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Original article

Periodontal disease among non-diabetic Coronary Heart Disease patients. A case-control study

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Summary. *Background:* There is well documented scientific evidence supporting the association between Coronary Heart Disease (CHD) and periodontitis. It is however, uncertain if this association is causal or is mediated by the common inflammatory pathways. Hence, the study assessed and compared the Periodontal Health Status among CHD patients with age and gender matched controls. *Methods:* A total of 808 medically confirmed CHD patients were compared with 808 age and gender matched controls. Oral examination was conducted using Simplified Oral Hygiene Index (OHI-S) and modified World Health Organization (WHO) Oral Health Assessment form, 1997. Mean scores were compared using Mann- Whitney-U test and Analysis of Variance (ANOVA). Logistic regression analysed the association between the risk factors and CHD. *Results:* Cases had significantly higher mean sextants with pockets and attachment loss ≥4mm compared to controls (p≤0.05). The cases also had significantly poor oral hygiene mean scores compared to controls (p=0.0001*). There was a lower and insignificant association between age (p=0.99), gender (p=0.84) and CHD. Risk factors education (p=0.001), lesser frequency of dental visit (p=0.001) also showed a lower, yet significant association. Risk of CHD was higher among tobacco (Odds ratio (OR) - 2.26) and alcohol (OR-1.83) users. Presence of poor oral hygiene (OR-5.20), pocket of ≥6 mm (6.70) and attachment loss of ≥9 mm (OR-11.31) also showed higher risk of CHD. *Conclusion:* The study results support the association between periodontal disease and CHD. To halt the epidemic of CHD, emphasis on screening of wide age range, reinforcement of public health systems and early detection is recommended. (www.actabiomedica.it)

Key words: Coronary Heart Disease, periodontal disease, India, epidemiology, oral hygiene

Introduction

Coronary Heart Disease (CHD) is the impairment of heart function due to inadequate blood flow to the heart compared to its needs, caused by obstructive changes in the coronary circulation to the heart (1). According to American Journal of Public Health (AJPHD), CHD manifests as myocardial infarction, angina pectoris, sudden death (coronary occlusion) and myocardial fibrosis (2).

Recent epidemiological data discloses that CHD has been established as the leading cause of mortality and morbidity, more in urban than in rural population, after a 6-9 fold increase in its prevalence over a period of time (3-5). Globally, cardiovascular diseases (CVD) have led to 17.5 million deaths with an estimate 7.4 million deaths due to CHD (6). India too has experienced the impact of this epidemiologic shift, with a proportional number of deaths (26.9%) due to CHD and thereby has become the leading cause of years of life lost (YLLs) to premature death (7-9). Besides, World Health Organization (WHO) foresees that the Disability Adjusted Life Years Lost (DALYs) from CHD in India will double both among men and

women by 2020 (10). Few studies on morbidity trends also divulge that CHD mortality is higher in South Indian States both among men and women compared to central Indian states (10, 11).

This escalating burden of CHD in India can be attributed to the disturbing increase in the risk factors (genetic and environmental) like diabetes, hypertension, abnormal serum lipids, age, smoking, socio-economic status, gender etc. (12, 13). Apart from its multifactorial pathophysiology, bacterial and viral agents are suggested to be contributory in both initiation and progression of thromboembolic events leading to CHD (14). Growing literature has also implicated the role of oral infections, particularly periodontitis in the pathogenesis of atherosclerosis (15, 16). The association between periodontitis and CHD was first given by Mackenzie and Millard in 1963 (17). Since then, evidence from various studies stated that there is a monotonic increasing gradient of risk for CHD due to periodontal pathogens (largely due to gram negative pathogens) (15, 16).

Periodontal gram negative bacteria along with their endotoxins enter the bloodstream and as a consequence, an increase in the plasma levels of inflammatory mediators like Interleukin-6 (IL-6) and tumor necrosis factor (TNF) is observed. These inflammatory mediators in turn induce secretion of C-reactive protein (CRP) and trigger a cascade of biological and biochemical reactions leading to atherosclerosis and vascular thrombotic events, thereby exacerbating CHD. It is also presumed that direct action of gram negative pathogens causes platelet aggregation, alteration in the host response and alter lipid metabolism thus promoting atherogenesis and thrombo-embolism leading to ischemia (18-20).

