow rates and alter the composition of saliva, leading to reduced oral defense mechanisms [13]. The reduction in salivary flow, coupled with an increase in total protein levels, creates an environment conducive to oral pathogens, exacerbating dental and periodontal diseases.

The correlation between stress and oral health status has been explored in multiple studies. Stress-related xerostomia, in particular, has been identified as a significant risk factor for dental decay and gum disease [12]. This study seeks to further explore this correlation by analyzing the effects of varying stress levels on salivary flow rates, pH, protein content, and oral health status indicators such as the DMFT index and plaque accumulation. Given the socio-economic context of Pakistan, this research also aims to highlight the local implications of stress on oral health status, providing insights into potential interventions.

The rationale for this study lies in the need for holistic healthcare approaches that address both the psychological and physical health of individuals. Chronic stress is a modifiable risk factor, and by identifying its impact on oral health status, preventive strategies can be developed. This

study contributes to the growing awareness of how stress management can improve not only mental health but also physical health outcomes, particularly in relation to oral hygiene and disease prevention.

Methodology

This cross-sectional study was conducted at Sardar Begum Dental College and Hospital, Peshawar, from January 2023 to January 2024. The study design aimed to investigate the relationship between chronic stress and salivary gland function, alongside oral health status parameters in a diverse population sample.

The study enrolled 250 participants, calculated using a margin of error of 5% and a confidence level of 95%, with an expected prevalence of stress-related oral health status issues of 20%. Participants were recruited through convenience sampling from outpatient clinics, ensuring a diverse representation of gender, age groups, and socio-economic backgrounds.

Inclusion criteria included, participants aged 18–65 years, no history of psychiatric illness or use of medications affecting salivary flow and willing to provide informed consent.

Exclusion criteria was individuals with diagnosed salivary gland diseases or systemic conditions affecting oral health status and use of tobacco or alcohol.

Data collection and procedure participants were assessed for stress levels using the validated Perceived Stress Scale (PSS). Salivary gland function was evaluated through both unstimulated and stimulated salivary flow rate measurements. Saliva samples were collected using the spitting method for five minutes, with the volume measured in milliliters per minute. Salivary pH was measured using a pH meter, and total protein content was assessed using the Bradford protein assay.

Oral health status assessments included the xerostomia score, DMFT index (Decayed, Missing, Filled Teeth), gingival index, and plaque accumulation percentage. Dental examinations were conducted by trained professionals in accordance with WHO guidelines.

Data were analyzed using SPSS version 25. ANOVA tests were employed to compare differences in salivary flow, pH, protein content, and oral health status parameters across different stress levels (low, moderate, high). A p-value of <0.05 was considered statistically significant.

Results

The analysis included 250 participants, categorized based on their stress levels into three groups: low stress (n = 85), moderate stress (n = 90), and high stress (n = 75). The results demonstrated significant associations between chronic stress levels and salivary gland function, as well as key oral health status parameters.

Table 1: Demographic Details of Participants

Characteristic	**n (%)**
Total Participants	250

Gender	
Male	135 (54%)
Female	115 (46%)
Age Groups (years)	
18-30	85 (34%)
31-45	90 (36%)
46-65	75 (30%)
Occupation	
Employed	150 (60%)
Unemployed	60 (24%)
Student	40 (16%)
Chronic Illness	
Yes	75 (30%)
No	175 (70%)

Salivary gland function and oral health status correlation, the data showed that salivary flow rates, pH, and total protein levels varied significantly with different stress levels. As stress levels increased, there was a noticeable decrease in unstimulated and stimulated salivary flow rates, accompanied by a reduction in pH and an increase in protein concentration.

Table 2: Correlation Between Chronic Stress Levels and Salivary Gland Function

Stress Level	**Unstimulated Salivary Flow Rate (mL/min)**	**Stimulated Salivary Flow Rate (mL/min)**	**Salivary pH**	**Total Protein (mg/dL)**
Low Stress	0.45 ± 0.08	1.15 ± 0.10	6.8 ± 0.4	150 ± 12
Moderate Stress	0.32 ± 0.06	0.90 ± 0.12	6.4 ± 0.5	180 ± 15
High Stress	0.20 ± 0.05	0.55 ± 0.08	5.9 ± 0.6	220 ± 20
p-value	<0.001	<0.001	0.002	<0.001

In **Table 2**, both unstimulated and stimulated salivary flow rates decreased significantly with increasing stress levels ($p < 0.001$). There was a concurrent reduction in salivary pH ($p = 0.002$), suggesting that elevated stress levels create an acidic oral environment. In contrast, total salivary protein levels increased as stress levels rose ($p < 0.001$), possibly indicating altered glandular function and compromised oral health status.

Oral health status outcomes based on stress levels oral health status parameters, xerostomia scores, DMFT index, gingival index, and plaque accumulation were also significantly affected by stress levels. Higher stress was associated with worsened oral health status indicators, as demonstrated in **Table 3**.

Table 3: Oral Health Status Parameters in Relation to Stress Levels

Stress Level	**Xerostomia Score**	**DMFT Index (Mean ± SD)**	**Gingival Index (Mean ± SD)**	**Plaque Accumulation (%)**
Low Stress	2.5 ± 1.2	4.0 ± 1.5	1.0 ± 0.5	15%
Moderate Stress	4.8 ± 1.5	6.5 ± 2.0	1.8 ± 0.6	35%
High Stress	7.2 ± 2.0	8.5 ± 2.5	2.5 ± 0.7	55%
p-value	<0.001	<0.001	<0.001	<0.001

The findings in **Table 3** show that participants with higher stress levels reported more severe xerostomia, with mean scores of 7.2 in the high-stress group compared to 2.5 in the low-stress group ($p < 0.001$). The DMFT index, representing dental health, also worsened with increasing stress, with participants in the high-stress group having a significantly higher number of decayed, missing, and filled teeth ($p < 0.001$). Gingival inflammation and plaque accumulation were significantly more pronounced in participants with high stress ($p < 0.001$).

