Evaluation of association between potential stress markers and periodontal health in medical and dental students: A questionnaire-based study

ABSTRACT

Aims and Objectives: Psychological conditions, particularly psychosocial stress, have been implicated as risk indicators for periodontal disease. The aim of the present study was to explore the role of psychosocial stress on periodontium through questionnaire and serum cortisol level.

Subjects and Methods: Two hundred medical and dental undergraduates were recruited for the study. Case group included 82 examination going and control group had 79 nonexam going students. Their stress level was evaluated using a standard questionnaire (perceived stress scale). Gingival index, periodontal disease index, bleeding on probing index, serum cortisol level, and serum alpha-amylase level were also measured.

Statistical Analysis Used: Bivariate correlations and multiple regression tests were done.

Results: A positive correlation was found among stress scores, salivary cortisol, alpha-amylase, and periodontal disease measures.

Conclusion: Periodontitis can be related to immunologic changes related to psychological states

Keywords: Cortisol, examination, periodontitis, stress

INTRODUCTION

Periodontitis is an inflammatory disease involving the destruction of the investing tissues around the teeth, resulting in loss of tooth support, ultimately tooth loss.

The etiology of periodontal disease involves numerous risk factors such as age, smoking, specific infections, uncontrolled diabetes, psychosomatic conditions such as anxiety and psychosocial stress.[1-3]

Stress is a state of physiological or psychological strain caused by adverse stimuli, physical, mental, emotional, internal or external that tend to disturb the functioning of an organism.[4] Researchers have reported an association between psychological stress and gingival inflammation and periodontitis.[5-9]

Gingivitis is mild, reversible form of periodontal disease characterized by gingival inflammation without attachment loss and detected clinically by bleeding on probing (BOP). Untreated gingivitis may evolve into periodontitis, a chronic inflammatory state resulting in periodontal attachment loss.[10] Clinical indicators of periodontitis include probing pocket depth, gingival recession, clinical attachment level, and radiographic loss of alveolar bone.[11]

PRERNA AGARWAL1,2, HIRAK S BHATTACHARYYA1,2, PAVITRA RASTOGI1,2, MANVI CHANDRA AGARWAL1,2, ASHUTOSH AGARWAL1

1Department of Periodontics, Institute of Dental Sciences, BIU, Bareilly, 2Department of Periodontics, Faculty of Dental Sciences, KGMU, Lucknow, Uttar Pradesh, India

Address for correspondence: Dr. Manvi Chandra Agarwal, Room No 228, Institute of Dental Sciences, BIU, Bareilly, Uttar Pradesh, India.
E-mail: agarwalmanvi25@gmail.com

Received: 26 December 2019, Revised: 13 February 2020, Accepted: 12 March 2021, Published: 20 April 2022

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMDmedknow_reprints@wolterskluwer.com

How to cite this article: Agarwal P, Bhattacharya HS, Rastogi P, Agarwal MC, Agarwal A. Evaluation of association between potential stress markers and periodontal health in medical and dental students: A questionnaire-based study. Natl J Maxillofac Surg 2022;13:90-4.
Chronic activation of the hypothalamic–pituitary–adrenal axis may influence the initiation and progression of periodontitis showing dysregulation of circulating cortisols and other glucocorticoids that affect immune function.\(^{[12]}\) Green et al. reported higher incidence of periodontal diseases in those experiencing stressed life events and a particularly strong correlation between stressors and periodontal disease.\(^{[13]}\)

In addition to this, occupational and academic stress may be associated with progression of periodontal disease. In a small study over the Nigerian students, those undergoing academic examinations had more periodontal inflammation than controls.\(^{[14]}\)

A systematic review\(^{[15]}\) of case control, cross-sectional and prospective studies examining psychological stress and periodontal disease indicated that 57.1% of the studies reported a positive correlation between psychological stress and periodontal disease and 14.2% did not.

The present study extends the research on chronic stress, depression and periodontal disease by measuring behaviors, psychological variables, and salivary stress markers such as alpha-amylase and cortisol levels to explore the behavioral and immunologic correlates of periodontal parameters.