Periodontal and coronary heart diseases are universal with a significant public health importance and relationship between the two has been identified in several studies (12, 14, 21), their association is still debatable. For instance, Parker SM et al (20), in their case control study concluded that patients with myocardial infarction exhibited higher severity of periodontitis and Simplified-Oral Hygiene Status scores compared to the control group. Likewise, Yu YH et al (22), also underlined that cases with periodontal diseases are at significantly higher risk for future cardiovascular events. On the other hand, a follow up study (23), did not support the assumption of a significant correlation between periodontitis and CHD. Similarly, another cohort study by Hujoel PP et al (24), also did not report convincing evidence of a causal association between periodontal disease and CHD. This could be due to variations in the study design, difference in criteria used, and lack of accurate criteria for periodontitis, assessment of the association without medical confirmation and presence of other confounding factors. (12, 14).

Hence, to clear this ambiguity, the present study was conducted with an aim to assess and compare the Periodontal Health Status among CHD patients with age and gender matched controls.

Materials and method

The present study was approved by the Institutional Review Board of the institution (PMVIDS&RC/IECPHD/DN/0038-15) and the study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all the subjects. The study fulfilled the STROBE guidelines for case-control study design.

Based on sample size calculation, it was estimated to include a minimum of 804 subjects in each case and control group. Therefore, a total of 808 cases and 808 controls, fulfilling the inclusion criteria were included in the study.

The present case-control study was conducted among patients with CHD and a healthy control group. The study participants were recruited from the Cardiology Outpatient Department, Aarogyasri ward of Yashoda Hospital, Malakpet, Hyderabad between June 2016-December 2016. Permission to conduct the study was obtained from authorities of the hospital. All patients aged ≥30 years; medically diagnosed and confirmed of having CHD by a cardiologist were included in the case group. While the control group comprised of age and gender matched healthy attendants of the patients, diagnosed to be free of the disease by a cardiologist. Other inclusion criteria for cases and controls are- having minimum of 20 functional teeth with no history of systemic diseases affecting perio-

dontal status (diabetes, chronic obstructive pulmonary disease etc) and history of antibiotic or prophylaxis in the last one month were included. Subjects not willing to give written informed consent were excluded from the study.

A structured questionnaire gathered information on demographics, deleterious habits and oral hygiene practices. A trained calibrated single examiner performed oral examination using a plane mouth mirror, no. 5 Shepard's Crook and CPI probe. Oral hygiene status was assessed using Simplified-Oral Hygiene Index (OHI-S) by John C. Greene and Jack R. Vermillion, 1964. Community Periodontal Index (CPI) and Loss of Attachment (LOA) indices as per codes and criteria of World Health Organisation (WHO) proforma, 1997 evaluated the periodontal status.

Statistical analysis

Statistical analyses were done using Statistical Package for Social Sciences Software (SPSS version 21.0). Descriptive statistics were carried out for the demographic variables. Chi-square test, Mann- Whitney-U test, Analysis of Variance (ANOVA) and regression analysis determined the association and compared the mean scores based on variables. Statistical significance was set at $p \leq 0.05$.

Results

The demographic details of the study population is described in table 1.

The majority of study population had fair Debris Index- Simplified (DI-S) scores (1069; 66.1%), however, higher percentage of study population had poor scores for Calculus Index- Simplified (CI-S) (952; 58.9%) and Simplified- Oral Hygiene Index (OHI-S) (905; 56%).

Comparison among cases and controls demonstrated that, a larger proportion of cases had poor scores for CI-S (617; 76.4%), OHI-S (610; 75.5%) whereas more number of controls had fair scores for the same (CI-S=363; 44.9% and OHI-S=417; 51.6%). These differences were statistically significant (p=0.0001 and p=0.0001* respectively). For DI-S scores, comparable number of cases (533; 65.9%) and controls (536; 66.3%) had fair rating but poor score was more among cases (213; 26.4%) (p=0.0001*) compared to controls (45; 5.6%) (Table 2).

Based on CPI codes, none of the subjects had code 0, code X and code 9. A larger proportion of them had a code of 3 (560; 34.7%) and code 4 (800; 49.5%). Furthermore, it was observed that only code 4 was recorded higher among cases (597; 73.9%) than controls (203; 25.1%) and it was significant (p=0.0001*).

On the contrary, for LOA, significantly higher number of cases had code 2 (236; 29%), code 3 (202; 25%) and code 4 (50; 6.2%) compared to controls (p=0.0001*) (Table 2).

