Review Article

Yoga as an Integrated Holistic Approach to Oral Health: A Review

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ABSTRACT

Objectives: The association between various systemic diseases and periodontitis has been explored extensively. A sedentary lifestyle plays a significant role in systemic and periodontal disease progression. Therefore, lifestyle modification has been considered a component of therapeutic aspects for periodontal disease and systemic disease. This review focuses on how yoga may reduce chronic gingival inflammation by improving the body's defense, which can act more efficiently on periodontal bacteria and help maintain healthy gingiva. **Materials and Methods:** A literature search was performed in PubMed/MEDLINE CINAHL, Web of Science, and Google Scholar for all the published articles related to yoga and its systemic benefits and potential role in reducing periodontal breakdown, and the findings were summarized. **Results:** The practice of yoga therapy has been proven to show several benefits, such as reduced stress levels, anxiety and depression, increased antioxidant levels, reduced insulin resistance, and improved respiratory function. It also helps to improve the immune system. **Conclusion:** Yoga can be used as a potential treatment modality adjunct to conventional periodontal therapy as it has been shown to have a potential benefit in controlling systemic risk factors.

Keywords: *Diabetes, hypertension, obesity, periodontal disease, stress, Yoga*

Introduction

Contemporary Yoga, as a form of mind-body rejuvenation, is an amalgamation of three core practices: physical poses (*asanas*), breath control (*pranayama*), and meditation (*dhyana*). However, the word "Yoga" has been through several vastly different interpretations throughout history; it is derived from the Sanskrit word "Yuj," which means "to yoke" or "to attach." The twenty-first century witnessed modern yoga become a mass cultural phenomenon and a form of a fitness lifestyle that nurtures the mind and the body. Since its inception, yoga has been claimed to have a plethora of beneficial effects on systemic health. Numerous studies have explored yoga to decipher its impact on the human body and the mind.

A sedentary lifestyle from the emerging globalization and modernization has resulted in stress, hypertension, cardiovascular diseases, diabetes mellitus, and many communicable and non-communicable diseases. Lack of physical activity is one of the primary causes of chronic diseases.[1] Periodontitis is a chronic inflammatory disease that affects the periodontium, which destroys connective tissue, decreases bone support, and eventually leads to tooth loss.[2] Various modifiable and nonmodifiable risk factors cause it. However, the primary etiologic factor is microbial and other factors, such as systemic and behavioral disorders, also play a significant role.

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Along with routine periodontal therapy, traditional therapies, including lifestyle modification such as yoga, is gaining more attention and importance. The benefits of yoga include a reduction in stress levels, increased immunity, strength, balance, and lowered blood pressure and cortisol levels.[3] It is considered one of the most influential, compelling, and essential means to overcome various physical and psychological problems. It also helps in wound healing by reducing the mediators of the inflammatory response.[4] This review aims to provide a summary on potential benefit of yoga in reducing periodontal breakdown.

Materials and Methods

This review was based on the question: What are the potential benefits of yoga in reducing periodontal breakdown? A literature search was performed in PubMed/MEDLINE CINAHL, Web of Science and Google Scholar for all the published articles related to yoga and its systemic benefits and potential role in reducing periodontal breakdown. The last search was performed on July 1, 2022. The following search terms were used: "yoga," "periodontitis," "periodontal disease," "oral health," "systemic diseases," "diabetes," "stress," "hypertension," and "obesity."

Publications in English and other languages were included. Publications in other languages were translated with google translator. Randomized and nonrandomized clinical trials, cross-sectional studies, cohort, case-control studies, and systematic and literature reviews were included for data collection. The Grey literature (Google scholar) was also searched for relevant articles. The cross-reference of all studies was searched to include anything relevant to the topic. All studies that did not refer to the risk factors for periodontal disease and the effect of yoga on the risk factors were excluded. The total of all the results (1023 articles) was compiled in the Mendeley reference manager (v 2.80.1), and duplicates were removed. After removing the duplicates, 543 articles were included and 44 articles were included for full-text screening. The data collected were reviewed by all the authors. Any disagreements were mutually discussed between the two reviewers (MK and SK), and a consensus was reached [Figure 1]. All the data related to the health benefits of the practice of Yoga on periodontium were summarized.

Results

The above literature shows that yoga reduces various systemic risk factors associated with periodontal disease.

