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**RESEARCH ARTICLE**

# Stress, Depression and Cortisol. Is our Periodontium vulnerable?

**Dr. Abhishek N Zingade**

[1] Senior Lecturer, Department of Periodontics, KLE VK Institute of Dental Sciences, KLE University. Belgaum 590010

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***Corresponding Author***

**Dr. Abhishek N Zingade**

## *Abstract*

Research has suggested that stress, depression and ineffective coping may contribute to development of periodontitis. The aim was to find an association between perceived stress and periodontitis**.**30 participants were included and periodontal screening was carried out. Unstimulated saliva was collected from these patients and the cortisol analysis was carried out. With an increase in the severity of depression, the cortisol levels and the clinical parameters were seen to rise.

**Keywords**: Stress, Cortisol, Periodontal disease



## Introduction:

Periodontal disease is a chronic bacterial infection involving the gingiva and periodontium, and is one of the most common causes of tooth loss. The presence of bacteria and their interaction with host defenses makes a person susceptible to develop periodontitis. Various risk elements such as diabetes, hypertension, smoking, age and genetics have shown to influence the onset and progression of this disease. Research has also suggested that stress, depression and ineffective coping may contribute to development of periodontitis.

Lazarus' has defined stress as "an inharmonious fit between the person and the environment, one in which the person's resources are taxed or exceeded, forcing the person to struggle, usually in complex ways, to cope". It has been known for several decades that stress-whether inflammatory, traumatic, or psychological is associated with concurrent activation of the hypothalamus-pituitary-adrenal axis.[2] Therefore, stress can be best understood as part of a complex and dynamic system of interaction between individuals and their environment and as a part of the human condition which is universally present but to varying degrees and with different effects on individuals. Though stress is necessary to cope with the challenges of everyday life, problems start when the stress response is inappropriate to the size of these challenges.

In response to stress and negative emotions, polypeptides like corticotropic – releasing hormone are released from the hypothalamus, which stimulates the release of Adrenocorticotropic hormone (ACTH) from the pituitary gland thereby producing cortisol (CORT), a glucocorticoid (GC) that helps to regulate inflammatory responses and lymphocytic activity. Short term elevations in CORT reduces inflammation and mobilizes immune components, however over long term may reduce immunocompetency through inhibition of immunoglobulin A (IgA), immunoglobulin G (IgG), and neutrophil function. There is also evidence that longer – term elevations in CORT may be associated with chronic inflammation because GC loses its ability to inhibit inflammatory responses initiated by the immune system. Hence, it has been suggested that chronically elevated CORT may result in inflammation and more destructive periodontitis.

The aim of the present cross sectional study thus was to find an association between perceived stress and periodontitis and also to assess the extent and severity of chronic periodontitis in individuals with different levels of salivary cortisol.