Age-wise comparison of mean DI-S scores among cases and controls reported that all age groups among cases (35-44 years=1.06±0.60, 45-54 years=1.29±0.58 and 55-65 years=1.46±0.58) had significantly higher mean scores compared to controls (p=0.0001*) for the same age group. A similar situation, was noted for mean CI-S scores also (cases- 35-44 years=1.72±1.07, 45-54 years=2.13±1.96 and 55-65 years=2.37±1.20) (p=0.0001*). Likewise, the mean OHI-S scores were also significantly higher among cases compared to controls (p=0.0001*). Higher scores among cases indicate a poor oral hygiene status among them compared to controls.

When periodontal health status of the study population was considered, cases of all age groups reported a poor periodontal health with significantly high CPI and LOA scores compared to controls (p=0.0001*).

Intragroup comparison within cases and controls revealed that, the mean scores of all oral parameters increased significantly with increase in age. Therefore, subjects aged 55-65 years reported significantly higher mean scores for all oral parameters in both case and control group, indicating a poor oral health and periodontal status among them. (Table 3)

Both males and females in case group had significantly higher scores for all the oral parameters compared to controls (DI-S- p=0.0001*, CI-S- p=0.0001*, OHI-S- p=0.0001*, CPI- p=0.0001* and LOA- p=0.0001*).

Comparison based on gender within the case and control group demonstrated that males in each group had significantly higher scores for all the parameters except CI-S (cases- p= 0.37 and controls p=0.06) compared to females (Table 4).

Table 1. Demographic distribution of the study population

Variables		n (%)		Total
		Cases	Control	
Age	35-44 years	271 (33.5)	271 (33.5)	542 (33.5)
	45-54 years	344 (42.6)	344 (42.6)	688 (42.7)
	55-65 years	193 (23.9)	193 (23.9)	386 (23.8)
Gender	Males	514 (63.6)	514 (63.6)	1028 (63.6)
	Females	294 (36.4)	294 (36.4)	588 (36.4)
Marital status	Married	808 (100)	797 (98.6)	1605 (99.3)
	Single	0 (0)	11 (1.4)	11 (0.7)
Education	Primary school	395 (48.9)	264 (32.7)	659 (40.8)
	High school	330 (40.8)	374 (46.3)	704 (43.5)
	University	83 (10.3)	170 (21)	253 (15.7)
Dental visit	Yes	284 (35.1)	205 (25.4)	489 (30.3)
	No	524 (64.9)	603 (74.6)	1127 (69.7)
Last dental visit	No visit	524 (64.9)	603 (74.6)	1127 (69.7)
	6 months- 1 year	80 (9.9)	46 (5.7)	126 (7.8)
	>1 year	204 (25.5)	159 (19.7)	367 (22.5)
History of tobacco use	Yes	256 (31.7)	136 (16.8)	392 (24.3)
	No	552 (68.3)	672 (83.2)	1224 (75.7)
History of alcohol use	Yes	163 (20.2)	98 (12.1)	261 (16.2)
	No	645 (79.8)	710 (87.9)	1355 (83.8)
Method of cleaning	Tooth brush and toothpaste	678 (84)	710 (87.9)	1388 (86)
	Any other	130 (16)	98 (12.1)	228 (14)
Frequency of cleaning	Once	797 (98.6)	770 (95.3)	1567 (97)
	Twice or more	11 (1.4)	38 (4.7)	49 (3)

n=number of people

Table 2. Distribution of study population based on Simplified-Oral Hygiene Index (OHI-S), Community Periodontal Index (CPI) and Loss of Attachment (LOA) coding criteria