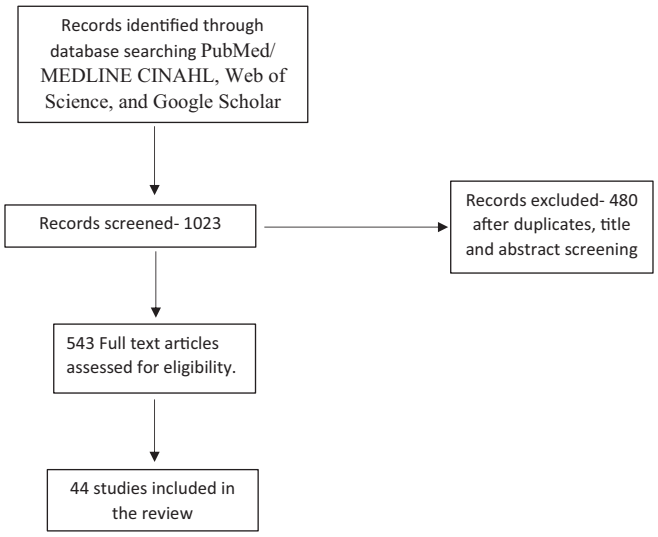

Figure 1: Flow diagram of the selection of articles

They favor a reduction in periodontal inflammation and prevent further destruction of the periodontium. Yogic lifestyle or lifestyle modification in terms of regular physical exercises, healthy eating habits, and relaxation could also be a possible way of managing the glycemic condition, obesity, stress and obesity. This, in return, helps reduce periodontal inflammation. Adiposity-associated hyperinflammation, along with microbial dysbiosis, altered immune response, specific genetic polymorphisms, and increased stress are some plausible mechanisms that link obesity and periodontal disease.[5] Reduction in psychosocial stress due to the meditative component of yoga helps in immune modulation, which could also cause a reduction in obesity. Mindfulness training comprising controlled breathing or correct postures creates a sense of relaxation that helps in coping with stress and not getting addicted to behaviors like overeating.

The practice of yoga optimizes the production of pro-inflammatory cytokines and increases the production of anti-inflammatory cytokines such as IL-6. IL-6 acts as both a pro-inflammatory and an anti-inflammatory cytokine. Therefore, it is seen that there is a reduction of these inflammatory cytokines by practicing yoga in daily life with a reversible effect on depression and stress-related periodontitis[6] [Figure 2]. As periodontitis is an inflammatory condition, the impact of yoga on the HPA axis reduces the production of cortisol, which decreases stress and helps maintain a healthy periodontium. Additional to the impact on stress, it also stimulates the parasympathetic nerves conserving energy by slowing the heart rate and releasing hormones that help to unwind and calm down.[7] It was also concluded that practicing yoga after periodontal

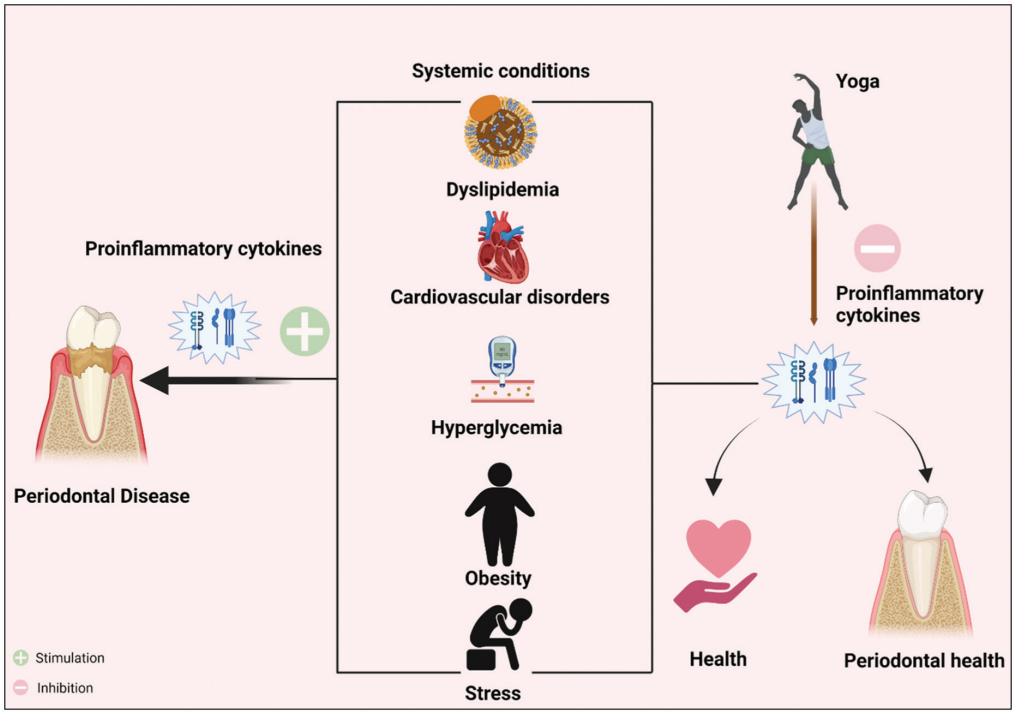

Figure 2: Effect of yoga on oral and general health

therapy reduces the levels of inflammation by assisting in the wound-healing mechanism.[8]