## Subjects and Methods:

Thirty participants in the age group of 35 – 60 years, who reported to the outpatient department of Pyschiatry, KLES Prabhakar Kore Hospital and Medical Research Centre, Belgaum, were included in the study.
Approval was obtained from the institutional ethical committee prior to the start of the study. A written informed consent was obtained from the patients, and only those willing to consent were included in the study.
Patients on anti- depressants and steroids, those with diabetes, pregnant women and those who have undergone periodontal screening/procedures over the past 3 months were excluded from the study.
The diagnosis of depression for all the admitted patients was made based on the Hamilton rating scale for rating of depression (A 21 questionnaire based rating), as mild, moderate and severely depressed. Of the 30 included patients, 10 each were included in the mild, moderate and severely depressed groups.
Periodontal screening was performed using a Williams's graduated periodontal probe. It involved recording of Oral hygiene index, pocket probing depth and loss of attachment.
The oral hygiene index simplified, involved examination of predetermined surfaces of 6 teeth to calculate debris and calculus index for determining the oral hygiene status.
Periodontal pockets were measured as the distance from the gingival margin to the location of the tip of William's periodontal probe inserted in to the pocket with moderate probing force. Pocket depth for each tooth on its all four surfaces i.e mesial, distal, buccal/ labial and lingual/ palatal surface was measured. The pocket depth on all the surfaces of each tooth was added and divided by the number of teeth examined.
Loss of attachment was measured as the distance from the cement-enamel junction (CEJ) to the base of the gingival sulcus using William's probe. When the gingival margin was on the crown, the attachment level was determined by subtracting from the depth of the pocket the distance from the gingival margin to the CEJ. When the gingival margin was seen to coincide with the CEJ, loss of attachment was considered as equal to the pocket depth. And when margin was located apical to the CEJ, the distance between CEJ and gingival margin was added to the pocket depth.
Severity of periodontal disease was classified with reference to extent of attachment loss as per AAP classification for chronic periodontitis.
Unstimulated saliva samples were collected for the cortisol analysis, which was done between 9 and 10 AM. Unstimulated saliva samples were obtained by means of sterilized cotton rolls. All participants were restricted from intake of any kind of food or liquid before the test. Cotton rolls were placed in the floor of the mouth for duration of 3minutes until they were completely saturated with saliva. The samples obtained were then stored in appendrof tubes and were quantitatively estimated for cortisol levels by means of Fluorescence Polarization Immunoassay on the AxSYM system. On obtaining the cortisol levels, the participants were categorized into mild, moderate and severe hypercortisolemics.
Statistical analysis was performed using the Chi square test to correlate between the states of depression and periodontal condition, and the quantitative analysis was done using one way Analysis of Varience using Tukey's test. A 'p' value of $<0.0001$ was considered to be statistically significant.

## Results:

The mean levels of cortisol, probing pocket depth and clinical attachment loss for individuals under mild, moderate and severe states of depression were as mentioned in Table 1.
It was noted that, with an increase in the severity of depression, the cortisol levels and the clinical parameters namely probing pocket depth and clinical attachment loss were seen to rise accordingly. However, no significant difference was observed in the mild and moderate groups of depression with regard to probing pocket depth.
Inter group comparison of the depression states with corresponding clinical parameters such as cortisol, probing pocket depth and loss of attachment was made. A high correlation was observed among the three groups of depression and their corresponding cortisol levels. (Fig 1) No significant difference was noted in terms of PPD and severity of depression among the three groups. However, in terms of CAL a statistically significant difference was noted among the mild and severe and the moderate and severe groups of depression. (Figs 2 and 3)

**Table 1 – table showing mean values**

| State of depression | Mean – cortisol levels (nmol/lt) | Mean - probing pocket depth (mm) | Mean – loss of attachment (mm) |
|---|---|---|---|
| **Mild** | 9.94 | 4.30 | 2.57 |
| **Moderate** | 21.25 | 4.32 | 3.12 |
| **Severe** | 40.85 | 5.42 | 4.25 |