Variables		n (%)			Total
		Cases	Controls	p-value	
DI-S	Good	62 (7.7)	227 (28.1)	0.0001*	289 (17.9)
	Fair	533 (65.9)	536 (66.3)		1069 (66.1)
	Poor	213 (26.4)	45 (5.6)		258 (16)
CI-S	Good	24 (2.9)	110 (13.6)	0.0001*	134 (8.3)
	Fair	167 (20.7)	363 (44.9)		530 (32.8)
	Poor	617 (76.4)	335 (41.5)		952 (58.9)
OHI-S	Good	15 (1.9)	96 (11.9)	0.0001*	111 (6.9)
	Fair	183 (22.6)	417 (51.6)		600 (37.1)
	Poor	610 (75.5)	295 (36.5)		905 (56)
CPI	Code 0	0 (0)	0 (0)	0.0001*	0 (0)
	Code 1	2 (0.2)	10 (1.2)		12 (0.7)
	Code 2	39 (4.8)	205 (25.4)		244 (15.1)
	Code 3	170 (21.1)	390 (48.3)		560 (34.7)
	Code 4	597 (73.9)	203 (25.1)		800 (49.5)
	Code X	0 (0)	0 (0)		0 (0)
	Code 9	0 (0)	0 (0)		0 (0)
LOA	Code 0	126 (15.6)	424 (52.5)	0.0001*	550 (34)
	Code 1	194 (24)	295 (36.5)		489 (30.3)
	Code 2	236 (29.2)	59 (7.3)		295 (18.2)
	Code 3	202 (25)	24 (3)		226 (14)
	Code 4	50 (6.2)	6 (0.7)		56 (3.5)
	Code X	0 (0)	0 (0)		0 (0)
	Code 9	0 (0)	0 (0)		0 (0)

*statistically significant (p≤0.05); n=number of people
DI-S- Debris Index- Simplified; CI-S- Calculus Index-Simplified; OHI-S- Simplified- Oral Hygiene Index
CPI- Community Periodontal Index; LOA-Loss of Attachment

On the whole, cases reported poor oral hygiene (DI-S=1.50±0.59, CI-S=2.35±1.41 and OHI-S= 3.90±2.39) and periodontal status (CPI= 3.69±0.57 and LOA=1.82±1.15) compared to controls (Table 5).

Based on total mean sextants scores of CPI, comparable number of cases and controls had mean number of sextants with code 1 (p=0.36). Furthermore, controls had significantly higher number of sextants affected with code 2 (cases- 0.89±1.33 and controls- 2.48±1.72) (p=0.001*) whereas mean number of sextants with pocket depth of 4-5mm (cases- 2.36±1.38 and controls- 2.00±1.63; p=0.001*) and 6mm or more (cases- 2.24±1.84 and controls- 0.51±1.09; p=0.001*) were significantly higher among cases compared to controls.

Contrary to the CPI mean sextant scores, cases had significantly higher number of sextants affected with majority of codes (code 1=0.001*, code 2=0.001*, code 3=0.001* and code 4=0.001*) compared to controls. Conversely, mean number of sextants with code

Table 3. Comparison of mean Simplified-Oral Hygiene Index (OHI-S), Community Periodontal Index (CPI) and Loss of Attachment (LOA) scores among cases and controls based on age

Variables		Mean ±S.D.		p-value
		Cases	Controls	
DI-S	35-44 years	1.06±0.60	0.81±0.47	0.0001*
	45-54 years	1.29±0.58	1.03±0.45	0.0001*
	55-65 years	1.46±0.58	1.28±0.53	0.0001*
	p-value	0.0001*	0.0001*	
CI-S	35-44 years	1.72±1.07	1.29±0.75	0.0001*
	45-54 years	2.13±1.96	1.89±2.33	0.0001*
	55-65 years	2.37±1.20	2.14±0.59	0.0001*
	p-value	0.0001*	0.0001*	
OHI-S	35-44 years	2.79±1.47	2.10±1.12	0.0001*
	45-54 years	3.64±3.95	3.17±4.45	0.0001*
	55-65 years	3.77±1.04	3.42±0.99	0.0001*
	p-value	0.0001*	0.0001*	
CPI	35-44 years	3.02±0.83	2.58±0.71	0.0001*
	45-54 years	3.38±0.71	3.01±0.68	0.0001*
	55-65 years	3.66±0.52	3.47±0.57	0.0001*
	p-value	0.0001*	0.0001*	
LOA	35-44 years	0.80±1.03	0.30±0.57	0.0001*
	45-54 years	1.28±1.15	0.58±0.72	0.0001*
	55-65 years	1.71±1.13	1.18±0.94	0.0001*
	p-value	0.0001*	0.0001*	

*statistically significant (p≤0.05)
DI-S- Debris Index- Simplified; CI-S- Calculus Index-Simplified; OHI-S- Simplified- Oral Hygiene Index; CPI- Community Periodontal Index; LOA-Loss of Attachment; S.D.-Standard Deviation

0 was higher among controls compared to cases (cases- 2.36±218 and controls- 4.74±1.69; p=0.001*).

