

Comparison of Stress and Periodontal Health Status among Individuals Practicing Yoga with Age and Gender Matched Controls in Hyderabad City

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ABSTRACT

Introduction: Stress, the most basic psycho-social factor causes disruption of a person's physiological as well as psychological well-being. Yoga originated in India thousands of years ago, is a primordial philosophical system aimed at bringing harmony to the individual's physical, mental, and emotional aspects.

Aim: To examine and compare the stress and periodontal health status of yoga practitioners in Hyderabad city with age and gender matched controls.

Materials and Methods: This case-control study was conducted on 278 subjects by the Department of Public Health Dentistry, Kamineni Institute of Dental Sciences, Narketpally Nalgonda, Hyderabad, Telangana, India from August 2019 to January 2020. Out of the selected subjects, 139 were the cases, aged between 25-40 years, who were practicing yoga in hyderabad city regularly while 139 were age and gender matched controls, selected from general population, not practicing yoga. The survey tool comprised of the Perceived Stress Scale (PSS developed by Cohen S et al.). Oral health status was recorded using the World Health Organisation (WHO) Basic Oral Health Survey Assessment Form of 2013. The data was analysed using version 21.0 of the Statistical Package for Social Sciences (SPSS). Statistical significance was set at $p \leq 0.05$.

Results: The total of 278 subjects (139 cases; mean age 28.30 ± 7.73 years and 139 controls; mean age 29.25 ± 7.73 years) were included. Both the genders in the control group had

noticeably elevated mean scores for caries status (1.50 ± 0.59), periodontal status (3.69 ± 0.57) and Loss of Attachment (LOA) (code 1: 1.63 ± 1.33) and overall PSS score (1.81 ± 0.60) compared to cases. The difference in periodontitis (p -value=0.05), OHI-S (Simplified Oral Hygiene Index) scores (p -value <0.001), PSS scores (p -value <0.001) and gingival scores (p -value <0.001) was found significant. A similar trend was noted when compared with both males and female regarding OHI-S and gingival scores but the difference was statistically non significant. The PSS score difference was found significant with age (p -value=0.02), gender (p -value=0.02) and subjects who were practicing yoga regularly (1.67 ± 0.69) (p <0.001) as compared to controls. However, all age groups who were not practicing yoga reported with poor periodontal health with high LOA scores compared to practitioners and no significant association was found between perceived stress and method (p -value=0.22) or frequency (p -value=0.17) of cleaning their teeth.

Conclusion: This study finding is extremely important for Indian population, where more than 50% of the population is suffering with gum diseases due to stress. Hence, suitable preventive and treatment approaches are endorsing to combat from the stress and periodontal disease. Therefore, yoga is effective in prevention of oral diseases and maintenance of personal as well as oral hygiene and healthy gingiva by improving the lifestyle, reducing the tension and periodontal inflammation.

Keywords: Oral hygiene, Perceived stress, Periodontal disease, Quality of life

INTRODUCTION

Oral health is a key indicator of overall health, well-being, and quality of life [1]. Besides general health conditions, dental diseases continue to be a significant public health problem across the globe [2]. Dental caries and periodontal diseases are among the most common oral health problems that affect the human population at high prevalence rates [3]. In addition to various pathological factors, diet, lifestyles, psycho-social factors like anxiety, stress, and depression can also cause oral diseases.

Stress, the most basic psycho-social factor causes disruption of a person's physiological as well as psychological well-being [4,5]. According to Lewith GT et al., stress is "the disruption of a person's biological, psychological and social dimensions as a result of environmental challenges or perceived threat" [6]. An individual experiences stress in response to changes in the ecological factors and arrange to achieve healthy living. Meanwhile, one's sense of well-being is maintained within acceptable limitations, but if these stimuli exceed typical limits, they become stresses [5].

However, individuals who experience long-term stress can cause elevated amounts of cortisol, a stress hormone that can weaken the immune system. Therefore, this weak defense system favors the microorganisms to colonise in the oral cavity causing various diseases [7]. Oral symptoms of stress include canker sores, dehydration, burning mouth syndrome, bruxism, halitosis, etc., [8]. Many researchers found that stress is a potential risk factor for periodontal disease and it modulates host response to bacteria as well as influences the progression of disease [8-12].

Yoga originated in India thousands of years ago, is a primordial philosophical system aimed at bringing harmony to the individual's physical, mental, and emotional aspects [13-14]. Because of its greater effectiveness and lack of associated side effects, it is considered a popular stress-relieving therapy [15]. Numerous yoga studies have demonstrated that, it can be beneficial for a broad spectrum of health conditions, including psychological well-being (anxiety, depression, stress response) [16-20].

