

ORIGINAL ARTICLE

Relationship of Cardiac Disease with Oral Health: A Single Centre Study

Javed Ashraf¹, Rana Modassir Shamsher Khan², Khawaja Rashid Hassan³, Muhammad Rizwan⁴, Ali Saad Tariq⁵, Sarah Ashraf⁶

ABSTRACT:

Objective: To observe relationship of chronic dental and oral morbidity with cardiovascular disease in Pakistani population. **Materials and Methods:** All indoor cardiac patients aged 40 and above, clinically and angiographically diagnosed with CHD at Islam Central Hospital, Sialkot, were included in the study. Demographic and clinical data (Age, Gender, Smoking, and Diabetes) were noted from patients' hospital record files. Missing teeth were examined and number of teeth missing was estimated from the number of teeth remaining in the mouth upon clinical examination. Attendants without a history of cardiac disease, of the cardiac patients who agreed to be included in the study, were examined for comparison of tooth loss. **Results:** Nine hundred and thirty six cardiac patients and 595 healthy attendants with mean age of 51.9 ± 8.4 years were examined. Chronic periodontal disease and mean (\pm SD) tooth loss was significantly ($P < 0.001$) higher in cardiac patients. Odds ratio (OR) = 1.543 was found in cardiac patients when compared with healthy controls (95%CI = 1.985–2.851). Tooth loss was significantly ($P < 0.001$) associated with both males and female cardiac patients especially along with diabetes and smoking. **Conclusion:** Chronic periodontal disease and tooth loss were found to be significantly higher in cardiac disease patients in comparison to healthy controls. Other risk factors found were age, gender, smoking and diabetes.

Keywords: Cardiac patients, Chronic dental morbidity, Oral morbidity

INTRODUCTION:

Non-communicable chronic diseases (NCDs) are presently, causing 80% of deaths in low and middle-income countries including Pakistan¹. Association of poor oral health, periodontal disease and tooth loss with increased risk of cardiovascular diseases (CVD), pulmo-

nary diseases, diabetes and adverse pregnancy outcomes such as low birth weight babies has been observed and established in scientific literature.² Chronic systemic and oral diseases share many common risk factors such as age, gender, education; smoking, diet, and obesity. These are also referred to as "shared risk factors".^{3,4,5} A healthy mouth is a pre-requisite for overall good general health. When oral health is compromised, overall health is also affected.⁶ Tooth loss is common among human beings, and having less than 20 natural teeth is categorized as poor Oral health.⁷ Including other systemic diseases, higher incidence of chronic periodontal disease and tooth loss has also been reported to be significantly associated with cardiovascular disorders in various case-control and cross-sectional studies.^{8,9,10} Tooth loss is found to be associated with CVD on the basis of chronic oral infections, such as chronic periodontal diseases.¹¹ Tooth loss may lead to changes in diet and other behaviors which in turn lead to increased risk for CVD.¹² CVDs are expected to rise as an epidemic in developing countries and projected to be a major cause of death by 2020.¹³ Despite an expected rise in NCDs in Asia and a high prevalence of oral disease, few studies on their association have been conducted in Asiatic region including Pakistan. The purpose of this study was to observe prevalence of tooth loss in cardiac patients of the Pakistani population and to explore its possible association with coronary heart disease.

MATERIALS AND METHODS:

This cross-sectional study was done from 1st Jan, 2014 to 30th June, 2015. Non-probability convenient sampling technique was employed for sample selection. All indoor cardiac patients aged 40 and above clinically and angiographically diagnosed with CHD at Islam Central Hospital, Sialkot, were included in the study. Healthy individuals were taken as control. Demographic and clinical data (Age, Gender, Smoking, and Diabetes) were noted from patients' hospital record files. Missing teeth were examined at bedside with the help of a mouth

✉ Dr. Javed Ashraf

Associate Professor and Head
Department of Community Dentistry
Islam Dental College
Sialkot
E-mail: dr_javedansari110@yahoo.com