Discussion

Consistent yoga practice not only improves the general health of the being but also helps achieve good oral well-being. It is noted that a taxing lifestyle leads to anxiety, increased blood pressure, and depression, impacting oral health.[9] Oral health is an essential part of general well-being and correlates to quality of life. Among the oral health problems considered, the most widespread chronic diseases include dental caries, gingivitis & periodontal disease. A remedy to the taxing lifestyle is to transform it into a yogic lifestyle. Early in the morning, it helps to enhance the motivation level for regular mechanical plaque control, which aids in preventing dental and soft tissue disorders of the oral cavity caused due to stress. A study conducted by Singh *et al.*[9] noticed that patients practicing yoga had a reduction in the debris index, calculus index, and gingival index with no adverse effects. Dentists have noted that a major factor affecting periodontal health after smoking is stress. According to some studies, stress impacts an individual's behavior and health in ways such as neglecting oral hygiene, decreased food intake, increased smoking frequency, and increased alcohol consumption, all of which affect collagen synthesis and ultimately result in periodontal diseases.[10] Therefore, investigators have concluded that by practicing yoga, individuals can improve their mental health and their periodontal condition.[7]

It is a known fact that oxygen and inflammation are correlated, and it plays a vital role in gingival inflammation. A study reported that the oxygen saturation is relatively low in the inflamed gingiva than in the healthy gingiva. The decreased oxygen consumption in inflamed gingiva is caused by the failure of blood supply to the tissue to meet the oxygen demand.[11] Hence, breathing exercises in yoga help increase lung capacity, thereby increasing the oxygen supply to tissues and reducing inflammation. The rhythmic breathing exercises in yoga aids in improving the oxidative stress of the body with a positive impact on the immune system and the body's defense mechanisms.[4] All these effects of yoga help in maintaining a healthy periodontium.

A systematic review done by Kalburgi *et al.*[12] concluded that with regular practice of yoga, one could control some of the risk factors associated with periodontal disease and help achieve a healthy lifestyle. Yoga affects other systemic diseases besides periodontitis but only a few studies have been conducted to analyze the effect of yoga on periodontium.

An increase in physical fitness is an axiomatic health benefit of yoga. A 2016 study demonstrated that 10-week yoga practice considerably increased the flexibility and balance among male college athletes,

potentially increasing their athletic performance.[9] A 2021 meta-analysis concluded that yoga positively affects muscle strength, flexibility, balance, and mobility, significantly increasing the physical fitness of 60-70-year-olds.[10] Stress relief is one of the most popular reasons for the mass following and practice that yoga has garnered. Interestingly, yoga and meditation practitioners were also associated with higher mental well-being during the COVID-19 pandemic when compared to non-practitioners of yoga.[11] A 2016 meta-analysis concluded that yoga is promising to be used as a therapeutic intervention in anxiety disorders. Participants with the highest anxiety benefitted the most and the effect was positively correlated with the duration of yoga practice.[12] Yoga also showed positive results in reducing the severity of mild to moderate major depressive disorder and anxiety.[13] However, another systematic review and meta-analysis found that yoga did not affect mood and anxiety disorders.[14] Yoga might be favorable in patients with higher anxiety levels, but yoga's effects on anxiety disorders are still inconclusive.[15]

Literature shows numerous physiological health benefits of practicing yoga. For instance, meditation and yoga cause a decrease in blood pressure across age groups and can potentially be a good integration into the anti-hypertensive lifestyle.[16,17] Also, yoga practitioners have been shown to exhibit lower inflammation; scientific evidence reveals pro-inflammatory markers like interleukin-6 (IL-6), tumor necrosis factor-α (TNF-α), and C-reactive protein (CRP) levels to be significantly lower in yoga practitioners when compared to novices or non-practicing controls.[18-20] A 2016 systematic review concluded that the practice of Hatha yoga shows promise in improving executive function among children, adolescents, adults, prisoners, and the healthcare population.[21] Yoga has been shown to prevent and aid in burnout among doctors and nurses; there was an improvement in self-care, emotional exhaustion, sleep quality, de-personalization, and mindfulness.[22-24]