**Figure 1 – Graph showing the correlation between cortisol levels and depression**

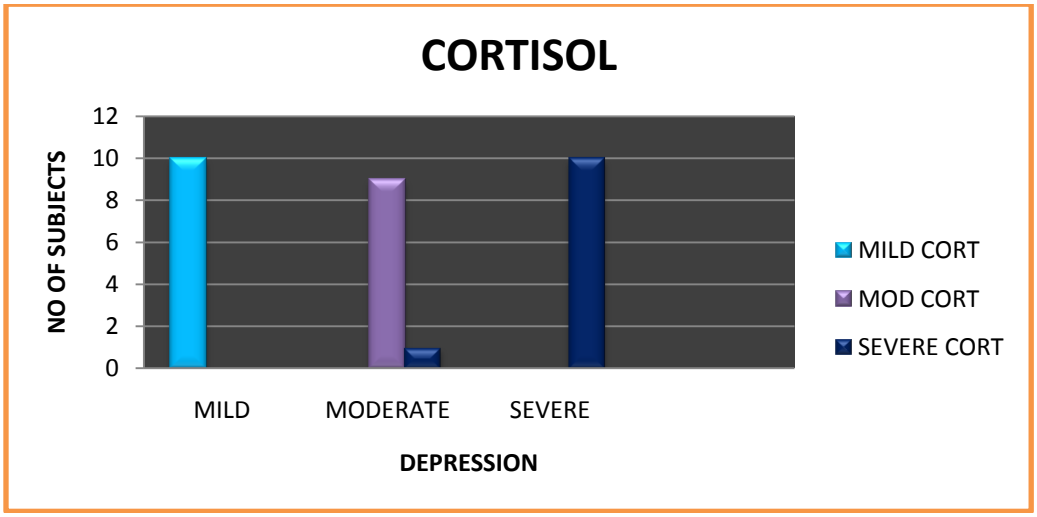



**Figure 2 - Graph showing relationship between severity of depression