However, yoga does not treat a specific disease or a specific symptom but it treats the individual's entire system (physical body, breathing,

mind and emotions) [15]. By practicing Asanas (exercise postures), pranayama (breathing techniques), and meditation, one can achieve this. In recent years, data from randomised controlled trials suggested that yoga reduces symptoms of anxiety and depression and also has a significant effect on oral environment [5,16]. Research has shown that people who are stressed are more likely to neglect their dental care [3,13-14]. Stress on the jaw muscle can lead to jaw clenching and teeth grinding. It can also shift the jaw, which can affect the alignment of the teeth and cause decay and periodontal disease. Therefore, the holistic application of yoga to clinical practice can provide health benefits that go beyond traditional treatment.

A previous study observed the effectiveness of yoga in maintaining oral hygiene and preventing dental problems, but found no strong evidence of a link between periodontal disease and yoga [3]. Different types of studies have looked into the link between yoga and dental health, but the results have been ambiguous [3,13-16]. Only a few studies have explored the impact of yoga on stress management [13-16], but there is no study that evaluates and compares stress and oral health between yoga and non yoga practitioners. As a result, the current study was planned to compare the stress and periodontal health status of yoga practitioners to age and gender matched controls.

MATERIALS AND METHODS

The present case-control study was conducted in the Department of Public Health Dentistry, Kamineni Institute of Dental Sciences (KIDS), Narketpally Nalgonda, Hyderabad, Telangana, India, for a period of six months from August 2019 to January 2020. The survey was conducted within the working hours of the yoga centers (generally in morning hours). Approval for the study was obtained from the Institutional Review Board (KIDS/IEC/PHD/2019/02). Subjects interested to participate completed the consent form after being informed about the study protocols and agreed to participate.

Inclusion criteria

Cases: Those subjects aged 25-40 years (divided into three age groups as 25-30, 31-35, and 36-40 years) and individuals who practice Yoga regularly in Hyderabad city were included as cases in the study.

Controls: The age and gender matched subjects selected from the general population who were not practicing Yoga were included as controls.

Exclusion criteria: Subjects with any systemic conditions affecting periodontal status that required antimicrobial prophylaxis before clinical examination (herpes simplex infection, rheumatic fever, infective endocarditis, or prosthetic joint infection), patients on recent medication (antibiotics and immunosuppressant), and subjects who had received oral prophylaxis in the previous three months were excluded from the study.

Sample size calculation: The sample size was calculated using periodontal health status in both groups, with a 95 percent confidence interval and 90 percent power, and a 10% dropout rate. Based on previously published preclinical investigations, it was determined that a minimum of 123 participants were required [3,5, 11-14]. Alpha error=5%, Beta error=90%, Standard Deviation=9, Precision=2, sample size obtained was minimum of 123 subjects in each group. Hence, 278 subjects were included in present study (139 subjects in each group) by employing stratified random sampling method.

$$n \geq \frac{\sigma^2}{\delta_0^2} (Z_\alpha + Z_\beta)^2$$

The Greater Hyderabad Municipal Corporation (GHMC) provided a list of zones in Hyderabad (south, north, east, west and central zone). To ensure that each zone received an equal amount of samples, the final sample was divided into five zones (278/5=55.6), resulting in about 55 individuals. Because there are five zones, the study required a total of ten yoga centres (2x5 zones) be included in the study.

Procedure

The survey tool comprised of the Perceived Stress Scale (PSS) developed by Cohen S et al., and demographic details like age, gender, history of yoga practice was obtained [21]. A higher PSS score reflects a larger degree of felt stress by an individual. The overall PSS score was calculated as the sum of ten elements, ranging from 0 to 40. Moreover, it has an excellent internal consistency and test-retest reliability ($\alpha=0.78$). In addition, Cronbach's alpha ranged from 0.64-0.86 as validated through various studies [10-12,21].

In clinical oral examination, oral hygiene status was assessed using Simplified-Oral Hygiene Index (OHI-S) by Greene JC and Vermillion JR (1964) [22]. Dentition status was recorded based on the codes and criteria according to World Health Organisation (WHO) Basic Oral Health Survey Assessment Form, 2013 [23]. While periodontal condition (gingival bleeding and pocket) was assessed using Community Periodontal Index (CPI) modified and Loss of Attachment (LOA) according to WHO criteria 2013 [23].