Effect of Yoga on the Risk Factors for Periodontal Diseases

Obesity

An abnormal accumulation of fat due to an imbalance in the calorie intake and calorie burnt that might impair the health of an individual is obesity. The vast amount of cytokines and hormones produced by the adipose tissue in obese individuals may be involved in the pathogenesis of periodontitis.[25] TNF-α is one of the cytokines released by the adipose tissue. It can promote hepatic dyslipidemia and reduction in insulin sensitivity with a consequent increase in the formation of Advanced Glycation End-products (AGEs). Subsequently, inflammatory cytokine release will be stimulated. Circulation of ROS is also increased in obese individuals promoting periodontal destruction. Plasminogen activator inhibitors-1 (PAI-1) is an adipokine that can affect the blood supply to the periodontium. Leptin is another cytokine secreted by adipocytes. It may decrease bone formation through the central nervous pathways or increase bone formation through its influence on bone cells. The varying levels of Leptin may affect the activation of either of the pathways, thereby influencing bone formation. Moreover, obesity can affect the Natural Killer-T cells (NK-T cells) and lymphocytes unfavorably and distress the cell-mediated immune response, which will contribute to the susceptibility of the periodontal tissue to infectious stimuli and the development of periodontitis.[26] Haffajee *et al.*[27] have shown that Tannerella forsythia, a putative periodontal pathogen, was significantly higher in obese periodontally healthy/gingivitis individuals. Chaffee and Weston recognized that obesity has a positive association with periodontitis in their systematic review and meta-analysis and the odds of periodontitis occurring in an obese individual was identified to be 1.35.[28] NHANES III data analysis showed that there was a higher risk of periodontitis when the BMI was greater than 30 kg/m^2.[29] Thus obesity may be considered a modifiable risk factor for periodontal disease.

The evidence available regarding the role of yoga in managing obesity and other chronic conditions related to being overweight or obese is limited. A cross-sectional study showed an inverse relationship between yoga practice and BMI in female yoga practitioners over 45 years. The study concluded that long-term yoga practice was associated with little or no obesity. The study also showed that yoga practitioners were less likely to use medication for mood disorders or other metabolic syndromes.[30] A clinical trial was conducted on a group of 47 obese people to evaluate the effect of 6 days of yoga and diet change showed that there was a decrease in BMI and fat-free mass, a reduction in hip waist circumference, and mid-arm circumference. Reduced HDL levels, and serum leptin levels were also seen.[31] A study comprising 62 subjects who were diabetic demonstrated a decrease in BMI and a significant decrease in weight following 45 days of yoga asanas and pranayama. The study also showed a reduction in serum insulin levels and improved lipid profiles.[32] The beneficial effect of yoga on weight loss could be

due to its effect on neuropsychology and behavior. Yogic practices help to achieve lifestyle modification. These modifications may help the individual to curb their need for unhealthy eating habits associated with boredom or stress or overeating in response to the taste and smell of the food which could be one of the reasons for weight gain.[33]

Diabetes

Periodontal disease is considered the sixth complication of diabetes.[34] Diabetic individuals have three times the risk of developing periodontitis as compared to non-diabetic individuals[35] and inflammation observed in periodontal tissues is more in diabetic individuals.[36] It has been observed that the Gingival Crevicular Fluid (GCF) levels of inflammatory mediators like PGE2 and IL-1β increase in patients with Diabetes Mellitus type 1 and periodontal disease. In comparison with those with no diabetes, the monocytes in these patients produced higher amounts of the cytokines TNF-α, IL-1β, and PGE2.[37] In addition, an HbA1c greater than 8% is associated with increased levels of GCF IL-1β in patients with type 2 Diabetes Mellitus.[38] Defective microbicidal functions of polymorphonuclear leucocytes (PMN) in diabetic patients can also affect periodontal health.[38] The AGEs which are elevated in diabetic subjects can upregulate the inflammatory mediators after binding with the Receptor for AGE (RAGE). AGE formation increases oxidative stress with the formation of Reactive Oxygen Species (ROS) along with endothelial cell changes with resultant vascular injury and boosts the respiratory burst in PMNs, resulting in local tissue damage in periodontitis. AGEs can adversely affect bone metabolism and decrease the production of extracellular matrix[39] which affects periodontal tissue health.

Complementary and alternative medicine is being explored vastly to improve the quality of life and to help control various diseases. Various mechanisms link the beneficial effects of yoga in the management of diabetes. One of them could be the behavioral intervention to manage stress, which may contribute to diabetes management. A systematic review conducted to assess the effect of yoga on the lifestyle and management of type II Diabetes showed improvement in Type II Diabetes outcomes following yoga practice as compared to the other interventions[40] A systematic review concluded that yoga had beneficial effects on the management of glycemic control as compared to the physical exercise group.[41] Rajesh *et al*.[42] conducted a clinical trial to examine the action of yoga on type 2 diabetes-related DNA damage and biochemical parameters, where ten weeks of yoga practice including, asanas and pranayama, was undertaken for the intervention group. The Control group performed physical exercises like walking and jogging. Various outcome measures like glycemic status, DNA damage status, total antioxidant capacity, Waist hip ratio, and BMI were evaluated. The study result demonstrated a significant reduction in the DNA damage and FBS levels compared to the control group.