✉ Dr. Rana Modassir Shamsher Khan

Associate Professor and Head
Department of Orthodontics
Islam Dental College
Sialkot

✉ Dr. Khawaja Rashid Hassan

Assistant Professor and Head
Department of Dental Materials
Islam Dental College
Sialkot

✉ Dr. Muhammad Rizwan

Associate Professor
Department of Oral Pathology
Islam Dental College
Sialkot

✉ Dr. Ali Saad Tariq

Assistant Professor and Head
Department of Oral Biology
Islam Dental College
Sialkot

✉ Dr. Sarah Ashraf

House Officer
Montmorency College of Dentistry
Lahore

Received: 15-01-2016

Revised: 17-02-2016

Accepted: 20-02-2016

mirror and tweezers. The number of teeth missing was estimated from the number of teeth remaining in the mouth upon clinical examination. Attendants without a history of cardiac disease, of the cardiac patients who agreed to be included in the study, were examined for comparison of tooth loss. Study subjects with other chronic systemic diseases, such as chronic obstructive pulmonary disease (COPD), chronic arthritis, chronic liver disease, and kidney diseases were excluded from the study. Data was analyzed using SPSS version 19. Summary statistics were calculated through descriptive analysis; independent t-test was applied for comparison of tooth loss between cardiac and healthy subjects. For comparisons of categorical variables, chi-square test was applied. Subjects were grouped into smoker–diabetic and nonsmoker–nondiabetic for a comparison of tooth loss. Multivariate regression models were fit to observe the association of tooth loss and CHD and confounding factors.

RESULTS:

During a nine-month study period, 1531 subjects were examined. Subjects' age ranged from 40 to 70 years and the mean age was 52.0 ± 8.4 years; 936 were CHD patients with a mean age of 53.7 ± 8.4 years, and 595 were healthy individuals with a mean age of 49.1 ± 7.7 years. Seventy four percent were cardiac patients and 58% healthy subjects were males. Thirty seven percent of cardiac patients and 20.5% healthy individuals were smokers. Thirty six percent were diabetics among cardiac patients as compared with 16.5% among healthy individuals. There was a statistically significant ($p < 0.001$) difference among cardiac patients and their healthy attendants with Odds ratio 2.82 (CI = 2.287-3.512), 2.036 (CI = 1.612-2.572) and 2.840 (CI = 2.202-3.663) healthy genders, smokers and diabetic subjects, respectively (Table 1).

The main variable of this study, tooth loss, was found in 1242 (81%) subjects of the study sample. Subjects with at least one missing tooth showed a mean (\pm SD) tooth loss 8.8 ± 8.5 . CHD patients showed a mean tooth loss of 9.8 ± 9.2 and healthy subjects had a mean tooth loss of 7.0 ± 6.9 ; the difference was statistically significant ($p < 0.001$). Seventeen percent of CHD patients had all natural teeth as compared with 33% healthy individuals. CHD patients were at OR of 1.54 (CI = 1.192-1.197) for having more tooth loss as compared with healthy individuals. Seventy eight percent of subjects showed tooth loss in the range of 1-15 teeth and 88% of subjects showed 2 teeth losses up to 20 teeth. Thirteen percent CHD patients as compared with 4% of healthy individuals had 21-32 teeth lost (Table 2).

Tooth loss analysis among genders showed that a mean tooth loss in CHD (56%) and healthy (21%) males was 7.1 ± 8.4 and 4.4 ± 6.5 , respectively, with a significant difference ($p < 0.001$). Mean tooth loss among CHD (42%) and healthy (46%) females was 11.5 ± 10.2 and 6.4 ± 6.8 respectively, with a statistically significant difference ($p < 0.001$). CHD males with tooth loss had an OR of 1.78 (CI = 1.307-2.427) and CHD females had an OR of 2.79 (CI = 1.521-5.148) (Table 3).