**SUBJECTS AND METHODS**

**Study population**
The study was conducted in Rohilkhand Medical College and Hospital and Institute of Dental Sciences (IDS), Bareilly.

A total of 200 dental and medical undergraduates were included. Out of these, 100 undergraduates were undergoing professional examination and 100 were in nonexam giving group.

The subjects were in the age range of 18–21 years with minimum 20 teeth excluding third molars. Participants on antibiotics, steroids, chemotherapeutic agents, or antipsychotic drug therapy and with immunosuppressive diseases were excluded [Table 1].

The study protocol was approved by the ethical committee of IDS (Reference Number: IEC/IDS/102/2019) dated 6\(^{th}\) January 2022 and informed written consent was taken from all the participants.

The health and oral hygiene survey included questions about age, family history of periodontal disease, smoking, and frequency of brushing and flossing. Participants also indicated whether they neglected oral hygiene during periods of stress or depression.

**Psychological evaluation**
Participants from both, examination giving and nonexam-giving group answered a questionnaire pertaining to the level of stress that they perceive\(^{[18]}\) perceived stress scale, [Table 2]. According to the interpretation of the scores [Table 3], participants from the exam giving group who scored above 20 were included in case group. Similarly, participants from nonexam-giving group who scored <11 were included in the control group. This made a case group of 82 participants and control group of 79 participants.

**Saliva sample**
Saliva was collected by passive drool through a 1-inch straw into a vial. Samples were drawn between 9 am and 10 am to avoid circadian rhythm changes.\(^{[19]}\) Refrigerate samples within 30 min, and freeze at or below −20°C within 4 h after collection. On day of assay, thaw completely, vortex, and centrifuge at 1500 × g (@3000 rpm) for 15 min. Samples should be at room temperature before adding to assay plate. Salivary cortisol and alpha-amylase were assayed using skits (Salimetrics salivary cortisol assay kit).

**Statistical analyses**
Mean stress scores, salivary stress markers, and clinical

**Table 1: Description of sample (n=161)**

| Variable                                      | Values         |
|-----------------------------------------------|----------------|
| Age (years), mean (SD)                        | 18.55 (1.43)   |
| Sex (males: females)                          | 45:55          |
| History of smoking (%)                        | 36             |
| History of alcohol (%)                        | 46             |
| Neglects brushing when stressed (%)          | 34.2           |
| Tooth brushing (number of times/day; mean) (%)|                |
| Once                                          | 27.3           |
| Twice                                         | 66.5           |
| Thrice                                        | 6.2            |
| Stress score, mean (SD)                       | 8.75 (1.70)    |
| Control                                       | 28.40 (1.85)   |

SD: Standard deviation
parameters were calculated for both case and control groups [Table 4]. Bivariate correlations were done among psychosocial variables, salivary stress markers, and periodontal disease measures [Tables 5 and 6]. Correlation was significant at 0.01 level and it was one tailed. Multiple regressions were used to relate periodontal disease measures with psychosocial variables, stress scores, and salivary stress markers [Tables 7-9].

RESULTS

Of the total 161 participants, 36% were smokers and 46% had a history of alcoholism. Most of the participants brushed their teeth twice daily (about 66.5%) and 34.2% gave a history of no brushing during stress [Table 1]. The GI and PDI means (standard deviation) were 1.75 (0.42) and 0.92 (0.43) respectively for control group and 2.69 (0.21) and 1.79 (0.13) respectively for case group. A positive correlation existed among stress scores, salivary cortisol and alpha-amylase and the periodontal disease measures. Stress score was significantly correlated with all three periodontal disease measures, i.e., GI, PDI, and BOP index [Table 6]. However, there was negative correlation between stress score and brushing frequency [Table 5].

DISCUSSION

The present study showed direct correlation between periodontal disease measures, stress scores, and salivary stress markers. The results were consistent with previous studies suggesting the association of periodontal disease with stress.[3,12]

In terms of behavior, the study did not show any significant correlation between brushing frequency and stress scores and markers. This was in contradiction to the previous studies.[20,21] Thus, the relationships among stress, oral hygiene, and markers of periodontal disease were unclear. The effect of oral hygiene may not be apparent because of socioeconomic class of sample selected and maintenance and awareness of hygiene maintenance.