Hypertension

One of the most common diseases affecting people worldwide is hypertension. Hypertension and periodontitis are linked through low-grade systemic inflammation and redox imbalance, dysbiosis in the oral-gut flora, dysfunction of neutrophils, T cell subtype imbalance, and hyperexpression of genes facilitating proinflammatory response.[43] hs-CRP is a probable link between periodontal diseases and hypertension through the chronic inflammatory pathway[44] which leads to endothelial dysfunction. It has been observed that in hypertensive patients and patients with periodontitis, the levels of myeloperoxidase, matrix metalloproteinases (MMP)-8, MMP-9, and neutrophil elastase increase.[45] A systematic review has identified an increased prevalence of periodontitis in hypertensive patients.[46] The increased prevalence of periodontitis in hypertensive patients is attributed to microcirculatory changes in the gingival tissue, which leads to ischemia, alteration in the composition of the dental biofilm, and an increase in inflammation.[47] Wolff *et al*.[48] conducted a clinical trial to evaluate the effect of yoga intervention on the blood pressure level and lifestyle changes in patients diagnosed with hypertension. The study's results showed that yoga improved blood pressure showing 4.4mmHg of decline in systolic blood pressure and improved quality of life. A systematic review conducted by Hagins *et al*.[49] showed a significant reduction in blood pressure in the pre-hypertension or hypertension group when all three elements of yoga i.e., posture, breathing, and meditation, were involved compared to limited yoga intervention. Another systematic review put forward that yoga leads to a significantly greater reduction in blood pressure compared to other forms of pharmacotherapy or no treatment and usual treatment groups in hypertensive patients[50]

Stress

Stress refers to a complex and dynamic interaction system between people and their surroundings. It can be best understood by an organism's psycho-physiological response to a perceived threat or challenge. Behavioral changes in dental hygiene, smoking, food consumption, bruxism, and drug use are psychosocial factors that

might affect periodontal health. Furthermore, changes in saliva, alterations in gingival blood circulation, hormone imbalances, and altered host resistance may all influence periodontal tissues via physiologic pathways. Emotional stress has been proven to influence the immune system in at least three ways through the brain and endocrine systems, according to research: (1) Through the autonomic nervous system pathways, (2) Through the release of neuropeptides, and (3) Through the release of hypothalamic and pituitary hormones. The hypothalamus–pituitary–adrenal (HPA) axis plays a crucial role in stress reactions and can be used as a model for integrating psychological data into physiological responses and immunological regulation.[51] Although the relationships between stress, endocrine, and periodontal alterations are still unknown, some theories have been offered. Periodontal disease is thought to be linked to changes in adrenal corticoid levels and in the sensitivity of oral tissues to bacterial toxins and other hormones implicated in the general adaption syndrome.[52] Psychosocial stressors may trigger a chain reaction in the corticotrophin-releasing hormone/HPA axis, the autonomic nervous system, and the central nervous system. The cascade's physiological effects are to lower immunity, increasing the risk of infection and, in particular, periodontal disease. Recent research has confirmed that the concentration of cytokines and cortisol in the GCF is higher in those who are depressed.[53] Moss *et al*.[54] used a self-reported questionnaire and immune system response to periodontal pathogens like *Tannerella forsythia, Porphyromons gingivalis, and Aggregatibacter actinomycetemcomitans comitans* in a case-control study in humans to investigate the role of psychosocial factors and adult periodontitis. This investigation revealed a link between T. forsythia IgG and periodontal disease in people who scored higher on the depression scale.

The understanding of the effect of yoga on stress reduction is still ambiguous. However, the non-invasive or non-pharmacological treatment of these disorders has increased the demand for practicing yoga. Various Asanas or stretching exercises help to relieve stiffness in the joints and increase muscle strength, thus helping to improve blood circulation and stimulating the nervous system.[55] The effect of yoga on stress has been studied by many researchers but is scientifically non-replicable. A sense of well-being, relaxation, or attentiveness induced by pranayama or meditation helps stabilize the ANS and create an optimistic outlook toward life.[56] Yoga practice or meditation has been shown to reduce the levels of serum cortisol in contrast to increased levels of serum cortisol observed during adverse life situations. Studies have also reported an increase in alpha waves produced by the brain following the yoga practice, indicative of an increase in calmness or the subject's mental relaxation.[57] The decrease in ACTH decreases the synthesis of cortisol from the adrenal glands, which could be due to the inhibitory action of yoga practice on the activity of the paraventricular nuclei of the hypothalamus and anterior pituitary. After sympathetic inhibition, a decrease in levels of corticosteroids and catecholamines is known to decrease stress responses.[58] Stress-reducing practices or interventions can also improve immune functioning. Various studies substantiate that patients who underwent the relaxation techniques like Sudarshan kriya or pranayama, which involved the rhythmic breathing process, showed enhancement in the activity of NK cells at the end of one month's intervention with a concomitant decrease in distress-related symptoms.[59]