Risk factors education (p=0.001*), dental visit (0.001*), last dental visit (0.001*), history of tobacco (p=0.001*) and alcohol use (p=0.001*), method of cleaning (p=0.02*) and frequency of cleaning (p=0.001*) showed a significant association with CHD.

In the present study, subjects aged 55-65 years were at 1.01 times higher risk for developing CHD compared to other age groups. However, after adjusting for other variables, age group 55-65 years reported to have lower and insignificant association (Odds Ratio (OR)=0.28; p=0.99).

A similar situation was observed when association between gender and CHD was evaluated, wherein males were at higher odds (OR=1.02) of developing the disease compared to females, but after adjusting, a lower association was noted (OR=0.82; p=0.84).

Subjects with primary (crude OR=0.60; adjusted OR=0.71) and high (crude OR- 0.32; adjusted OR=0.45) school education showed significantly lesser association with CHD.

Considering the dental visit, subjects with no history of dental visit were at 1.63 times higher risk for developing CHD compared to those with history of dental visit. This finding was persistent even after adjusting for other variables, wherein, subjects without history of dental visit were at higher odds (OR=1.62) of developing CHD.

However, of last dental visit reported to have a lower association with CHD (OR= 0.54 and adjusted OR=0.59).

Table 4. Comparison of mean Simplified-Oral Hygiene Index (OHI-S), Community Periodontal Index (CPI) and Loss of Attachment (LOA) scores among cases and controls based on gender

Variables		Mean ±S.D.		p-value
		Cases	Controls	
DI-S	Males	1.60±0.61	1.09±0.53	0.0001*
	Females	1.33±0.53	0.89±0.44	0.0001*
	p-value	0.0001*	0.0001*	
CI-S	Males	2.38±1.56	1.78±1.77	0.0001*
	Females	2.30±1.11	1.70±1.37	0.0001*
	p-value	0.37	0.06	
OHI-S	Males	3.98±2.25	2.92±2.44	0.0001*
	Females	3.78±2.62	2.79±3.93	0.0001*
	p-value	0.0001*	0.0007*	
CPI	Males	3.73±0.53	3.04±0.77	0.0001*
	Females	3.60±0.62	2.85±0.69	0.0001*
	p-value	0.01*	0.0006*	
LOA	Males	1.95±1.17	0.72±0.86	0.0001*
	Females	1.59±1.09	0.47±0.66	0.0001*
	p-value	0.0001*	0.0003*	

*statistically significant (p≤0.05)
DI-S- Debris Index- Simplified; CI-S- Calculus Index-Simplified; OHI-S- Simplified- Oral Hygiene Index
CPI- Community Periodontal Index; LOA-Loss of Attachment; S.D.- Standard Deviation

Table 5. Comparison of total mean scores of Simplified-Oral Hygiene Index (OHI-S), Community Periodontal Index (CPI) and Loss of Attachment (LOA) among cases and controls

Variables	Mean ±S.D.		p-value
	Cases	Controls	
DI-S	1.50±0.59	1.01±0.51	0.0001*
CI-S	2.35±1.41	1.75±1.64	0.0001*
OHI-S	3.90±2.39	2.87±3.07	0.0001*
CPI	3.69±0.57	2.97±0.74	0.0001*
LOA	1.82±1.15	0.63±0.80	0.0001*

*statistically significant (p≤0.05)
DI-S- Debris Index- Simplified; CI-S- Calculus Index-Simplified; OHI-S- Simplified- Oral Hygiene Index; CPI- Community Periodontal Index; LOA-Loss of Attachment;
S.D.- Standard Deviation

Subjects with habit of tobacco and alcohol use were at 2.26 times and 1.83 times respectively, higher risk of developing CHD compared to non tobacco and alcohol users. Conversely, after adjusting for other variables, both the risk factors showed lower association (tobacco user- adjusted OR=0.89 and alcohol user-adjusted OR=0.97) compared to non-users.

Cleansing of teeth using other hygiene aids (like neem sticks, miswak etc) showed lower risk of developing CHD (OR=0.71), however upon adjusting, it showed a 1.15 times higher risk for CHD.

Lower frequency of teeth cleaning among subjects was associated with 3.38 times higher risk for CHD (OR=3.38; adjusted OR=2.54).