A positive relationship exists among depression scores, salivary cortisol, and alpha-amylase and the indices of periodontal disease. This is likely because of altered immune responses that facilitate increased colonization parameters were calculated for both case and control groups [Table 4]. Bivariate correlations were done among psychosocial variables, salivary stress markers, and periodontal disease measures [Tables 5 and 6]. Correlation was significant at 0.01 level and it was one tailed. Multiple regressions were used to relate periodontal disease measures with psychosocial variables, stress scores, and salivary stress markers [Tables 7-9].

RESULTS

Of the total 161 participants, 36% were smokers and 46% had a history of alcoholism. Most of the participants brushed their teeth twice daily (about 66.5%) and 34.2% gave a history of no brushing during stress [Table 1]. The GI and PDI means (standard deviation) were 1.75 (0.42) and 0.92 (0.43) respectively for control group and 2.69 (0.21) and 1.79 (0.13) respectively for case group. A positive correlation existed among stress scores, salivary cortisol and alpha-amylase and the periodontal disease measures. Stress score was significantly correlated with all three periodontal disease measures, i.e., GI, PDI, and BOP index [Table 6]. However, there was negative correlation between stress score and brushing frequency [Table 5].

DISCUSSION

The present study showed direct correlation between periodontal disease measures, stress scores, and salivary stress markers. The results were consistent with previous studies suggesting the association of periodontal disease with stress.[3,12]

In terms of behavior, the study did not show any significant correlation between brushing frequency and stress scores and markers. This was in contradiction to the previous studies.[20,21] Thus, the relationships among stress, oral hygiene, and markers of periodontal disease were unclear. The effect of oral hygiene may not be apparent because of socioeconomic class of sample selected and maintenance and awareness of hygiene maintenance.

A positive relationship exists among depression scores, salivary cortisol, and alpha-amylase and the indices of periodontal disease. This is likely because of altered immune responses that facilitate increased colonization parameters were calculated for both case and control groups [Table 4]. Bivariate correlations were done among psychosocial variables, salivary stress markers, and periodontal disease measures [Tables 5 and 6]. Correlation was significant at 0.01 level and it was one tailed. Multiple regressions were used to relate periodontal disease measures with psychosocial variables, stress scores, and salivary stress markers [Tables 7-9].

RESULTS

Of the total 161 participants, 36% were smokers and 46% had a history of alcoholism. Most of the participants brushed their teeth twice daily (about 66.5%) and 34.2% gave a history of no brushing during stress [Table 1]. The GI and PDI means (standard deviation) were 1.75 (0.42) and 0.92 (0.43) respectively for control group and 2.69 (0.21) and 1.79 (0.13) respectively for case group. A positive correlation existed among stress scores, salivary cortisol and alpha-amylase and the periodontal disease measures. Stress score was significantly correlated with all three periodontal disease measures, i.e., GI, PDI, and BOP index [Table 6]. However, there was negative correlation between stress score and brushing frequency [Table 5].

DISCUSSION

The present study showed direct correlation between periodontal disease measures, stress scores, and salivary stress markers. The results were consistent with previous studies suggesting the association of periodontal disease with stress.[3,12]

In terms of behavior, the study did not show any significant correlation between brushing frequency and stress scores and markers. This was in contradiction to the previous studies.[20,21] Thus, the relationships among stress, oral hygiene, and markers of periodontal disease were unclear. The effect of oral hygiene may not be apparent because of socioeconomic class of sample selected and maintenance and awareness of hygiene maintenance.

A positive relationship exists among depression scores, salivary cortisol, and alpha-amylase and the indices of periodontal disease. This is likely because of altered immune responses that facilitate increased colonization parameters were calculated for both case and control groups [Table 4]. Bivariate correlations were done among psychosocial variables, salivary stress markers, and periodontal disease measures [Tables 5 and 6]. Correlation was significant at 0.01 level and it was one tailed. Multiple regressions were used to relate periodontal disease measures with psychosocial variables, stress scores, and salivary stress markers [Tables 7-9].