Loss of Attachment (LOA)- codes [23]

0=0-3 mm

1=4-5 mm Cemento-Enamel Junction (CEJ) within black band

2=6-8 mm CEJ between upper limit of black band and 8.5 mm ring

3=9-11 mm CEJ between 8.5 mm and 11.5 mm ring

4=12 mm or more CEJ beyond 11.5 mm ring

X=Excluded sextant

9=Not recorded

STATISTICAL ANALYSIS

Statistical analyses were done using Statistical Package for Social Sciences Software (SPSS version 21.0). Chi-square test was used to find the significant difference between two or more variables. Mann-Whitney U test, Analysis of Variance (ANOVA) was used for comparison of mean scores of all variables based on age and gender. The Crude Odds ratio and adjusted odds ratio were calculated for cases and controls. The variables adjusted were age, gender, dental visit, history of yoga practice and oral hygiene practices. Logistic regression was also applied to see association between cases and controls for the oral parameters (OHI-S, Caries Status, Gingivitis, Periodontitis and LOA). Statistical significance was set at $p \leq 0.05$.

RESULTS

In the present study, the mean age of the cases was 28.30 ± 7.73 years and for controls was 29.25 ± 7.73 years. The controls were pair-matched for age and gender and an equal number of controls were taken in each age group similar to that of cases. The bulk of the study participants (124; 44.60 percent) were in the age group of 31-35 years, with 84 (30.22 percent) in the age group of 36-40 years and 70 (25.18 percent) in the age group of 25-30 years.

Among total population, females were 142 (51.08%) and males were 136 (48.92%). In both case and control groups, the majority had never visited the dentist in past six months (cases-83; 59.21% and controls- 97; 69.78%). Regarding the history of yoga practice among cases, around 41% of subjects practicing yoga since three years and only a small percentage of subjects (17.27%) practicing yoga regularly for more than three years [Table/Fig-1]. With regard to oral hygiene practices, almost the entire population cleaned their teeth once (cases- 135; 97.12% and controls- 133; 95.68%) with majority using toothbrush and toothpaste (cases-127; 91.37% and controls- 119; 85.61%).

On the subject of the perceived stress scale, subjects who were not practicing yoga had a significantly higher mean score (1.81 ± 0.60) compared to subjects who were practicing yoga regularly (1.67 ± 0.69) ($p < 0.001$).

Variables		n (%)		Total
		Cases	Controls	
Age	25-30 years	35 (25.18)	35 (25.18)	70 (25.18)
	31-35 years	62 (44.60)	62 (44.60)	124 (44.60)
	36-40 years	42 (30.22)	42 (30.22)	84 (30.22)
Gender	Males	68 (48.92)	68 (48.92)	136 (48.92)
	Females	71 (51.08)	71 (51.08)	142 (51.08)
Dental visit	Yes	56 (40.29)	42 (30.22)	98 (35.25)
	No	83 (59.21)	97 (69.78)	180 (64.75)
History of yoga practice	<1 year	58 (41.73)	0 (0)	58 (20.86)
	1-3 years	57 (41.01)	0 (0)	57 (20.50)
	>3 years	24 (17.27)	0 (0)	24 (8.63)
	No	0 (0)	139 (100)	139 (50)
Method of cleaning	Toothbrush and toothpaste	127 (91.37)	119 (85.61)	246 (88.49)
	Any other	12 (8.63)	20 (14.39)	32 (11.51)
Frequency of cleaning	Once	135 (97.12)	133 (95.68)	268 (96.40)
	Twice or more	4 (2.88)	6 (4.32)	10 (3.60)

[Table/Fig-1]: Demographic distribution of the study population.

When mean PSS scores were examined by age group, the 25-30 years old group showed a substantially higher mean score (1.91 ± 0.66) than the 31-35 year (1.73 ± 0.64) and 36-40 year (1.62 ± 0.64) with p -value=0.02. Likewise, significant gender difference (p -value=0.02) was also observed, with females (1.83 ± 0.60) having a higher mean PSS score than males (1.60 ± 0.69). [Table/Fig-2].

Variables		Mean±SD	p-value
PSS	Overall PSS	Cases	1.67±0.69
		Control	1.81±0.60
	Gender	Males	1.60±0.69
		Females	1.83±0.60
	Age	25-30 years	1.91±0.66
		31-35 years	1.73±0.64
36-40 years		1.62±0.64	

[Table/Fig-2]: Comparison of total mean scores of Perceived Stress Scale (PSS) based on age, gender among study population.
*Statistically significant ($p \leq 0.05$); Chi-square test

The majority of the study population had (48.5%) poor oral hygiene. However, more number of the study population had fair Debris Index-Simplified (DI-S) (123; 44.2%) and Calculus Index-Simplified (CI-S) (115; 41.3%) scores. When cases and controls were compared, it was noted that a higher proportion of cases (76; 27.3%) had fair DI-S and OHI-S (96; 69%) scores whereas more number of controls had poor scores for the same (DI-S=59; 42.4% and (OHI-S=105; 74.1%). These differences were statistically significant ($p < 0.001$ and $p < 0.001$, respectively). However, comparable mean Calculus Index-Simplified scores were noted among the subject who were practicing yoga and those who do not [Table/Fig-3].

