

EVALUATION OF EFFECTS OF YOGA ON PSYCHOLOGICAL STRESS, SERUM CORTISOL LEVEL AND PERIODONTAL DISEASE IN ADULT INDIAN POPULATION - A PILOT STUDY

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ABSTRACT

Aim: This cross-sectional pilot study was done to assess the effects of yoga on psychological stress, serum cortisol level and periodontal diseases in adult Indian population.

Materials & Method: The study was conducted among 81 systemically healthy participants which were divided into three groups of 27 each. Psychological stress was evaluated using Perceived stress scale (PSS), Social Re-adjustment Rating Scale (SRRS). Clinically, Plaque Index (PI) (Silness J and Loe H in 1964), Gingival Index (GI), Probing Pocket Depth (PPD) and Clinical attachment level (CAL) were recorded in all the three groups. Blood samples were collected and serum cortisol level was evaluated by immunoassay.

Results: After comparing the mean values of the clinical periodontal parameters, stress scores and serum cortisol level by one-way ANOVA test in total 81 study participants of all the three groups, statistically significant difference was seen. In study participants practising yoga, there was a significant correlation of PSS score with PI only. Whereas in chronic periodontitis patients not practising yoga, all the periodontal clinical parameter, except PPD showed a significant correlation with stress and serum cortisol level.

Conclusion: Results of the study suggest that yoga plays an important role in the reduction of stress, serum cortisol level and thus severity of periodontal disease. It can improve the treatment outcomes of periodontal diseases and can be added in the line of treatment.

Key words: Stress, Serum Cortisol, Yoga, Chronic Periodontitis.

Introduction

Stress has affected every individual in this global urbanisation with busy lifestyle, competition, financial crisis and other environmental problems. Hans seyle was the first person to coin the term stress. He defined stress as a response state of organism to forces acting simultaneously on the body which if excessive, that is straining the capacity of adaptive process beyond their limits, leads to disease of exhaustion and death.¹ If we put this in simple words, it is just an individual response to the challenge perceived. Every individual responds to stress in a different manner, but excessive stress can pose many health problems. WHO has defined health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity."² Stress not only affects your mind and body but can also cause a serious impact on oral health.

Periodontal disease is an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms, resulting in progressive destruction of the periodontal ligament and the alveolar bone with pocket formation and recession. It is one of the most common diseases of man and is responsible for most of the tooth loss in adults. Periodontal disease occurs due to complex interaction between subgingival microflora and nonbacterial factors, host and environmental factors. These nonbacterial bacterial factors increase host's susceptibility to bacterial infection and thus increase the risk for progressive periodontal disease. Thus, it is a multifactorial disease.

There are many studies including systematic review which state that psychological stress has possible effect on

periodontium. Periodontitis is a chronic inflammatory disease characterized by episodes of active destruction to pronounced inflammatory infiltration, attachment loss and alveolar bone loss.³ Some investigators claim that psychological stress causes changes in an individual behaviour and the person indulges into habits of drinking alcohol, smoking which impairs collagen synthesis,⁴ intake of poor diet, neglected oral hygiene increases the accumulation of plaque thus leading to the increased risk of periodontal diseases.⁵ A review article mentioned about the letters of Han seyle, which stated that psychological stress downregulates the immune system through activation of hypothalamo-pituitary axis which causes release of adrenocorticotrophic hormone through anterior pituitary gland and increases secretion of cortisol hormone from adrenal cortex. Cortisol reduces the secretion of immunoglobulin A and immunoglobulin G and decreases the functioning of neutrophils, thus increasing the susceptibility to periodontal destruction.¹

People are getting more health conscious nowadays because of the health awareness and are getting more inclined towards natural treatment. In India yoga has been practised since 3000 B.C. the origin of this word Yoga is derived from a Sanskrit word Yuz which means there is union of mind, body and soul.^{6,7} A preliminary study stated that the activation of hypothalamo-pituitary axis system is optimized by practicing yoga and a balance is created between the sympathetic and parasympathetic limbs of the autonomic nervous system when the subject is faced with a stress.⁸

Although there are various studies which show that the psychological stress affects the periodontium, but there are

very few studies which assess the management of stress by practising yoga and its effect on periodontium. Thus, the present study is to evaluate the effect of Yoga on psychological stress, serum cortisol level and periodontal health. The main hypothesis of this study was that the practice of Yoga results in reduction of chronic periodontitis, psychological stress and serum cortisol level.