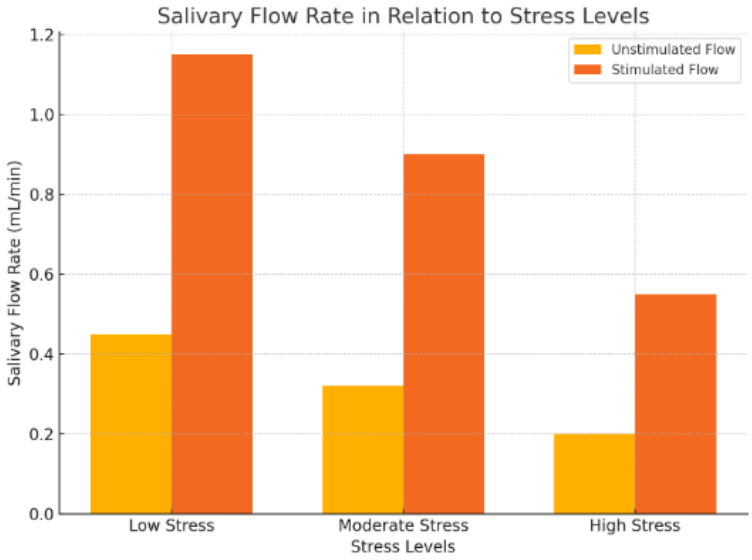

Figure 1: Salivary Flow Rate in Relation to Stress Levels – This graph demonstrates how both unstimulated and stimulated salivary flow rates decrease as stress levels increase from low to high.

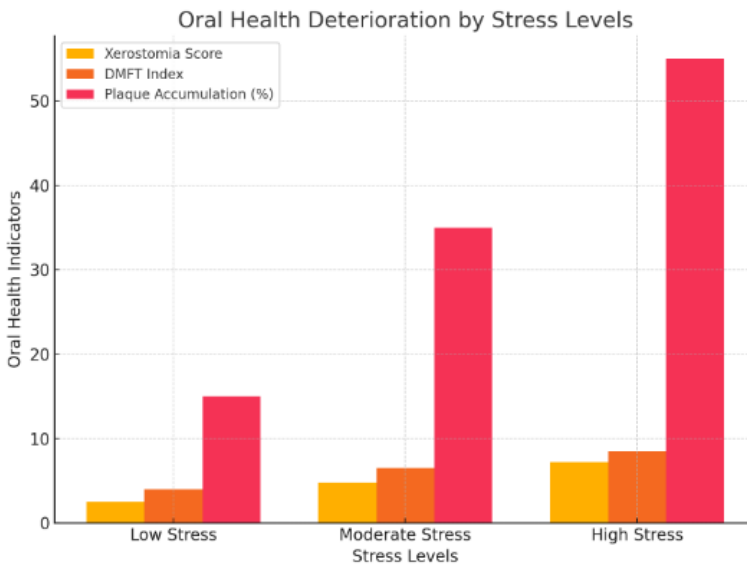

Figure 2: Oral health status Deterioration by Stress Levels – This graph shows the relationship between stress levels and oral health status indicators, including xerostomia scores, DMFT index, and plaque accumulation. As stress increases, all these oral health status parameters worsen significantly.

Discussion

The results from this study are in agreement with numerous international studies that emphasize the negative impact of chronic stress on oral health status. Pires et al. (2020) reported similar findings in their investigation of the U.S. population, where chronic stress was linked to reduced salivary flow and increased oral diseases [14]. Similarly, Werfalli et al. (2021) demonstrated comparable reductions in salivary flow rates and increased incidence of xerostomia in individuals experiencing chronic stress [15].

Locally, the results align with studies conducted by Atif et al. (2022) and Sharif et al. (2021) in Pakistan, which showed similar patterns of reduced salivary function and worsened oral health status among stressed populations [16 17]. This study further confirms the growing concern about the effect of stress on oral health status, particularly in urban populations where socio-economic pressures are high.

Contrarily, some research, such as that conducted by Nakayama et al. (2018) in Japan, failed to establish a direct correlation between stress and salivary changes [18]. These disparities may stem from cultural differences in stress coping mechanisms, as well as variations in methodologies used for assessing stress levels.

The significant differences in salivary gland function and oral health status parameters across stress levels in this study reinforce the importance of integrating stress management into routine dental care. Reducing stress through behavioral interventions such as mindfulness or therapy could have profound benefits on oral health status, as supported by existing literature [19 20].

The present study adds to the growing body of research advocating for the inclusion of mental health support in dental care, especially in regions like Pakistan, where stress-related health issues are prevalent. Dentists should be trained to recognize the signs of stress-induced oral health status deterioration and collaborate with mental health professionals for comprehensive patient care.

Future studies should explore longitudinal outcomes to better understand the long-term effects of stress on oral health status. Additionally, public health initiatives aimed at reducing stress and promoting oral hygiene should be prioritized in high-risk populations.

Conclusion

Chronic stress significantly impacts salivary gland function and oral health status, as evidenced by reduced salivary flow rates, altered salivary composition, and worsening oral health status parameters such as xerostomia, dental caries, and gingival inflammation. Integrating stress management with oral health status care is essential to mitigate these negative effects, particularly in high-stress environments like Pakistan.

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