Among smoker-diabetic subjects, 67% of cardiac patients were presented with a mean tooth loss of 8.8 ± 9.3 as compared with 13% of healthy individuals with a mean tooth loss of 4.7 ± 6.00 ($p = 0.014$). Nonsmoker-nondiabetic CHD (40%) and healthy (40%) subjects were found with a mean tooth loss of 8.0 ± 8.6 and 7.3 ± 8.5 , respectively. Smoker-diabetic patients with tooth loss (OR = 2.246; CI = 1.789-6.394) had higher risk for CHD (Table 3).

Table 4a presents an age-related pattern of tooth loss prevalence in cardiac and healthy subjects. Forty to fifty five year old subjects showed a significantly higher tooth loss ($p = 0.015$) in cardiac patients with an OR of 1.396 (CI = 1.046-1.863). Mean tooth loss showed a steady increase in age groups 40-49 years (3.9 ± 5.2), 50-59 years (7.7 ± 8.2), and P60 years ($12.9-10.8$), however, statistical differences were insignificant in all age cohorts.

In multivariate regression analysis, coefficient was positive and a higher code for smoking was 1, the OR was 1.33; higher code for diabetes was 1 and the OR was 3.50; higher code for genders was 1 and the OR was 3.24; higher code for tooth loss was again 1 and the OR was 1.45. It can be significantly concluded that cardiac patients with smoking, diabetes, male gender and tooth loss were at higher risk as compared with healthy individuals.

Logistic regression model adjusted for all risk factors of CHD noted in this study showed that tooth loss P 1 teeth ($p = 0.010$), 620 teeth ($p = 0.024$) and >20 teeth ($p < 0.001$) are statistically significant predictors of CHD. Adjusted OR for tooth loss 620 teeth and >20 teeth were 1.39 (95%CI = 1.04–1.78) and 3.52 (95%CI = 2.01–6.18) (Table 4b).

DISCUSSION:

This cross-sectional study on the topic from Pakistan has found a statistically significant difference in tooth loss between cardiac and healthy subjects. An association of tooth loss with prevalent coronary heart disease is observed in this study that supports previous studies on the relationship of tooth loss and cardiac conditions.^{8,10,11,14,15}

Demographic data of the study sample shows that males, diabetics and smokers were more than twice (OR P 2.036; CI = 1.612–2.572) at risk of CHD as compared with the healthy individuals. Males were significantly higher than females in the CHD group; whereas there was no difference in male–female ratio in the healthy group. Age is the constant and most commonly reported factor associated with missing teeth.^{16,17} Tooth loss difference is found in genders; in particular, males have less number of teeth.¹⁸ This study has noted a monotonous relationship between increasing tooth loss and advancing age in CHD/non-CHD individuals who were closely related with respect to their socioeconomic status (SES) background, and this finding corresponds with another contemporary study.¹⁹ The current study showed that CHD males with tooth loss were twice the number of CHD females; however a mean tooth loss was much higher in females. These findings also correspond with other studies.^{20,21} In the current study, incidence of tooth

Table: 1
Summary statistics of cardiac and healthy subjects

Variables	Cardiac n (%)	Healthy n(%)	Total	P-value/OR (CI=95%)
Study Sample	936(61)	595(39)	1531(100)	
Age				
Mean	53.7 + 8.4	49.1 + 7.7	52 + 8.4	< 0.001a
Range	40-70			
Male	692(74)	298(50)	990(65)	< 0.001/2.827b
Female	244(26)	297(50)	541(35)	
Smokers	348(37)	134(22.5)	482 (31.5)	
Non-Smokers	588(63)	461(77.5)	1049(68.5)	< 0.001/2.036b
Diabetics	336(36)	98(16.5)	434(28)	
Non-Diabetics	600(64)	497(83.5)	1097(72)	< 0.001/2.840b

a = Students T-test.
b =Chi-Square Test.