Taking oral hygiene into account, poor oral hygiene showed significantly higher risk of developing CHD compared to those with good, fair oral hygiene (OR=5.2). Even after adjusting for other variables, subjects with poor oral hygiene were at higher odds of developing the disease (adjusted OR=2.30) (p=0.001*).

Similarly, significant association was found be-

tween CHD and subjects having periodontitis (code 3, 4) (OR=6.70 and unadjusted OR=3.06) compared to those having only bleeding and calculus (code 1, 2) (p=0.001*).

Likewise, subjects with LOA ≥9 mm (code 3, 4) were at higher odds of developing CHD (OR=11.31).

Table 6 - Logistic regression analysis of variables with Coronary Heart Disease (CHD)

Variables		Crude odd ratio (95% CI)	Adjusted Odds ratio (95% CI)	p- value
Age	35-44 years	Ref.	Ref.	0.99
	45-54 years	1.00 (0.80-1.26)	0.51 (0.38- 0.67)	
	55-65 years	1.01 (0.78-1.31)	0.28 (0.20- 0.40)	
Gender	Females	Ref.	Ref.	0.84
	Males	1.02 (0.83 –1.25)	0.82 (0.63- 1.07)	
Education	Primary school	0.60 (0.48 – 0.74)	0.71 (0.55- 0.93)	0.001*
	High school	0.32 (0.24 – 0.45)	0.45 (0.30- 0.67)	
	University	Ref.	Ref.	
Dental visit	Yes	Ref.	Ref.	0.001*
	No	1.63 (1.31 – 2.02)	1.62 (1.22-2.16)	
Last Dental visit	6 months- 1 year	Ref.	Ref.	0.001*
	>1 year	0.54 (0.37 – 0.78)	0.59 (0.36- 0.97)	
History of tobacco use	No	Ref.	Ref.	0.001*
	Yes	2.26 (1.78 – 2.86)	0.89 (0.62- 1.30)	
History of alcohol use	No	Ref.	Ref.	0.001*
	Yes	1.83 (1.40 – 2.41)	0.97 (0.64- 1.47)	
Method of cleaning	Tooth brush and toothpaste	Ref.	Ref.	0.02*
	Any other	0.71(0.53 – 0.94)	1.15 (0.81- 1.64)	
Frequency of cleaning	Twice or more	Ref.	Ref.	0.001*
	Once	3.38 (1.71 – 6.69)	2.54 (1.14- 5.66)	
OHI-S	Good, Fair	Ref.	Ref.	0.001*
	Poor	5.2 (4.20-6.45)	2.30 (157-3.36)	
CPI	Code 1,2	Ref.	Ref.	0.001*
	Code 3,4	6.70 (4.72-9.52)	3.06 (2.03-4.60)	
LOA	Code 0,1,2	Ref.	Ref.	0.001*
	Code 3,4	11.31 (7.67-16.68)	6.46 (4.24-9.85)	

*statistically significant (p≤0.05), CI= Confidence Interval
OHI-S- Simplified- Oral Hygiene Index; CPI- Community Periodontal Index; LOA-Loss of Attachment

However, after adjusting the risk of association reduced (adjusted OR=6.46) (p=0.001*) (Table 6).

Discussion

A significant role of periodontal diseases in the CHD is evident from the findings of the present study. In order to fulfil the aim of the present study, OHI-S Index by John C Greene and Jack R Vermillion, was used since the criteria are clear and examinations can be carried out quickly (25). The periodontal status was assessed using CPI and LOA index as per WHO codes and criteria (1997) as it is simple, reproducible and shows international uniformity (26).

A total of 1616 (808-cases and 808-controls) subjects matched for age and gender were included in the study. Similar studies in Karnataka (19), (54.97±7.97 years) and Gujarat (20), (54.3±11.01 years) reported higher mean age compared to the cases in the present study (48.30±7.73 years). This shows a change in the disease pattern and emphasizes the need to screen individuals of different and younger age groups to detect disease at an early stage. In this group of Indian population, both periodontitis and CHD showed male preponderance. Similar findings were reported by Greets et al (27), among Hongkong population (cases-85.2% males).

An important determinant of CHD and poor oral health is socioeconomic status (SES), with greater morbidity and mortality among people of lower SES (28). Hence, to minimise this difference, attempt was made to include both cases and controls from the Aarogyasri ward (lower SES) of the hospital. Presence of traditional risk factors like lower frequency of dental visit, tobacco and alcohol use, non-usage of tooth brush and toothpaste and lower frequency of tooth brushing was higher among cases compared to controls which was akin to other studies conducted in other parts of India (19, 27), Finland (29), and Scotland (30).