Dentistry as a profession is very demanding as it requires a precise and focused approach while performing procedures with utter attention. Therefore, dental education is linked with a substantial amount of stress. The stress factors differ in different stages of dental education, causing a negative impact on physical, mental, and academic performance.[60] One of the main health problems encountered by dental professionals is various musculoskeletal disorders, with a documented prevalence between 64% and 93%, with significant concerns being back pain (36.3%–60.1%) and neck pain (19.8%–85%). The risk factors identified for these musculoskeletal disorders include frequent and awkward posture while performing clinical procedures and other non-ergonomic work habits. It has been suggested that practicing yoga could be a good way to ease stress among dentists and reduce the risk of repetitive strain injury and dysfunctional posture.[61] A survey done in 2015 found that there was a statistically significant difference in the prevalence of musculoskeletal pain relief among dentists over 12 months with the help of yoga, and yoga was found to be more effective than other modes of physical activities.[62] Stress is a major factor affecting the general population, and yoga is gaining popularity as it has been proven to reduce stress and improve the lifestyle. Hence, the present review discusses the hypothesized benefit of yoga in reducing periodontal inflammation and its potential to treat other systemic inflammatory conditions.

The use of yoga as a therapeutic measure for inflammatory conditions is not fully established in scientific literature. There are many studies regarding yoga and its benefit on systemic conditions but limited

data regarding its efficacy when used as an adjunctive therapeutic strategy for periodontitis.

Conclusion

Several surgical and non-surgical therapeutic modalities are beneficial in managing periodontal diseases. Since yoga involves pranayama and meditation, along with various asanas which involve physical exercise, the practice of yoga may optimize the production of pro-inflammatory cytokines and aid in improving periodontal health by reducing the mediators of inflammatory response. Hence, it can be used as a potential treatment modality adjunct to conventional periodontal therapy.

There is a need for more randomized controlled clinical trials to prove the association between yoga and its benefits on the periodontal disease by indirectly controlling the modifiable and non-modifiable systemic conditions.

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Conflicts of interest

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Authors' contribution

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Ethical policy and institutional review board statement

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References

1. Booth FW, Roberts CK, Laye MJ. Lack of exercise is a major cause of chronic diseases. Compr Physiol 2012;2:1143-211.
2. Kinane DF, Mombelli A. Periodontal disease. Periodontal Disease 2022;15:1-180.
3. Raghavendra RM, Vadiraja HS, Nagarathna R, Nagendra HR, Rekha M, Vanitha N, *et al*. Effects of a yoga program on cortisol rhythm and mood states in early breast cancer patients undergoing adjuvant radiotherapy: A randomized controlled trial. Integr Cancer Ther 2009;8:37-46.
4. Sudhanshu A, Sharma U, Vadiraja H, Rana RK, Singhal R. Impact of yoga on periodontal disease and stress management. Int J Yoga 2017;10:121.
5. Dahiya P, Kamal R, Gupta R. Obesity, periodontal and general health: Relationship and management. Indian J Endocrinol Metab. 2012;16:88-93.
6. Jadhav S. Effect of Yoga Intervention on Anxiety and Subjective Well-being. J Indian Acad Appl Psychol 2009;35:37-43.
7. Riley KE, Park CL. How does yoga reduce stress? A systematic review of mechanisms of change and guide to future inquiry. Health Psychol Rev 2015;9:379-96.
8. Wicker J, Kamler K. Current concepts in limb regeneration: A hand surgeon's perspective. Ann N Y Acad Sci 2009;1172:95-109.
9. Singh K, Singh P, Oberoi G. Effect of yoga on promotion of oral health. International Journal of Dentistry Research 2017;2:18-21.
10. Szabo S, Tache Y, Somogyi A. The legacy of Hans Selye and the origins of stress research: A retrospective 75 years after his landmark brief "Letter" to the Editor# of Nature. Stress 2012;15:472-8.
11. Polsgrove M, Eggleston B, Lockyer R. Impact of 10-weeks of yoga practice on flexibility and balance of college athletes. Int J Yoga. 2016;9:27.
12. Hanioka T, Shizukuishi S, Tsunemitsu A. Hemoglobin concentration and oxygen saturation of clinically healthy and inflamed gingiva in human subjects. J Periodontal Res 1990;25:93-8.
13. Kalburgi V, Harsha NSS. Effect of yoga on periodontal health – A systematic review and meta-analysis. Journal of Dental Research and Review 2021;8:241.
14. Shin S. Meta-Analysis of the Effect of Yoga Practice on Physical Fitness in the Elderly. Int J Environ Res Public Health 2021;18:11663.
15. None P, SK R. A cross--sectional study of mental wellbeing with practice of yoga and meditation during COVID-19 pandemic. J Family Med Prim Care. 2021;10:1576.
16. Hofmann SG, Andreoli G, Carpenter JK, Curtiss J. Effect of Hatha Yoga on Anxiety: A Meta-Analysis. J Evid Based Med 2016;9:116-24.
17. Prathikanti S, Rivera R, Cochran A, Tungol JG, Fayazmanesh N, Weinmann E. Treating major depression with yoga: A prospective, randomized, controlled pilot trial. PLoS One 2017;12:e0173869.
18. Vollbehr NK, Bartels-Velthuis AA, Nauta MH, Castelein S, Steenhuis LA, Hoenders HJR, *et al*. Hatha yoga for acute, chronic and/or treatment-resistant mood and anxiety disorders: A systematic review and meta-analysis. PLoS One 2018;13:e0204925.
19. Cramer H, Lauche R, Anheyer D, Pilkington K, de Manincor M, Dobos G, *et al*. Yoga for anxiety: A systematic review and meta-analysis of randomized controlled trials. Depress Anxiety 2018;35:830-43.
20. Park SH, Han KS. Blood Pressure Response to Meditation and Yoga: A Systematic Review and Meta-Analysis. J Altern Complement Med 2017;23:685-95.
21. Wu Y, Johnson BT, Acabchuk RL, Chen S, Lewis HK, Livingston J, *et al*. Yoga as Antihypertensive Lifestyle Therapy: A Systematic Review and Meta-analysis. Mayo Clin Proc 2019;94:432-46.
22. Kiecolt-Glaser JK, Christian L, Preston H, Houts CR, Malarkey WB, Emery CF, *et al*. Stress, inflammation, and yoga practice. Psychosom Med 2010;72:113-21. [Internet].
23. Estevao C. The role of yoga in inflammatory markers. Brain Behav Immun Health 2022;20:100421.
24. Falkenberg RI, Eising C, Peters ML. Yoga and immune system functioning: A systematic review of randomized controlled trials. J Behav Med 2018;41:467-82. [Internet].
25. Luu K, Hall PA. Hatha Yoga and Executive Function: A Systematic Review. J Altern Complement Med 2016;22:125-33.