Table :2
Cardiac and Healthy subjects compared for tooth loss

Variables	Cardiac	Healthy	Total	P-value
Tooth loss				
Mean± SD	9.8 ± 9.2	7.0 ± 6.9	8.7 ± 8.5	< 0.001 ^a
Subjects with tooth loss				
n(%)	n(%)	n(%)	n(%)	n(%)
> 1 tooth	784(84)	458(77)	1242(81)	< 0.01 ^b
2-15 teeth	606(65)	373(63)	979(79)	< 0.01 ^b
16-32 teeth	178(19)	85(14)	263(21)	NS

a=T-test.
b=Chi-square.
NS = Not-Significant

Table: 3
Cardiac and healthy subjects with tooth loss compared among genders, smokers, non-smokers, diabetics, non-diabetics

Variables	Cardiac	Healthy	Total	P-value
Males				
N= 990				
N (%)	555(56)	207(23)	762(79)	< 0.01 ^b
Mean ± SD	7.1 ± 8.4	4.4 ± 6.5	6.2 ± 7.9	< 0.01 ^a
Females				
N=541				
N (%)	229(42)	251(46)	480(88.7)	< 0.01 ^b
Mean ± SD	11.5 ± 10.2	6.4 ± 6.8	8.8 ± 8.9	< 0.01 ^a
Smokers and Diabetics				
N (%)	77(67)	15(13)	92(80)	< 0.02 ^b
Mean ± SD	8.8 ± 9.3	4.7 ± 6.0	8.0 ± 8.8	< 0.01 ^a
Non-smokers and Non-Diabetics				
N (%)	290(40)	291(40)	581(79.6)	NS ^b
Mean ± SD	8 ± 8.6	7.3 ± 8.2	7.8 ± 8.5	NS ^a

a = Independent T-test.
b = Chi-Square test.
NS= Non-significant.

Table: 4a
Cardiac and Healthy subjects compared for tooth loss in different age group

Variable	Cardiac	Healthy	Total	P-Value/OR (CI 95%)
40-55 years (n=1046)				
n%	451	354 (34)	805 (77)	<0.050/1.396 (1.046-1.863) ^b
Mean ± SD	5.7±7.0	4.1 ± 5.2	5.0 ± 6.3	<0.001 ^a
56+years (n=485)				
n%	333 (69)	104 (21)	437 (90)	NS ^b
Mean ± SD	12 ± 10.6	10.42 ± 9.6	11.6 ± 10.3	NS ^a
40-49 years (n=615)				
n%	207 (34)	241 (39)	448 (73)	NS ^b
Mean ± SD	3.9 ± 5.2	3.3 ± 4.0	3.6 ± 4.6	NS ^a
50-59years (n=538)				
n%	307 (57)	141 (26)	448 (83)	<0.050/1.665 (1.049-2.643)
Mean ± SD	7.7 ± 8.2	6.3 ± 7.0	7.2 ± 7.8	NS ^a
60+years (n=378)				
n%	270 (71)	76 (20)	346 (91.5)	NS ^b
Mean ± SD	12.9 ± 10.8	11.6 ± 9.9	12.7 ± 10.6	NS ^a

NS: nonsignificant
a Stands for Independent t-test
b Stands for Chi square test

Table: 4b
Multivariate Logistic regression models for CHD/non-CHD subjects.

Variable	OR(CI=95)	P-value
Tooth Loss		
No	1	< 0.01
1 tooth	1.45	< 0.01
2-20 teeth	1.39	< 0.03
>20 teeth	3.52	
Smoking		
No	1	< 0.01
Yes	1.33	< 0.01
Diabetes		
No	1	< 0.01
Yes	3.5	< 0.01
Gender		
Female	1	< 0.01
Male	3.24	< 0.01

loss was noted significantly higher in subjects with diabetes and smoking, which are the most important confounding factors associated with cardiac diseases; and the Odds Ratio associated with cardiac patients was more than two times than the non-cardiac subjects. CHD subjects with diabetes and smoking having missing teeth, were five times higher in number and two times higher with a mean tooth loss than the healthy subjects. These results support the previous studies^{22,23} showing that smoking and diabetes significantly contribute to tooth loss. However, cardiac patients of this study remained 1.232 times at higher risk for tooth loss, and this association was observed independent of confounding factors. Tooth loss (partial/total) is the dental equivalent of death, and tooth loss diminishes quality of life, often substantially.¹¹ The findings of studies on tooth loss and systemic diseases provide a clue that tooth loss may be considered as one of the

important components of oral diseases that affects the general health of the people.