On the whole, controls ensured higher mean score for all oral parameters than cases and the difference was significant except for gingival ($p = 0.22$) and Caries status ($p = 0.67$). Regarding LOA score, subjects who do not practice Yoga had significant higher mean score for code 1 (1.63 ± 1.33 ; $p < 0.001$) and code 2 (1.18 ± 1.25 ; $p = 0.004$) than who do yoga [Table/Fig-4].

All control age groups (25-30 years= 1.94 ± 0.64 , 31-35 years= 1.80 ± 0.57 , and 36-40 years= 1.74 ± 0.60) showed substantially higher mean PSS scores than cases ($p < 0.001$) in the same age group. No significant group difference was found for OHI-S scores among all ages ($p > 0.05$). Regarding caries status, all age groups in controls showed higher mean score than cases but the difference was insignificant. A similar trend was observed for gingival status but

Variables		n (%)			Total
		Cases	Controls	p-value	
Debris Index-Simplified (DI-S)	Good	36 (12.9)	33 (23.7)	<0.001**	69 (24.8)
	Fair	76 (27.3)	47 (33.8)		123 (44.2)
	Poor	27 (9.7)	59 (42.4)		86 (30.9)
Calculus Index-Simplified (CI-S)	Good	30 (21.5)	48 (34.5)	0.52	78 (28.1)
	Fair	91 (65.4)	24 (17.2)		115 (41.3)
	Poor	19 (13.6)	67 (48.2)		85 (30.5)
Simplified- Oral Hygiene Index (OHI-S)	Good	11 (7.9)	21 (15.1)	<0.001**	32 (11.5)
	Fair	96 (69)	15 (10.7)		111 (39.9)
	Poor	32 (23)	103 (74.1)		135 (48.5)

[Table/Fig-3]: Distribution of study population based on Simplified-Oral Hygiene Index (OHI-S) scores.
*Statistically significant ($p \leq 0.05$); Chi-square test

Variables		Mean±SD		p-value
		Cases	Controls	
Simplified- Oral Hygiene Index (OHI-S)		2.87±3.07	3.90±2.39	<0.001**
Caries status		1.01±0.51	1.50±0.59	0.67
Gingivitis		1.75±1.64	2.35±1.41	0.22
Periodontitis		2.97±0.74	3.69±0.57	0.05*
LOA	Code 0	4.74±1.69	2.36±2.18	0.13
	Code 1	0.97±1.28	1.63±1.33	<0.001**
	Code 2	0.17±0.57	1.18±1.25	0.004*
	Code 3	0.05±0.28	0.56±0.99	0.78
	Code 4	0.01±0.16	0.09±0.37	0.43

[Table/Fig-4]: Comparison of total mean scores of oral parameters among Yoga and non yoga practitioner.
*Statistically significant ($p \leq 0.05$); Mann-Whitney U test; LOA: Loss of attachment

the significant difference was noted with age group 36-40 years only ($p = 0.05$). As it came to periodontal health, controls of all ages reported poor periodontal health with high LOA scores when compared to cases, however only the age groups 31-35 ($p = 0.02$) and 36-40 ($p < 0.001$) showed a significant difference.

The mean scores of all oral measures increased significantly ($p < 0.05$) with increasing age, according to intragroup comparisons within patients and controls. As a result, in both the case and control groups, patients aged 36-40 years reported significantly higher mean scores for all oral indicators, indicating poor oral health. In contrast, mean perceived stress scores were significantly reduced as age of the subjects increased in both case ($p = 0.003$) and control group ($p = 0.04$) [Table/Fig-5].

When compared to patients, both males and females in the control group had significantly higher mean scores for oral parameters (caries status, periodontal state, LOA) and overall PSS score compared to cases ($p \leq 0.05$). A similar trend was noted regarding OHI-S and gingival scores but the difference was not statistically significant.

Among cases, males had significantly higher mean scores for all the parameters but the difference was statistically significant for OHI-S ($p < 0.001$), periodontal disease ($p = 0.006$) and LOA scores ($p = 0.003$) compared to females. In contrast, females (1.73 ± 0.67) perceived significantly more stress than males (1.51 ± 0.70) among cases ($p = 0.03$).

Within controls, however, there was a significant gender difference, with males having a higher mean score (3.73 ± 0.53 , $p < 0.001$) for periodontal disease and LOA score (1.95 ± 1.17 , $p < 0.001$) than females. In contrast, females (1.33 ± 0.53) showed a significantly higher mean OHI-S score than males (1.09 ± 0.53) ($p < 0.001$). Furthermore, overall mean PSS, caries and gingival scores were comparable among males and females in control group [Table/Fig-6].