26. Alexander GK, Rollins K, Walker D, Wong L, Pennings J. Yoga for Self-Care and Burnout Prevention Among Nurses. Workplace Health Saf. 2015;63:462-70; quiz 471.
27. Zhang XJ, Song Y, Jiang T, Ding N, Shi TY. Interventions to reduce burnout of physicians and nurses: An overview of systematic reviews and meta-analyses. Medicine (Baltimore) 2020;99:e20992.
28. Hilcove K, Marceau C, Thekdi P, Larkey L, Brewer MA, Jones K. Holistic Nursing in Practice: Mindfulness-Based Yoga as an Intervention to Manage Stress and Burnout. J Holist Nurs 2021;39:29-42.
29. Jagannathachary S, Kamaraj D. Obesity and periodontal disease. J Indian Soc Periodontol 2010;14:96-100.
30. Dahiya P, Kamal R, Gupta R. Obesity, periodontal and general health: Relationship and management. Indian J Endocrinol Metab 2012;16:88-93.
31. Haffajee AD, Socransky SS. Relation of body mass index, periodontitis and Tannerella forsythia. J Clin Periodontol 2009;36:89-99.
32. Chaffee BW, Weston SJ. Association between chronic periodontal disease and obesity: A systematic review and meta-analysis. J Periodontol 2010;81:1708-24.
33. Ganesan SM, Vazana S, Stuhr S. Waistline to the gumline: Relationship between obesity and periodontal disease-biological and management considerations. Periodontol 2000 2021;87:299-314.
34. Moliver N, Mika E, Chartrand M, Burrus S, Haussmann R, Khalsa S. Increased Hatha yoga experience predicts lower body mass index and reduced medication use in women over 45 years. Int J Yoga. 2011;4:77-86.
35. Telles S, Naveen VK, Balkrishna A, Kumar S. Short term health impact of a yoga and diet change program on obesity. Med Sci Monit 2010;16:CR35-40.
36. Singh S, Kyizom T, Singh KP, Tandon OP, Madhu SV. Influence of pranayamas and yoga-asanas on serum insulin, blood glucose and lipid profile in type 2 diabetes. Indian J Clin Biochem 2008;23:365.
37. Rioux JG, Ritenbaugh C. Narrative review of yoga intervention clinical trials including weight-related outcomes. Altern Ther Health Med 2013;19:32-46.
38. Loe H. Periodontal disease. The sixth complication of diabetes mellitus. Diabetes Care 1993;16:329-34.
39. Mealey BL, Ocampo GL. Diabetes mellitus and periodontal disease. Periodontol 2000. 2007;44:127-53.
40. Preshaw PM, Alba AL, Herrera D, Jepsen S, Konstantinidis A, Makrilakis K, *et al*. Periodontitis and diabetes: A two-way relationship. Diabetologia 2012;55:21-31.
41. Salvi GE, Yalda B, Collins JG, Jones BH, Smith FW, Arnold RR, *et al*. Inflammatory mediator response as a potential risk marker for periodontal diseases in insulin-dependent diabetes mellitus patients. J Periodontol 1997;68:127-35.
42. Engebretson SP, Hey-Hadavi J, Ehrhardt FJ, Hsu D, Celenti RS, Grbic JT, *et al*. Gingival crevicular fluid levels of interleukin-1beta and glycemic control in patients with chronic periodontitis and type 2 diabetes. J Periodontol 2004;75: 1203-8.
43. Cortizo AM, Lettieri MG, Barrio DA, Mercer N, Etcheverry SB, McCarthy AD. Advanced glycation end-products (AGEs) induce concerted changes in the osteoblastic expression of their receptor RAGE and in the activation of extracellular signal-regulated kinases (ERK). Mol Cell Biochem 2003;250:1-10.