and probing pocket depth**

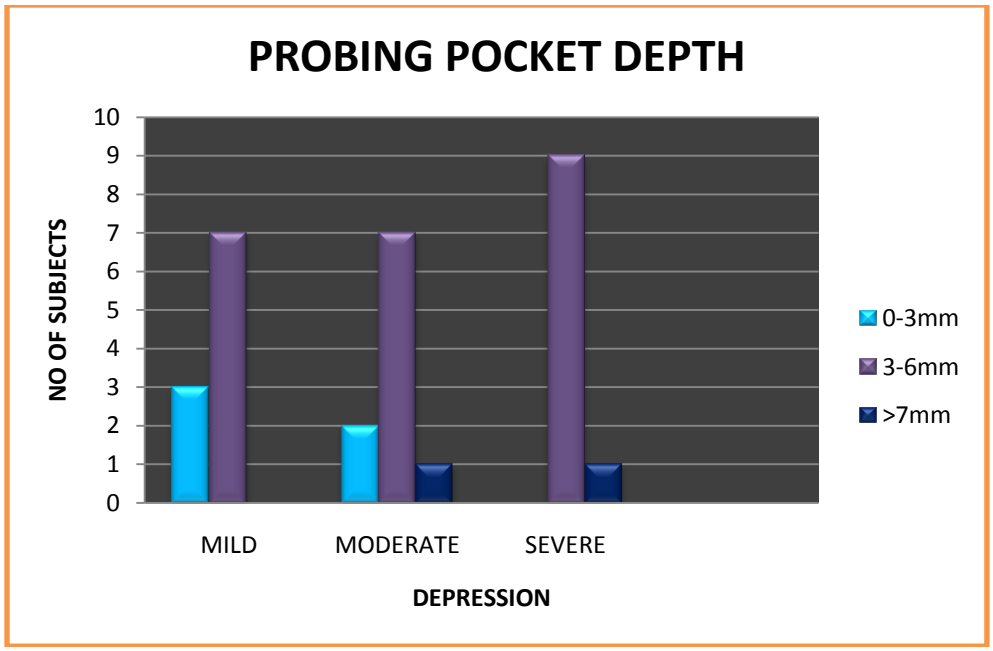



**Figure 3 – Graph showing relationship between severity of depression and loss of attachment**

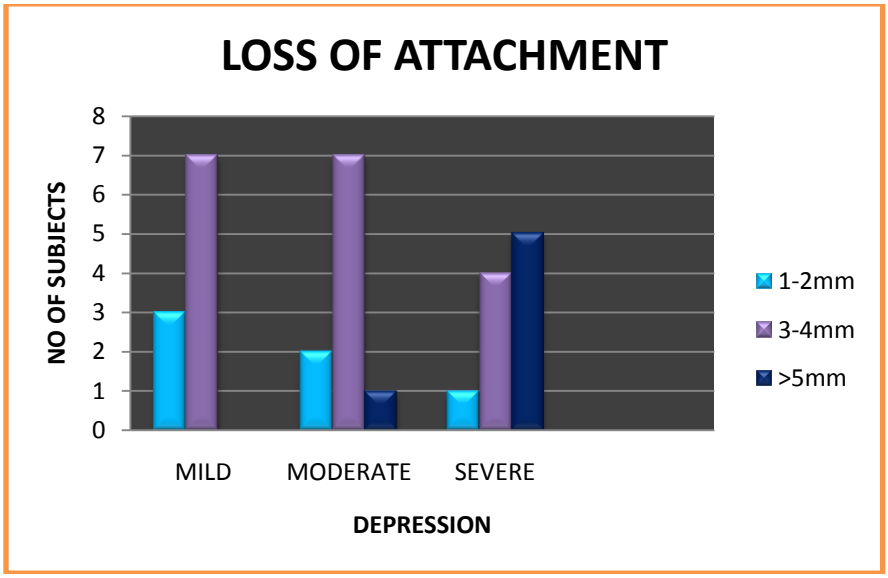