Materials & Method

The main objective of this study was to assess and compare the association between periodontal disease, psychological stress, anxiety, depression and serum cortisol levels in patients with chronic periodontitis practising yoga, patients with chronic periodontitis and systemically and periodontally healthy individuals. This case-control clinicobiochemical study was done in patients having chronic periodontitis patients referred to the Department of Periodontology, patients from yoga centre in Ahmednagar and also in healthy individuals.

The study was conducted among 81 systemically healthy participants within the age range of 35 - 44 years and practising yoga for at least 2 years. The subjects having at least 4 sites with periodontal pocket depth $\geq 4\text{mm}$ with minimum of 20 teeth present in the oral cavity were included in group I and group II. These participants were selected using simple random sampling technique.

The study participants were divided into three groups, 27 of each group. Group 1 consisting of chronic periodontitis patients practising yoga, group 2 consisting of chronic periodontitis patients and group 3 consisting of systemically and periodontally healthy individuals. Those study participants on any antibiotic, steroidal, chemotherapeutic or antipsychotic drug therapy, on any hormonal treatment, those suffering from any systemic disease, those having history of any periodontal treatment within last 6 months, pregnant patients and those giving history of use of oral contraceptives in last 6 months were excluded from the study.

All the study participants were explained in detail about the study procedure, and written consent was obtained from the patient before including him or her in the study. A detailed case history of each patient, including the periodontal health examination was recorded according to the proforma specially designed for this study. The approval for this study protocol was given by institutional ethical committee.

Periodontal health status of the study participants was assessed using Plaque Index (PI) (Silness J and Loe H in 1964),⁹ Gingival Index (GI) (Loe H and Silness J 1963),⁹ Probing Pocket Depth (PPD), Clinical attachment level (CAL) in all the three groups. The level of stress was measured in all the study participants using Perceived stress scale (PSS) & Social Readjustment Rating Scale (SRRS).

Perceived stress scale (PSS) by Sheldon Cohen is the most widely used psychological instrument for measuring the perceived stress. It consists of 10 questions out of which 4 questions are positive and 6 questions are negative.

Negative questions are scored as it is whereas positive questions are scored reversely. In these questions the participants are asked to indicate by circling how often they felt or thought a certain way during the last month. Each question is scored on a scale of 0 (Never) to 4 (Very Often) and is summed up.

Social Readjustment Rating Scale (SRRS) is a well-known psychometric instrument for measuring the amount of stress a person has experienced within past year. It is a copyrighted scale and measures the impact of wide range of common life stressors. These 43 stressors are called as life change units. A weightage has been assigned to each life change unit depending upon the relative amount of stress the event creates. The study participants are asked to mark the life events that has occurred in their life over the past year. To determine the level of stress all values are added to get the total score. A total score of 150 or less suggests a low level of stress, and a low probability of developing a stress-related disorder. A total score of 150 to 299 suggests a moderate level of stress, and the chances of developing a stress-related disorder are about 50%. A total score of 300 or more suggests a high level of stress and the chances of developing a stress-related disorder are about 80%.

Then the study participants were called the next day in between 8am-10am for collection of blood to assess serum cortisol level. All the study participants were advised to avoid all the unusual physical activity. After 20 minutes of rest to the study participant 1.5ml of blood was collected from median cubital vein under all aseptic conditions. The serum cortisol level was evaluated using immunoassay.

The data analysis was done by SPSS software (version 2).

Results

Mean values of the clinical periodontal parameters, stress scale and serum cortisol level were calculated in total 81 study participants and comparison of these mean values was done in all the three groups by one-way ANOVA test as shown in Table 1. All three groups showed statistically significant difference when they were compared for periodontal clinical parameters such as PI, GI, PPD and CAL, stress level as assessed by PSS score and SRRS score, and serum cortisol level. All the values were significantly high in group II as compared to group I and III.