44. Aljasir B, Bryson M, Al-Shehri B. Yoga practice for the management of type II diabetes mellitus in adults: A systematic review. Evidence-based Complementary and Alternative Medicine 2010;7:399-408.
45. Jayawardena R, Ranasinghe P, Chathuranga T, Atapattu PM, Misra A. The benefits of yoga practice compared to physical exercise in the management of type 2 Diabetes Mellitus: A systematic review and meta-analysis. Diabetes Metab Syndr 2018;12:795-805.
46. Nair RG, Vasudev MM, Mavathur R. Role of Yoga and Its Plausible Mechanism in the Mitigation of DNA Damage in Type-2 Diabetes: A Randomized Clinical Trial. Ann Behav Med 2022;56:235-44. [Internet].
47. Del Pinto R, Pietropaoli D, Munoz-Aguilera E, D'Aiuto F, Czesnikiewicz-Guzik M, Monaco A, *et al*. Periodontitis and Hypertension: Is the Association Causal? High Blood Press Cardiovasc Prev. 2020;27:281-9.
48. Pradeep AR, Kumari M, Kalra N, Priyanka N. Correlation of MCP-4 and high-sensitivity C-reactive protein as a marker of inflammation in obesity and chronic periodontitis. Cytokine 2013;61:772-7.
49. Türkoğlu O, Barış N, Tervahartiala T, Şenarslan O, Sorsa T, Atilla G. Evaluation of systemic levels of neutrophilic enzymes in patients with hypertension and chronic periodontitis. J Periodontol 2014;85:908-16.
50. Muñoz Aguilera E, Suvan J, Buti J, Czesnikiewicz-Guzik M, Barbosa Ribeiro A, Orlandi M, *et al*. Periodontitis is associated with hypertension: A systematic review and meta-analysis. Cardiovasc Res 2020;116:28-39.
51. Tsioufis C, Kasiakogias A, Thomopoulos C, Stefanadis C. Periodontitis and blood pressure: The concept of dental hypertension. Atherosclerosis 2011;219:1-9.
52. Wolff M, Sundquist K, Larsson Lönn S, Midlöv P. Impact of yoga on blood pressure and quality of life in patients with hypertension - a controlled trial in primary care, matched for systolic blood pressure. BMC Cardiovasc Disord 2013;13:1-9.
53. Hagins M, States R, Selfe T, Innes K. Effectiveness of yoga for hypertension: Systematic review and meta-analysis. Evidence-based Complementary and Alternative Medicine 2013;2013:649836.
54. Posadzki P, Cramer H, Kuzdzal A, Lee MS, Ernst E. Yoga for hypertension: A systematic review of randomized clinical trials. Complement Ther Med 2014;22:511-22.
55. da Silva AMM, Newman HN, Oakley DA. Psychosocial factors in inflammatory periodontal diseases. A review. J Clin Periodontol 1995;22:516-26.
56. Davis CH, Jenkins CD. Mental stress and oral disease. J Dent Res 1962;41:1045-9.
57. Johannsen A, Rylander G, Söder B, Marie A. Dental plaque, gingival inflammation, and elevated levels of interleukin-6 and cortisol in gingival crevicular fluid from women with stress-related depression and exhaustion. J Periodontol 2006;77:1403-9.
58. 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.
59. Iyengar BKS. Yoga: The path to holistic health.:432.
60. Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. Int J Yoga. 2011;4:49-54.
61. Anand BK, Chhina GS, Singh B. Some aspects of electroencephalographic studies in Yogis. Electroencephalogr Clin Neurophysiol 1961;13:452-6.
62. Kamei T, Toriumi Y, Kimura H, Kumano H, Ohno S, Kimura K. Decrease in serum cortisol during yoga exercise is correlated with alpha wave activation. Percept Mot Skills 2000;90:1027-32.