Mackenzie et al reported that presence of calculus can lead to alveolar bone loss and arteriosclerosis (17). Poor oral hygiene among cases was seen compared to controls in this study (p=0.0001*). This could be because of lower frequency of dental visit (>1 year- cases=25.5%) and tooth cleaning (brushing once a day- cases= 98.6%) or due to longer duration of hospital stay which additionally could hamper their oral hygiene practices (31). The overall higher significant mean scores of DI-S (1.50±0.59; p=0.0001*), CI-S (2.35±1.41; p=0.0001*) and OHI-S (3.90±2.39; p=0.0001*) among cases also support the aforementioned results.

A remarkable observation of the study was that pocket depth of ≥6 mm was observed more among cases, while significantly higher percentage of controls had bleeding, calculus and pocket depth of 4-6 mm (p=0.0001*). In addition, significant percentage of cases had LOA of ≥6 mm, compared to controls (p=0.001*). These results further rationalize the significant difference in the CPI (p=0.0001*) and LOA (p=0.0001*) mean scores among cases (3.69±0.57 and 1.82±1.15, respectively) and controls (2.97±0.74 and 0.63±0.80, respectively), with cases showing poor periodontal status. On the other hand, research by Johansson SC et al among Swedish population, reported a significantly higher percentage of sites with bleeding on probing (p=0.009*) and periodontal pockets with 4-6mm probing depth (p=0.007*) among patients with CHD compared to controls (32). Conversely, results of a similar Indian study were in accordance with the present study wherein cases had significantly (p≤0.05*) higher mean CPI and LOA scores indicating a poor periodontal status among them (19). Another notable finding of the study was, the cases had significant more number of mean sextants with pocket and LOA of ≥4mm (p≤0.05). In congruence were the results of a study by Parker et al, where cases had significant poor oral hygiene scores and higher mean sextants with CPI code 3,4 and LOA code 2,3 (20).

Prevalence of debris, calculus, deeper pockets and severe loss of attachment among cases is indicative of a long standing and established form of periodontal disease, validating its role as a risk factor for CHD (20). These pockets act as ideal niche for bacterial lodgement, resulting in bacteraemia and inflammation. This proves that, severe periodontitis is associated with greater thickness of carotid arterial lining, supporting its role in formation of atheromas and consequent coronary heart diseases (20, 30, 31, 33).

When strength of association between oral risk factors and occurrence of CHD was accounted (i.e., among cases), poor oral hygiene and periodontal health

showed a significantly (p≤0.05) higher risk for CHD. Zanella et al, reported that age and gender were associated with the presence of CHD (14). On the contrary, the present study did not confirm these findings, which could be due to variation in the inclusion criteria. Further, the multivariate logistic regression analyses confirmed the cumulative effect of other potential risk factors like lower frequency of dental visit and brushing, tobacco and alcohol habits on the incidence of the disease. These findings were similar to many other studies conducted worldwide (12, 13, 19, 21, 27, 30).

Considering the entire study sample as a unit, irrespective of both cases and control group, it was observed that oral health and periodontal status worsened with increasing age. Male participants had poor oral hygiene and periodontal status compared to females. This could be attributed to the fact that younger individuals and females are more concerned about their aesthetics in both personal and social context and hence, may exercise proper oral hygiene practices.

Well-defined and pair-matched case and control groups are strengths of this study. Exclusion of participants with diabetes mellitus, a major confounding factor for both the diseases (CHD and periodontal disease) and confirmation of CHD with angiography by a cardiologist are other strengths. However, the present study acknowledges few limitations. Firstly, the sample comprised of individuals with low socio-economic status, using a public health service. Single hospital based study design may further limit the generalisation of the results which could be overcome by replicating the study in a homogenous group, representative of the larger national population.

Conclusion

The results of this study conclude that periodontal disease and poor oral health have a significant role in the pathogenesis of CHD. Crucial events that follow periodontal diseases are increased inflammation and coagulation. Other contributors like lower education, tobacco and alcohol use, and poor oral hygiene behaviour further accentuate the risk of CHD among periodontitis patients. This study finding is especially important for Indian population, where more than half of the population is suffering with periodontitis. Hence, suitable preventive and treatment strategies are recommended to combat the epidemic of CHD.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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