Variables		Mean±SD		p-value
		Cases	Controls	
PSS	25-30 years	1.88±0.68	1.94±0.64	<0.001**
	31-35 years	1.68±0.69	1.80±0.57	<0.001**
	36-40 years	1.47±0.67	1.74±0.60	<0.001**
	p-value	0.003*	0.04*	
Simplified-Oral Hygiene Index (OHI-S)	25-30 years	0.81±0.47	1.06±0.60	0.07
	31-35 years	1.03±0.45	1.29±0.58	0.06
	36-40 years	1.28±0.53	1.46±0.58	0.4
	p-value	0.03*	<0.001**	
Caries status	25-30 years	1.29±0.75	1.72±1.07	0.09
	31-35 years	1.89±2.33	2.13±1.96	0.45
	36-40 years	2.14±0.59	2.37±1.20	0.53
	p-value	<0.001**	<0.001**	
Gingivitis	25-30 years	2.10±1.12	2.79±1.47	0.18
	31-35 years	3.17±4.45	3.64±3.95	0.08
	36-40 years	3.42±0.99	3.77±1.04	0.05*
	p-value	0.02*	<0.001**	
Periodontitis	25-30 years	2.58±0.71	3.02±0.83	0.36
	31-35 years	2.01±0.68	3.38±0.71	0.02*
	36-40 years	2.47±0.57	3.66±0.52	<0.001**
	p-value	<0.001**	<0.001**	
LOA	25-30 years	0.30±0.57	0.80±1.03	0.22
	31-35 years	0.58±0.72	1.28±1.15	0.02*
	36-40 years	1.18±0.94	1.71±1.13	<0.001**
	p-value	0.003*	0.006*	

[Table/Fig-5]: Comparison of mean scores of oral parameters among cases and controls based on age.

PSS: Perceived stress scale; LOA: Loss of attachment; *statistically significant ($p \leq 0.05$); Mann-Whitney U test for comparing cases and controls; Kruskal Wallis test for comparing different age groups

Variables		Mean±SD		p-value
		Cases	Controls	
PSS	Males	1.51±0.70	1.69±0.68	<0.001**
	Females	1.73±0.67	1.91±0.51	<0.001**
	p-value	0.03*	0.49	
Simplified-Oral Hygiene Index (OHI-S)	Males	1.60±0.61	1.09±0.53	0.11
	Females	0.89±0.441	1.33±0.53	0.45
	p-value	<0.001**	<0.001**	
Caries status	Males	1.78±1.77	2.38±1.56	<0.001**
	Females	1.70±1.37	2.30±1.11	<0.001**
	p-value	0.06	0.37	
Gingivitis	Males	2.92±2.44	3.98±2.25	0.56
	Females	2.79±3.93	3.78±2.62	0.37
	p-value	0.07	0.11	
Periodontitis	Males	3.04±0.77	3.73±0.53	<0.001**
	Females	2.85±0.69	3.60±0.62	<0.001**
	p-value	0.006*	0.01*	
LOA	Males	0.72±0.86	1.95±1.17	<0.001**
	Females	0.47±0.66	1.59±1.09	<0.001**
	p-value	0.003*	<0.001**	

[Table/Fig-6]: Comparison of mean scores of oral parameters among cases and controls based on gender.

*Statistically significant ($p \leq 0.05$); Mann-Whitney U test.

Risk factors, age ($p=0.004$), gender ($p<0.001$) and years of practicing yoga ($p<0.001$) showed a significant effect on individual's oral health. In the present study, subjects aged 25-30 years in the control group were at 1.01 times higher odds for developing dental diseases compared to other age groups. However, after adjusting for other variables, the age group 25-30 years reported

to have lower and significant association {Odds Ratio (OR)=0.28; $p=0.004$ }.

Cleaning teeth using alternative hygiene aids (such as neem sticks, miswak, and so on) was associated with a decreased risk of acquiring oral disorders (OR=0.71), but when adjusted, it was associated with a 1.15 times higher risk of developing dental problems. Subjects who cleaned their teeth less frequently had a 3.13 times higher risk of poor oral health (OR=3.38; adjusted OR=2.54), but there was no significant difference between cases and controls in terms of the manner or frequency with which they cleaned their teeth ($p>0.05$).

A similar situation was observed when association between gender and stress was evaluated, wherein females were at higher odds (OR=1.02) of developing the stress compared to males, but after adjusting, a lower significant association was noted (OR=0.82; $p<0.001$). When it came to dental visits, controls without a history of dental visits had a 1.63 times higher risk of acquiring stress than those who had a history of dental visits. Even after controlling for other variables, this result remained.

Subjects who did not practise yoga had a 3.38 times higher odds of developing stress than those who did. Conversely, after adjusting for other variables, controls showed significantly lower association (adjusted OR=2.54) compared to subjects who practicing Yoga regularly ($p<0.001$) [Table/Fig-7].