**Figure 4 - Model 1 depicting psychosocial stress and coping behaviours in periodontal disease**

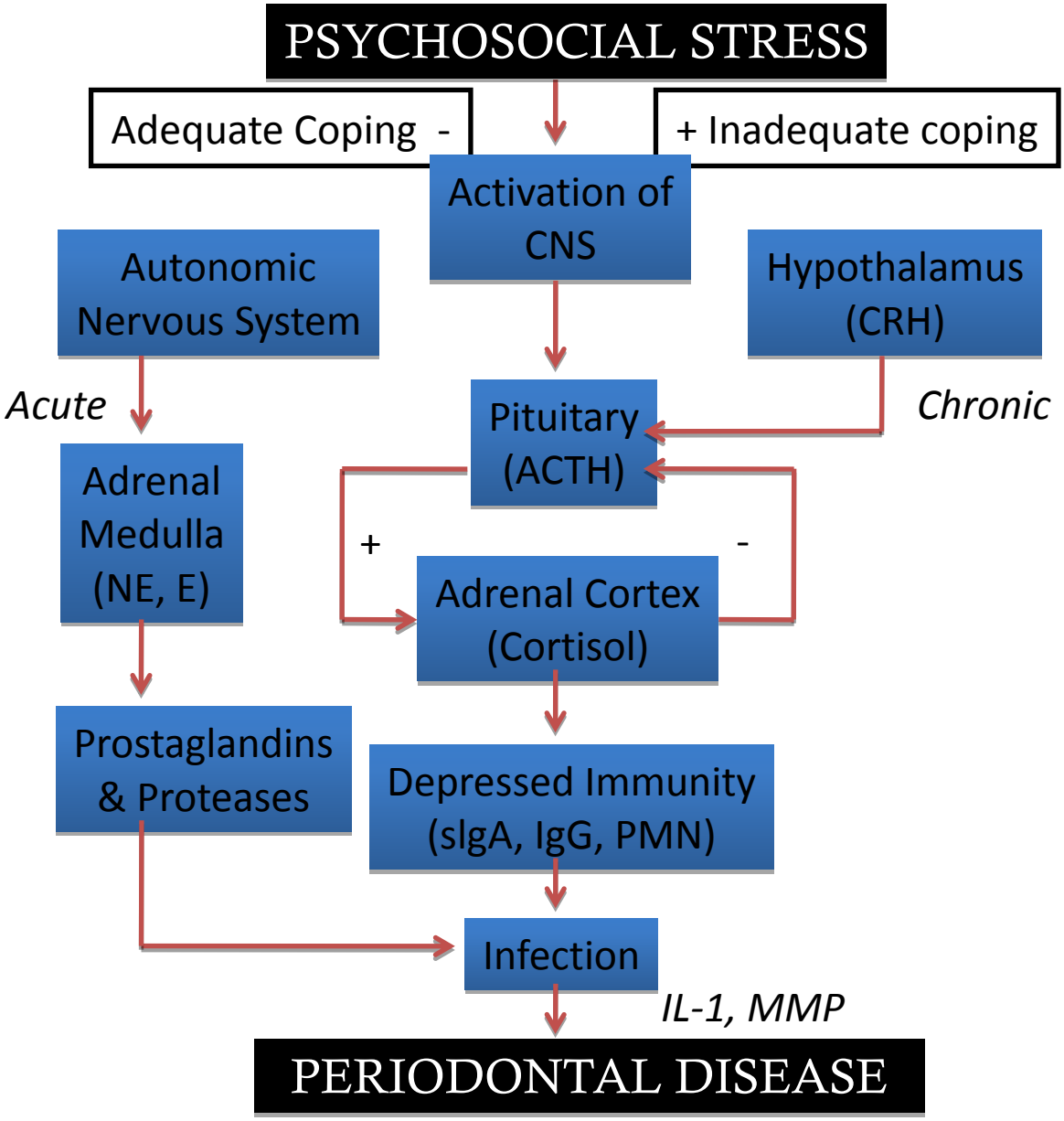
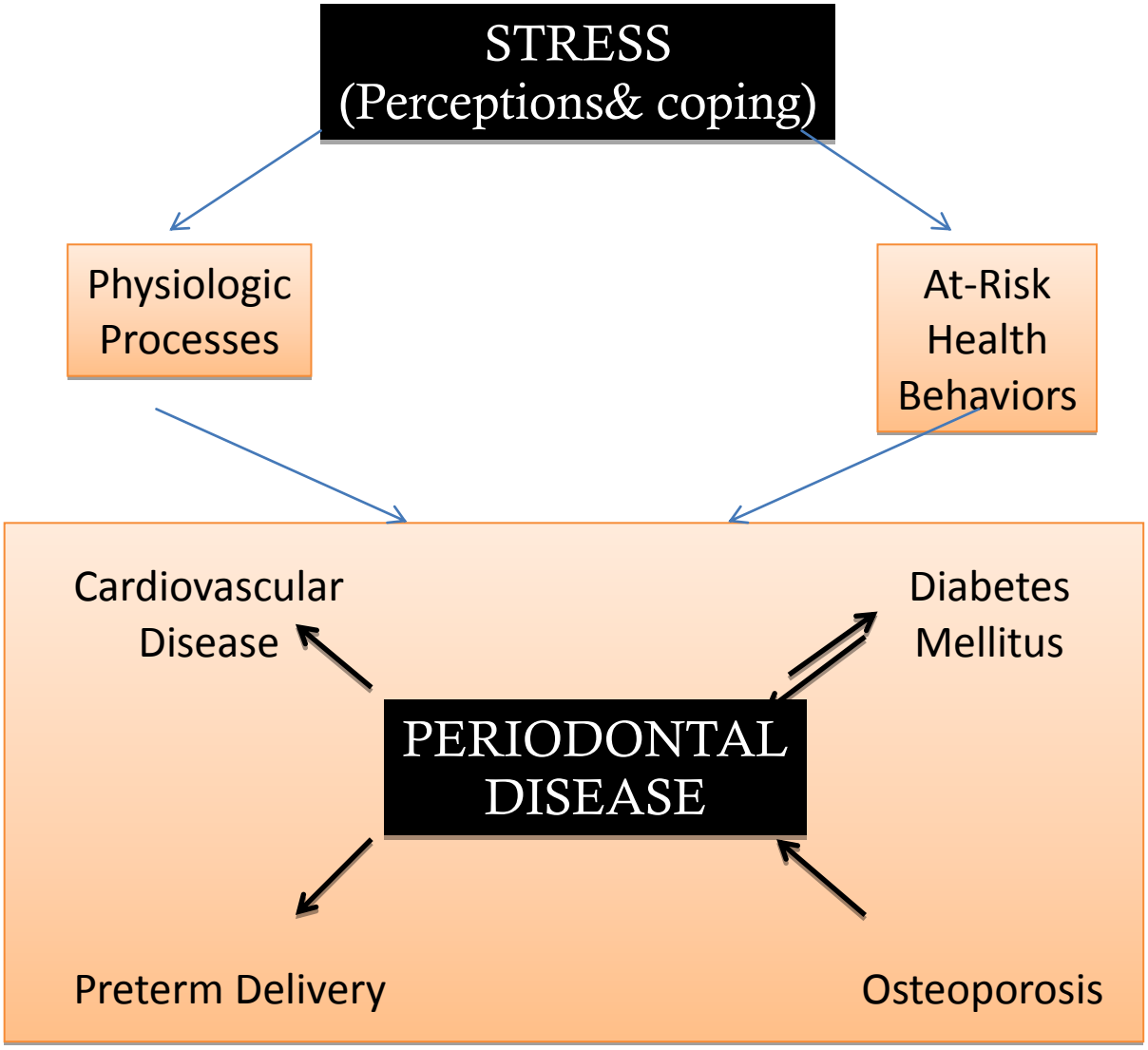