In group I study participants (practising yoga), significant correlation of PSS score was observed only with PI, whereas there was no significant correlation between all other periodontal parameters, stress scores and serum cortisol level. [Table 2]

In group II study participants (chronic periodontitis patients not practising yoga), a statistically significant correlation of all periodontal clinical parameters except PPD, was observed with PSS score, SRRS score and serum cortisol level. There was no significant correlation of PPD with PSS score, SRRS score and serum cortisol level. [Table 3]

Discussion

Many studies have been conducted to evaluate the effects of stress on periodontium. Although the conventional treatment of the periodontal diseases is the mechanical debridement, yoga can offer an additional natural and conservative approach to the line of treatment of these periodontal diseases. The main aim of this study was to evaluate the effect of Yoga on psychological stress, serum cortisol level and periodontal health. The main hypothesis of this study was that the practice of Yoga results in reduction of chronic periodontitis, psychological stress and serum cortisol level. In the present study a strong positive correlation was seen in between periodontal clinical parameters and stress scores and serum cortisol level. These results were in agreement with the study done by Sunil Goyal *et al.*¹⁰ who explored the role of psychosocial stress that influences the periodontium with the use of a questionnaire data and serum cortisol level in 47 subjects and reported a statistically significant correlation ($p < 0.05$) between serum cortisol level and periodontal disease severity; and cortisol and PI in chronic periodontitis patients and positive correlation was found between stress, cortisol, PI, GI and periodontal disease severity in stressed individuals.¹³ The results of this study showed a significant association of all periodontal parameters except PPD with PSS score, SRRS score and serum cortisol level. Statistically significant difference was also found between group I & group II. This can be explained by, in group I is of chronic periodontitis patients practising yoga, periodontal probing depth, Clinical attachment level were less when compared to group II chronic periodontitis patients, also the level of stress in group I, assessed by perceived stress scale and social readjustment rating scale, serum cortisol level was also significantly less as compared to group II. These results are in accordance with the study done by Katuri, *et al.*¹² They examined 70 subjects with age range of 35–60 years for serum cortisol levels, psychological stress and periodontal clinical parameters and a significant difference in plaque index, CAL, serum cortisol levels and HAM-A scale and ZSDS scores was found between stressed individuals and individuals practicing yoga.

These findings suggest that stress can pose harmful impact on the immune system of the individual. The psychological stress can influence the immune system through three different ways:¹⁴

1. autonomic nervous system path ways
2. release of neuropeptides
3. release of hypothalamic and pituitary hormones

Stress stimulates the autonomous nervous system (ANS) and secretes catecholamines (adrenalin/noradrenalin) (CAs), neuropeptides like substance P, somatostatin, the endogenous opioid peptides (beta endorphin and enkephalins), Vasoactive intestinal peptide VIP and nerve growth factors.¹⁴

The emotional stress can cause the hypothalamus-pituitary-adrenal (HPA) axis to release of corticotrophin-releasing factor (CRF) and vasopressin from the hypothalamus. This further stimulate adrenal cortex to produce and release glucocorticoid hormones that depresses the immune system by diminishing the IgA and IgG secretions, thereby enhancing the periodontal disease progression and poor treatment response.¹⁵ Cortisol production has a circadian rhythm with levels peaking in the early morning and dropping at night. In saliva, the majority of cortisol remained unbound to protein.¹² Elevated levels of glucocorticoids can decrease in vitro fibroblasts, collagen production and in vivo sulphated glycosaminoglycans.¹⁵ The number of circulating inflammatory cells including lymphocytes, monocytes macrophages, neutrophils, eosinophils, and mast cells and their activities like chemotaxis, secretion, and degranulation is also suppressed.¹⁴ Increased production of pro-inflammatory cytokines and interleukin-6 in response to psychological stress leads to sustained inflammatory destruction within the periodontium.³ There are studies that have confirmed that the concentrations of cytokines [interleukin (IL)-6, IL-1 β , etc.] and cortisol in the gingival crevicular fluid (GCF) are at higher concentrations in people showing depression signs.¹⁵

The findings of this study have helped to connect the dots between yoga and its effect on periodontal disease by comparing the levels of serum cortisol levels and stress scale with periodontal parameters in chronic periodontitis patients and patients practicing yoga. Similar study was done by Sudhanshu A *et al.*¹⁶ which concluded that although yoga does not play a direct role in improving periodontal disease, it accelerates the treatment outcomes by combating the stress which is a major factor affecting the treatment of periodontal disease. A total of eighty patients were recruited in the study and were assessed at baseline, i.e., on the day of enrollment and thereafter, at an interval of 30 days for 90 days. Patients assigned to the yoga group were trained in a comprehensive yogic intervention. It was observed that mean PI score, mean probing pocket depth, mean CAL score and Cohen's perceived stress scale score were reduced in patients assigned to the yoga group. Bleeding on probing also showed better improvement in patients assigned to the yoga group.