Variables	Cases n (%)	Control n (%)	Crude odd ratio (95% CI)	Adjusted odds ratio (95% CI)	p-value	
Age	25-30 years	35 (25.18)	35 (25.18)	1.01 (0.78-1.31)	0.28 (0.20-0.40)	0.004*
	31-35 years	62 (44.60)	62 (44.60)	1.00 (0.80-1.26)	0.51 (0.38-0.67)	
	36-40 years	42 (30.22)	42 (30.22)	Ref.	Ref.	
Gender	Females	68 (48.92)	68 (48.92)	1.02 (0.83-1.25)	0.82 (0.63-1.07)	<0.001**
	Males	71 (51.08)	71 (51.08)	Ref.	Ref.	
Dental visit	Yes	56 (40.29)	42 (30.22)	Ref.	Ref.	0.99
	No	83 (59.21)	97 (69.78)	1.63 (1.31-2.02)	1.62 (1.22-2.16)	
History of yoga practice	<1 year	58 (41.73)	0	Ref.	Ref.	<0.001**
	1-3 years	57 (41.01)	0	0.54 (0.37-0.78)	0.59 (0.36-0.97)	
	>3 years	24 (17.27)	0	0.23 (0.21-0.43)	0.15 (0.10-0.30)	
	No	0 (0)	139 (100)	3.38 (1.71-6.69)	2.54 (1.14-5.66)	
Method of cleaning	Tooth brush and toothpaste	127 (91.37)	119 (85.61)	Ref.	Ref.	0.22
	Any other	12 (8.63)	20 (14.39)	0.71 (0.53-0.94)	1.15 (0.81-1.64)	
Frequency of cleaning	Once	135 (97.12)	133 (95.68)	Ref.	Ref.	0.17
	Twice or more	4 (2.88)	6 (4.32)	3.13 (1.71-6.69)	2.54 (1.14-5.66)	

[Table/Fig-7]: Logistic regression analysis of variables among study population.

*Statistically significant ($p \leq 0.05$); CI: Confidence interval; Multiple Logistic Regression

When oral hygiene was taken into account, controls had a higher likelihood of having poor oral hygiene than cases who had good and fair oral hygiene (OR=5.23). Even after adjusting for other variables, subjects who are not practicing yoga were more likely to have poor oral hygiene (adjusted OR=2.30) ($p<0.001$).

Taking periodontal status into account, controls showed significantly ($p<0.001$) higher risk of developing periodontal diseases compared to cases (OR=3.38) but after adjusting the risk of association reduced (adjusted OR=2.54). Likewise, subjects who were no

Variables		Cases n (%)	Controls n (%)	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI)	p-value
OHI-S	Good, Fair	107 (76.98)	36 (25.90)	Ref.	Ref.	<0.001**
	Poor	32 (23.02)	103 (74.10)	5.23 (4.20-6.45)	2.30 (1.57-3.36)	
Caries status	Absent	46 (33.09)	29 (20.86)	Ref.	Ref.	0.19
	Present	93 (66.91)	110 (79.14)	2.26 (1.78-2.86)	0.89 (0.62-1.30)	
Gingivitis	Absent	45 (32.37)	39 (28.1)	Ref.	Ref.	0.99
	Present	94 (67.63)	100 (71.94)	6.70 (4.72-9.52)	3.06 (2.03-4.60)	
Periodontitis	Absent	67 (48.20)	30 (21.58)	Ref.	Ref.	<0.001**
	Present	72 (51.80)	109 (78.42)	3.38 (1.71-6.69)	2.54 (1.14-5.66)	
LOA	Code 0,1,2	132 (94.96)	129 (92.81)	Ref.	Ref.	<0.001**
	Code 3,4	7 (5.04)	10 (8.63)	11.31 (7.67-16.68)	6.46 (4.24-9.85)	

[Table/Fig-8]: Logistic regression analysis of oral parameters with yoga.
*statistically significant ($p < 0.05$); CI: Confidence interval; Multiple Logistic Regression

practicing yoga were at higher odds of developing LOA ≥ 9 mm (code 3, 4) (OR=11.31). However, the risk of association was lowered after adjustment (adjusted OR=6.46) ($p < 0.001$) [Table/Fig-8].

DISCUSSION

One of the major causes of dental diseases is mere ignorance towards oral hygiene practices and lack of knowledge for the proper maintenance of the oral cavity. In addition to these, poor lifestyle habits play a major role in substandard oral hygiene [3]. Modern industrious and civilised lifestyles result in increased levels of stress leading to various health problems including dental. Chronic elevations of stress hormone may lead to the immune system becoming resistant leading to poor defence mechanisms, thereby increasing oral infections [7,24]. Investigations have also shown that stressed people are also more likely to neglect their oral hygiene, which can lead to caries and periodontal disease [7-10].