Desvarieux²⁴ reported that greater the number of teeth lost, the greater the extent of severe periodontal disease; in turn the severity of periodontal disease is associated with increased risk of CHD.²⁵ Correspondingly, other previous studies^{8,10,11} have reported on the risk of myocardial infarction, stroke and prevalent coronary heart disease in relation to tooth loss. The findings emerging from this study analysis explained a relationship between tooth loss and cardiac diseases and partially/fully confirmed from other studies on the same topic.^{26,27,28,29}

The association of tooth loss, as observed in this study, with CHD and previous periodontal disease may be a significant public health problem because of the higher prevalence of the periodontal disease in the general public of developing countries.³⁰ Tooth loss distribution and risk association in individuals with and without cardiac diseases in this study provides a good reason for conducting such studies in developing countries like Pakistan where oral health is not a priority for the country stakeholders and the public at large where non-communicable diseases also show a steep rise.³¹ This study illustrates that total tooth loss is a risk indicator for established CHD and confirms that some classical risk factors associated with an increase in CHD risk are also associated with the increased likelihood of tooth loss. Other risk factors for tooth loss, such as education and income, could not be included in this study; these may be considered as limitations.

CONCLUSION:

Chronic periodontal disease and tooth loss were found to be significantly higher in cardiac disease patients in comparison to healthy controls. Other risk factors found were age, gender, smoking and diabetes.

Conflict of interest: No conflict of interest by the authors.

REFERENCES:

1. Strong K, Mathers C, Leeder S, Beaglehole R. Preventing chronic diseases: how many lives can we save? *Lancet* 2005;366(9496):1578-82
2. Joshipura KJ, Ritchie C, Douglass C. Strength of evidence linking oral conditions and systemic disease. *Compendium* 2000;21(Suppl 30):13-23
3. Page RC. The pathology of periodontal diseases may affect systemic diseases: inversion of a paradigm. *Annals Periodontol* 1998;3(1):13-23
4. DeBowes LJ. The effects of dental disease on systemic disease. *Vet Clin North Am Small Anim Pract* 1998;28(5):1057-62
5. Seymour RA, Preshaw PM, Steele JG. Oral health and heart disease. *Prim Dent Care* 2002;9(4):125-31
6. Gift H. Issues of aging and oral health promotion. *Gerodontics* 1988;4:194-206
7. Beck JD, Slade G, Offenbacher S. Oral disease, cardiovascular disease and systemic inflammation. *Periodontol* 2000;23:110-20
8. Destefano F, Anda RF, Kahn HS, Williamson DF, Russell CM. Dental Diseases and risk of coronary heart disease and mortality. *Br Med J* 1993;306:668-91
9. Okoro CA, Balluz LS, Eke PL, Ajani UA, Strine TW, Town M, et al. Tooth loss and heart diseases: findings from the Behavioral Risk Factor Surveillance System. *Am J Prev Med* 2005;29(5 suppl 1):50-6
10. Paunio K, Impivaara O, Tiesko J. Missing teeth and ischemic heart disease in men aged 45–64 years. *Eur Heart J* 1993;14(Suppl. K):54-6
11. Loesche WJ. Periodontal disease as a risk factor for heart disease. *Compendium Continuing Edu Dent* 1994;15:976-91
12. Joshipura KJ, Hu FB, Manson JE, Stampfer MJ, Rimm EB, Speizer FE, et al. The effect of fruit and vegetable intake on risk for coronary heart disease. *Ann Intern Med* 2001;134:1106-14
13. Bokhari SAH, Khan AA. Growing burden of non-communicable diseases: the contributory role of oral diseases, Eastern Mediterranean region perspective. *Eastern Mediterranean Health J* 2009;15:1011-20
14. Joshipura KJ, Douglass CW, Willet WC. Possible explanations for the tooth loss and cardiovascular disease relationship. *Ann Periodontol* 1998;3:175-83
15. Ylostalo PV, Jarvelin MR, Laitinen J, Knuutila ML. Gingivitis, dental caries and tooth loss: risk factors for cardiovascular diseases or indicators of elevated health risks. *J Clin Periodontol* 2006;3(2):92-101
16. Katz R, Gustavsen F. Tooth mortality in dental subjects in a US urban area. *Gerodontics* 1986;2:104-7
17. Douglass CW, Jette AM, Fox CH, Tennsted SL, Joshi A, Feldman HA, et al. Oral health status of elderly in New England. *J Gerontol* 1993;48:M 39-46
18. Hamasha AH, Sasa I, Al Qudah M. Risk indicators associated with tooth loss in Jordanian adults. *Community Dent Oral Epidemiol* 2000;28:67-72
19. Andriankaja OM, Genco RJ, Dorn J, Dmochowski J, Hovey K, Falkner KL, et al. The use of different measurements and definitions of periodontal disease in the study of the association between periodontal disease and risk of myocardial infarction. *J Periodontol* 2006;77(6):1067-73
20. Slade GD, Gansky SA, Spencer AJ. Two-year incidence of tooth loss among South Australian aged 60+ years. *Community Dent Oral Epidemiol* 1997;25:429-37
21. Lukacs JR. Gender differences in oral health in South Asia: metadata imply multifactorial biological and cultural causes. *Am J Hum Biol* 2011 May;23(3):398-411
22. Holm G. Smoking as an additional risk factor for tooth loss. *J Periodontol* 1994;65:996-1001
23. Ueno M, Takeuchi S, Oshiro A, Shinada K, Ohara S, Kawaguchi Y. Association between diabetes mellitus and oral health status in Japanese adults. *Int J Oral Sci* 2010;2:82-9
24. Desvarieux M, Demmer RT, Rundek T, Boden-Albala B, Jacobs Jr DR, Papapanou PN, et al. Relationship between periodontal disease, tooth loss, and carotid artery plaque: the Oral Infections and Vascular Disease Epidemiology Study (INVEST). *Stroke* 2003;34(9):2120-5
25. Holmlund A, Holm G, Lind L. Severity of periodontal disease and number of remaining teeth are related to the prevalence of myocardial infarction and hypertension in a study based on 4, 254 subjects. *J Periodontol* 2006;77(7):1173-8
26. Steele JG, Sanders AE, Slade GD, Allen PF, Laltis, Nuttal N, et al. How do age and tooth loss affect oral health impacts and quality of life? A study comparing two national samples. *Community Dent Oral Epidemiol* 2004;32(2):107-14
27. Shah SA, Khitab U, Chughtai MA, Khan AS. Causes of dental extractions among 2000 patients—a study at oral and maxillofacial surgical unit, Khyber College of Dentistry. Peshawar-Pakistan *Pak Oral Dent J* 2004;24(2):209-12
28. Desvarieux M, Schwahn C, Volzke H, Demmer RT, Ludemann J, Kessler C, et al. Gender differences in the relationship between periodontal disease, tooth loss, and atherosclerosis. *Stroke* 2004;35:2029-35
29. Buhlin K, Gustafsson A, Ahnve S, Janszky I, Tabrizi F, Klinge B. Oral Health in women with coronary heart disease. *J Periodontol* 2005;76(4):544-50
30. Desvarieux M. Periodontal disease, race, and vascular disease. *Compend Contin Educ Dent* 2001;22(3 Spec):34-41
31. Boutayeb A, Boutayeb S. The burden of non-communicable diseases in developing countries. *Inter J Equity Health* 2005;4:2 doi: 10.1186/1475-9276-4-2