Yoga has gained a lot of popularity in today's world as one of the natural way to reduce stress. Yoga boosts the immune system of the body which in turn improves the oral defensive system. A study conducted by Ambarish Vijayaraghava *et al.*¹⁷ showed that the regular practice of yoga lowers basal TNF- α and IL-6 levels. Two hundred and eighteen subjects participated in the study. TNF- α and IL-6 was analyzed before and after the exercise by Sandwich ELISA (Enzyme Linked Immunosorbent Assay). Resting plasma TNF- α concentration was significantly higher in non-yoga group when compared to yoga group. Mechanistic explanations for yoga's potential mental and physical health benefits have highlighted reductions in

sympathetic nervous system tone, and increases in vagal activity, both of which could have favorable endocrine and immune consequences, including lower inflammation⁶. There are studies which show that yoga also reduces the effect of cortisol on the immune system. A study conducted by Garcia-Sesnich J N *et al.*¹⁸ on 26 people showed that Kundalini Yoga practice had an immediate effect on salivary cortisol. The knowledge on the effects of yoga on periodontium is limited, hence studies on larger sample size including other forms of periodontal diseases is required to get a clearer picture regarding it.

Conclusion

The results of the study thus suggest stress can affect the periodontium through various mechanisms like behavioural and physiological changes. Practising yoga can be a good stress buster, thus improving the lifestyle, oral hygiene and immune system. Practising Yoga can in turn give a synergistic effect to the line of treatment of periodontal disease and thus improving its outcome. Further studies should be conducted on larger scale to evaluate the effects of yoga on periodontal diseases.

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	Group	Min.	Max.	Mean	SD	F value	P value
PI	Group I	1.10	2.89	1.552	0.485	130.022	0.000**
	Group II	1.12	2.17	1.658	0.275		
	Group III	0.00	0.94	0.212	0.306		
GI	Group I	1.25	2.89	1.906	0.425	244.613	0.000**
	Group II	1.21	2.82	2.144	0.526		
	Group III	0.00	0.00	0.000	0.000		
CAL	Group I	3	5	4.11	0.506	1293.12	0.000**
	Group II	5	7	6.41	0.636		
	Group III	0	0	0.00	0.000		
PPD	Group I	1.44	5.37	4.133	0.623	652.617	0.000**
	Group II	4.06	6.60	4.913	0.691		
	Group III	0.00	0.00	0.000	0.000		
PSS score	Group I	18	30	25.04	3.228	81.967	0.000**
	Group II	15	35	24.67	6.288		
	Group III	0	18	9.00	5.731		
SRRS score	Group I	142	304	227.30	39.595	31.933	0.000**
	Group II	97	334	219.00	75.745		
	Group III	25	293	100.15	74.367		
Sr. Cortisol	Group I	11.00	18.39	14.579	2.149	47.396	0.000**
	Group II	13.51	26.40	19.660	3.954		
	Group III	8.00	17.35	11.848	2.571		

Group I Periodontitis with yoga; Group II Chronic Periodontitis; Group III Healthy

Table 1: Comparison of mean values of all parameters using one-way ANOVA

Correlation between	Pearson's correlation coefficient (r)	P value
PSS score & PI	0.440	0.022*
PSS score & GI	0.292	0.140
PSS score & CAL	- 0.003	0.990
PSS score & PPD	0.104	0.606
SRRS score & PI	0.145	0.470
SRRS score & GI	0.191	0.341
SRRS score & CAL	0.317	0.107
SRRS score & PPD	0.205	0.304
Sr. Cortisol & PI	0.248	0.212
Sr. Cortisol & GI	0.095	0.636
Sr. Cortisol & CAL	0.076	0.707
Sr. Cortisol & PPD	0.135	0.502

Table 2: Correlation of stress, serum cortisol and clinical parameters in Group I (Periodontitis with yoga)

Correlation between	Pearson's correlation coefficient (r)	P value
PSS score & PI	0.917	0.000**
PSS score & GI	0.984	0.000**
PSS score & CAL	- 0.898	0.000**
PSS score & PPD	0.118	0.556
SRRS score & PI	0.882	0.000**
SRRS score & GI	0.762	0.000**
SRRS score & CAL	- 0.713	0.000**
SRRS score & PPD	0.117	0.563
Sr. Cortisol & PI	0.962	0.000**
Sr. Cortisol & GI	0.924	0.000**
Sr. Cortisol & CAL	- 0.830	0.000**
Sr. Cortisol & PPD	0.231	0.247

Table 3: Correlation of stress, serum cortisol and clinical parameters in Group II (Chronic Periodontitis patients not practising yoga)