Yoga, originated in India, helps in relieving both mental and physical infirmities. Despite the fact that it was performed in ancient India 5000 years ago, it has only recently gained widespread popularity [3]. It is thought to help with a variety of mental and physical ailments, including schizophrenia, depression, anxiety, and post-traumatic stress disorder (PTSD) [25,26]. Yoga has been shown to reduce stress and anxiety while also improving a person's quality of life [24,27]. Hence, these beneficial effects of yoga were helpful in preventing oral diseases associated with stress.

The psychological determinant of health has always been underplayed, yet emerges as a significant factor in various diseases [26]. Physical exercise, on the other hand, is a key component in reducing inflammation, and those who are physically active have lower inflammatory markers than those who live a sedentary lifestyle [24]. Yoga incorporates mind-body relaxation techniques and helps to control stress-related alterations [3]. As a result, the primary goal of this research was to see how effective yoga is at maintaining oral hygiene, preventing dental disorders, and reducing stress. This is the first case-control study that considers independent oral health benefits related with yoga practice and samples drawn from the general population. Earlier research [3,24-27] focused on the influence of yoga on chronically ill persons and the usefulness of yoga in a variety of systemic illnesses.

Among the total study population, females were 51.08% ($n=142$) and males were 48.92% ($n=68$) in each case and control group. However, almost equal number of male and females were included in case, which indicates that the interest of practicing yoga were parallel in both males and females. Most of our lives today are so busy because of workload, scheduled plans, lifestyle choices, and priorities that it gives minimum time for healthy practices [28]. It has been noted in this study that around 41% of subjects have been practicing yoga for three years and only a small percentage of subjects (17.27%) have been practicing yoga regularly for more than three years.

Subjects who practised yoga on a regular basis had lower stress levels than those who did not. Similarly, Malathi A and Damodaran A assigned 50 stressed Indian medical students to yoga or a non intervention control group, finding showed that yoga group's sense of well being improved as a result of the reduced stress [20]. Moreover, subjects aged 25-30 years perceived higher stress compared to other age groups. It may be fact that the, younger people have academic or personal competition in career and education [29]. A study conducted by Singh K et al., among young individuals in Uttarakhand found similar results [3]. Furthermore, significant gender difference ($p=0.02$) was noted with high levels of stress among females. This suggests that women take on more responsibilities at work while retaining their responsibilities at home. Similar findings were noted with a study done by Kiecolt-Glaser JK et al., among 30-45-year-old women of USA and Al-Sowayh ZH among Saudi female students of King Saud University [27,30].

Taking oral hygiene into account, subjects who practice yoga had fair oral hygiene status and those who did not practice had poor oral cleanness in current study. Mechanical plaque control, on the other hand, is dependent on the individual's lifestyle, such as sleeping in late, not having enough time to clean one's teeth, delay wake up in the morning, and so on. However, individuals who follow a yogic lifestyle get up early in the morning for yoga in order to clean their teeth [31]. However, more number of controls was at high risk of developing caries, periodontitis and LOA ≤ 9 mm (code 1, 2) than cases. Similarly, a study conducted by Kiecolt-Glaser JK et al., among 50 healthy women in Ohio and Sudhanshu A et al., on 80 women in New Delhi, concluded that yoga can help you improve your lifestyle, relieve stress and reduce gingival inflammation [27,32]. Psychological stress and yoga are supposed to be reciprocally related. Yoga provides a variety of options for managing one's overall health, including stress reduction and the prevention of autonomic deregulation. Reduced perceived stress levels lead to fewer negative anxiety and depression feelings, a higher sense of well-being, and increased sensory-motor function [28].

In the current study, stress among study population declines as age increases in both yoga as well as non yoga group but mean PSS score were higher among controls than cases for all ages. Similar findings were noted by Streeter CC et al., among 34 subjects in Boston, USA and Shohani M et al., among 52 women living in Ilam, Iran [31,33]. They discovered that practicing yoga poses is linked to higher levels of G-Aminobutyric Acid (GABA) in the brain, which leads to better mood and less stress.

When the complete study sample was considered as a whole, independent of the cases and controls, it was discovered that oral health and periodontal status deteriorated with age ($p < 0.001$). This could be due to the fact that younger people are more concerned about their appearance in both a personal and social setting, and hence are more likely to practice good dental hygiene. In contrast, mean perceived stress scores were significantly reduced as age of

the subjects increased in both groups ($p < 0.001$). Significant data suggests that older people have fewer life experiences and rate them as less stressful than younger people [30].