RESULTS

Of the total 161 participants, 36% were smokers and 46% had a history of alcoholism. Most of the participants brushed their teeth twice daily (about 66.5%) and 34.2% gave a history of no brushing during stress [Table 1]. The GI and PDI means (standard deviation) were 1.75 (0.42) and 0.92 (0.43) respectively for control group and 2.69 (0.21) and 1.79 (0.13) respectively for case group. A positive correlation existed among stress scores, salivary cortisol and alpha-amylase and the periodontal disease measures. Stress score was significantly correlated with all three periodontal disease measures, i.e., GI, PDI, and BOP index [Table 6]. However, there was negative correlation between stress score and brushing frequency [Table 5].

DISCUSSION

The present study showed direct correlation between periodontal disease measures, stress scores, and salivary stress markers. The results were consistent with previous studies suggesting the association of periodontal disease with stress.[3,12]

In terms of behavior, the study did not show any significant correlation between brushing frequency and stress scores and markers. This was in contradiction to the previous studies.[20,21] Thus, the relationships among stress, oral hygiene, and markers of periodontal disease were unclear. The effect of oral hygiene may not be apparent because of socioeconomic class of sample selected and maintenance and awareness of hygiene maintenance.

A positive relationship exists among depression scores, salivary cortisol, and alpha-amylase and the indices of periodontal disease. This is likely because of altered immune responses that facilitate increased colonization
The immune response does not operate autonomously but in close cooperation with the neuroendocrine systems. When the body is in stress, the glucocorticoids released through the activation of the hypothalamus–pituitary–adrenal axis seem to be important, due to their ability to regulate the recruitment of immune cells into inflamed tissues and to skew the Th1/Th2 balance toward a Th2-dominant response, thereby leading to the progression of periodontal disease.[24] In the presence of stress hormone, collagen production is shown to be decreased due to increase in amounts of glucocorticoids.[23] Deinzer et al. reported that academic stress can lead to gingival inflammation with increased crevicular interleukin-1b and diminished quality of oral hygiene. Furthermore, stress modifies the salivary pH and its chemical composition like IgA secretion, thus contributing to gingival and periodontal inflammation.[7]

Multiple regression analysis showed that stress scores and salivary amylase were highly significant predictors of PDI and cortisol was marginally significant predictor after controlling for sex, smoking, and alcohol history and brushing frequency [Table 7].

Analysis also depicted cortisol and amylase as highly significant predictors of GI [Table 8]. While for BOP, stress scores, cortisol, and amylase emerged to be highly significant predictors after controlling for sex, smoking, alcohol, and brushing frequency [Table 9].

Salivary cortisol showed positive correlation with periodontal disease measures, but in regression models, it was seen that cortisol was a marginally significant predictor of PDI. Although this finding may seem counterintuitive, it is consistent with recent research on stress that distinguishes between acute stress and the chronic, debilitating negative effect that is more likely to be associated with depression and flattened cortisol patterns.[26] Subjective distress, feeling out of control, and traumatic or physically threatening stress are associated with lower morning levels and suppressed diurnal variability of cortisol.[26]

Patients experiencing such changes in cortisol may eventually have immune effects that result in periodontitis.