**Figure 5:**




**Discussion**:

Results of the study conducted are consistent with previous reports, suggesting that stress and depression symptoms are associated with periodontal disease.[3,5,6,7] The correlations between depression scores, periodontal disease and salivary cortisol levels confirm the hypothesized association. The existance of such a relationship has been suggested by 2 models.

One model to evaluate the role of psychosocial stress and coping behaviours in periodontal disease is depicted in fig 4, according to which, psychosocial stress can activate the central nervous system.

Hypothalamus releases Corticotropin Releasing Hormone which, among other things stimulates release of Adrenocorticotropic hormone from the pituitary, resulting in production of cortisol by the adrenal cortex. Glucocorticoids, including cortisol, have an inhibitory effect on the immune system. It depresses the secretory IgA, IgG, and neutrophil functions, all of which are important in protection against infection by periodontal organisms. This then gives rise to increased susceptibility, which leads to the establishment of periodontal infection, which in turn results in destructive periodontitis. Periodontitis is brought about by tissue-destroying factors such as Il-1 and

matrix metalloproteinases activated by the periodontal pathogens, as well as by the direct effects of pathogenic bacteria.

Mental as well as physical stress can also result in responses being transmitted to the adrenal medulla through the autonomic nervous system, resulting in secretion of catecholamines such as epinephrine and norepinephrine. These increase prostaglandin and protease synthesis, which enhance periodontal destruction.

The 2nd model (Fig 5)stresses on the behavioral changes due to stress which affect at-risk health behaviors such as smoking, poor oral hygiene, and poor compliance with dental care. There is also a possibility that stress leads to other behavioral changes such as overeating, especially a high-fat diet, which then can lead to immunosuppression through increased cortisol production. It has shown to cause depression, which can have significant effects on periodontal disease.

The data from the present study explains the first model of association with stress, wherein increased cortisol levels are associated with an increased risk of periodontal disease.

The results obtained in the present study are in accordance with the previous studies, conducted by Belting and Gupta (1961)[8], Freeman et al (1993)[9], Johannsen et al (2006)[10], and Amy et al (2009)[1]. The present study showed mean cortisol levels of 40.85nm/lt with a corresponding increase in probing pocket depth (mean – 5.42mm) and clinical attachment loss (mean – 4.25mm) in severely depressed participants. Similar findings were observed in the mild and moderate groups of depression. The presence of deep pockets and increasing CAL indicate an increased risk for development or progression of existing periodontal disease in these individuals.

## Conclusion:

Analysis of the present data suggests a positive correlation between stress and periodontal disease. However longitudinal studies involving a larger number of participants is necessary to further validate the hypothesis.

Thus, it can be hypothesized that the activation of the hypothalamus-pituitary adrenal axis may be associated with the observed periodontal destruction and that depression and cortisol are important correlates of periodontal disease, independent of oral hygiene status

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