A remarkable observation of the present study was that, all age groups who were not practicing yoga reported with poor periodontal health with high LOA scores ($p < 0.001$) compared to practitioners. This was in accordance with the systematic review by Woodyard C; and stated that yoga is a more natural way of life that aids in the prevention of dental and soft tissue disorders of the oral cavity that are caused by life's pressures [34]. In this study, it was observed that both males and females in the control group had high stress levels and poor periodontal health compared to cases because stress decreases the blood supply to the teeth and gums as a result of which teeth become unhealthy and weak [35]. These findings were in accordance with the case control design by Seltmann CL et al., in USA and a systematic review by Jayawardena R et al., [36,37].

In the current research, female yoga practitioners perceived more stress than male practitioners. It may be due to a completely different women hormonal system, female sex hormones decrease the sympathoadrenal and Hypothalamic-Pituitary-Adrenal (HPA) axis (e.g., cortisol) responsiveness. This causes sluggish cortisol feedback in the brain, as well as reduced or delayed control of the stress response, causing them to react more emotionally and become emotionally weary [35]. In contrast, Bhattacharya S et al., found low stress reduces inflammation and improve oxidative status and immunity of the body among male yoga experts [38]. In the present study, subjects without practicing yoga and no history of dental visit were higher risk for developing stress and were more prone for oral diseases. However, Bussing A et al., revealed a linear relationship between yoga practice frequency and subjective health parameters in a cross-sectional investigation [39].

In the present study, when compared to other age groups, participants aged 25-30 years in the control group had a 1.01 times higher odds of experiencing stress. In contrast, data from 200 undergraduates and 84 mature adults was evaluated by Archer JA et al., observed that the link between stress and well-being and stress and health was significantly modulated by groups, however the association ($OR = 0.51$) was weaker in older persons in both situations [40]. However, health-related factors such as cognitive impairment, the coexistence of two or more chronic illnesses in the same person, and depressive symptoms may explain the rise in perceived stress levels as people get older. These findings are logical, as perceived stress has been linked to depressive symptoms, which have been shown to worsen with age [41].

In terms of gender, men controls had a higher risk of developing stress ($OR = 1.02$) than female non yoga practitioners. The findings are unlike with the study by Sudhanshu A et al., among 15 to 45-year-old periodontal patients in New Delhi and stated that both females and males had comparable stress levels [32]. It could be that females are more likely to show outward signs or to express that they are stressed. However, males may also be more likely to internalise their stress and not express it [42].

Plaque build-up, tooth decay, and gum disease are all caused by a dry mouth, which provides an environment where bacteria can thrive. Practicing yoga can stimulate the salivary glands and help to prevent your mouth and throat from drying out. Yoga positions like forward bends, twists, and inverted poses are believed to increase saliva production [3,28]. In current study, non yoga practitioners were significantly higher risk of developing dental diseases compared to cases. These findings were in line with the study by Singh K et al., among young adults in Uttarakhand [28].

Therefore, the present study highlights the effect of yoga on oral health through stress reduction. The study's merits are its well-defined and pair-matched case and control groups. Other advantages include the exclusion of participants with systemic

diseases, a major confounding factor for periodontal disease, and the allocation of regular yoga practitioners. However, several studies [29,37-40] have been done in the past to know the effect of yoga on stress and oral diseases but those entire samples were drawn from the individuals with systemic conditions (mental disorders, musculoskeletal disorder and cancer patients). Moreover, there is a need for more studies with larger number of people and other factors affecting oral health should be considered because they act as confounders.

Limitation(s)

The study reported here has several limitations like small sample size; most relevant socio-demographic and clinical factors were not matched between cases and controls and not consider the frequency, length and type of yoga practice. The survey used to assess the study participant's oral hygiene but did not discuss periodontal probing radiographic screening to assess bone loss etc.

CONCLUSION(S)

According to the findings of this study, stress and poor dental health play a significant impact in the occurrence of periodontal diseases. However, this study stated that there should be a direct or indirect effect of yoga on oral disease and it may be due to decrease stress levels and change in lifestyle patterns. This study's findings are particularly significant for the Indian population; as more than half of the population suffers from periodontitis as a result of stress. As a result, to combat stress and periodontal disease, appropriate preventative and treatment techniques are recommended. Therefore, yoga is useful in the prevention of dental disorders as well as the maintenance of oral hygiene and healthy gingiva by enhancing one's lifestyle, lowering stress, and reducing periodontal inflammation.

The future studies are recommended on a larger sample size, more planned case-control study with comparable socio-demographic and clinical characters along with explicitly different yoga techniques, may be exasperated in different cultures for the self-management of excessive stress, for better generalisability of the results. Such researches would throw more light on the generalisability of yoga practice and the reproducibility of the effect of yoga worldwide.

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