**CONCLUSION**

The results showed positive correlations among stress, salivary stress markers and PDI, independent of dental hygiene. Therefore, it can be concluded that periodontitis can be related to immunologic changes related to psychological states. Further, cortisol seems to have different associations with periodontal outcomes in regression models involving stress.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Genco RJ. Current view of risk factors for periodontal diseases. J Periodontol 1996;67 Suppl 10S:1041-9.
2. Moss ME, Beck JD, Kaplan BH, Offenbacher S, Weintraub JA, Koch GG, et al. Exploratory case-control analysis of psychosocial factors and adult periodontitis. J Periodontol 1996;67:1060-9.
3. Monteiro da Silva AM, Oakley DA, Newman HN, Nohl FS, Lloyd HM. Psychosocial factors and adult onset rapidly progressive periodontitis. J Clin Periodontol 1996;23:789-94.
4. Dorland WA. Dorland Dorland’s Illustrated Medical Dictionary. Oxford, UK: WB Saunders; 2000.
5. Breivik T, Thrane PS, Murison R, Gjermo P. Emotional stress effects on immunity, gingivitis and periodontitis. Eur J Oral Sci 1996;104:327-34.
6. da Silva AM, Newman HN, Oakley DA. Psychosocial factors in inflammatory periodontal diseases. A review. J Clin Periodontol 1995;22:516-26.
7. Deinzer R, Förster P, Fuck L, Herforth A, Stiller-Winkler R, Idel H. Increase of crevicular interleukin 1beta under academic stress at experimental gingivitis sites and at sites of perfect oral hygiene. J Clin Periodontol 1999;26:1-8.
8. Mengel R, Bacher M, Flores-De-Jacoby L. Interactions between stress, interleukin-1beta, interleukin-6 and cortisol in periodontally diseased patients. J Clin Periodontol 2002;29:1012-22.
9. Vettore MV, Leão AT, Monteiro Da Silva AM, Quintanilha RS, Lamarca GA. The relationship of stress and anxiety with chronic periodontitis. J Clin Periodontol 2003;30:394-402.
10. Ng SK, Keung Leung W. A community study on the relationship between stress, coping, affective dispositions and periodontal attachment loss. Community Dent Oral Epidemiol 2006;34:252-66.
11. Kaufman E, Lamster IB. Analysis of saliva for periodontal diagnosis – A review. J Clin Periodontol 2000;27:453-65.
12. Genco RJ, Ho AW, Kopman J, Grossi SG, Dunford RG, Tedesco LA. Models to evaluate the role of stress in periodontal disease. Ann Periodontol 1998;3:288-302.
13. Green LW, Tryon WW, Marks B, Huryn J. Periodontal disease as a function of life events stress. J Human Stress 1986;12:32-6.
14. Arowojolu MO, Onyeaso CO, Dosumu EB, Idahoh GK. Effect of academic stress on periodontal health in Nigerians. Odontostomatol Trop 2006;29:9-13.
15. Peruzzo DC, Benatti BB, Ambrosano GM, Nogueira-Filho GR, Sallum EA, Casati MZ, et al. A systematic review of stress and psychological factors as possible risk factors for periodontal disease. J Periodontol 2007;78:1491-504.
16. Loe H, Silness J. Periodontal disease in pregnancy. I. Prevalence and severity. Acta Odontol Scand 1963;21:533-51.
17. Ramfjord SP. The periodontal disease index (PDI). J Periodontol 1967;38:602-10.
18. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav 1983;24:385-96.
19. Krahwinkel T, Nastali S, Azzar B, Willershagen B. The effect of examination stress conditions on the cortisol content of saliva – A study of students from clinical semesters. Eur J Med Res 2004;9:256-60.
20. Abegg C, Croucher R, Marcenes WS, Sheiham A. How do routines of daily activities and flexibility of daily activities affect tooth-cleaning behavior? J Public Health Dent 2000;60:154-8.
21. Rosania AE, Low KG, McCormick CM, Rosania DA. Stress, depression, cortisol, and periodontal disease. J Periodontol 2009;80:260-6.
22. Pruessner JC, Hellhammer DH, Kirschbaum C. Burnout, perceived stress, and cortisol responses to awakening. Psychosom Med 1999;61:197-204.
23. Schleifer SJ, Keller SE, Bartlett JA, Eckholdt HM, Delaney BR. Immunity in young adults with major depressive disorder. Am J Psychiatry 1996;153:477-82.
24. Breivik T, Thrane PS. Psychoneuroimmune interaction in periodontal disease. In: Ader R, Fettten DL, Cohen N, editors. Psychoneuroimmunology. 3rd ed.., Vol. 2. San Diego: Academic Press; 2001. p. 627-44.
25. Chandna S, Bathla M. Stress and periodontium: A review of concepts. J Oral Health Community Dent 2010;1 Suppl 4:117-22.
26. Miller GE, Chen E, Zhou ES. If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. Psychol Bull 2007;133:25-45.