

CORRELATION BETWEEN CARDIOVASCULAR DISEASES AND PERIODONTITIS - A RETROSPECTIVE STUDY

Padmaharish V¹, Deepika Rajendran², Deepa G³

Abstract

Periodontitis is a chronic inflammatory disease caused by bacterial colonization, which results in destruction of the tissues between the tooth surface and gingiva, loss of connective tissue attachment, erosion of alveolar bone, and tooth loss. There is much evidence stating that prevalent periodontitis is associated with increased coronary heart disease risk. Thus there is a need to evaluate the extent to which the strength of this association has been established. The aim of this study was to evaluate the correlation between cardiovascular diseases and periodontitis. A retrospective study was conducted using the patient records from a private dental college from June 2019 - March 2020. The study population included the case records of cardiovascular disease patients, selected by non-probability purposive sampling. Data was collected and then subjected to statistical analysis. Microsoft Excel 2016 (Microsoft office 10) data spreadsheet was used to collect data and later exported to SPSS IBM (version 20.0). Descriptive statistics and chi square test were employed with a level of significance set at $p < 0.05$. The prevalence of periodontitis among cardiovascular patients was 81.47%. Among patients with CVD, 78.06% of hypertension patients, 3.41% of MI patients and 0.22% patients with other cardiac diseases had periodontitis. Within the limits of this study, there was a significant correlation between CVD and periodontitis ($p = 0.000$), with a higher prevalence among hypertension patients. Patients with periodontitis are at an increased risk for cardiovascular diseases. The systemic inflammatory or immune response to periodontal infection may increase cardiovascular risk. Thus proper oral hygiene practices are important in maintaining overall health.

Keywords : Cardiovascular disease; Hypertension; Myocardial Infarction; Periodontitis.

Introduction

Dentofacial problems are known to cause negative effects over the patients satisfaction with their dentition[5,6]. Single teeth can be restored to full function, and improvement in cosmetic effect can be achieved. The health of the oral cavity can have wide-reaching effects on overall health. Poor oral health may occur concomitantly with a more serious underlying disease process or may predispose an individual to other health conditions. Protecting oral health is therefore critical in maintaining overall health[1].

Periodontium refers to the supporting structures around the tooth - namely gingiva, cementum, periodontal ligament and alveolar bone. Periodontitis, one of the most ubiquitous diseases, is characterized by the

¹ Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India, Email : 151501080.sdc@saveetha.com

² Senior lecturer, Department of Oral Medicine and Radiology, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India, Email : deepikar.sdc@saveetha.com

³ Professor and Head, Department of Pedodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India, Email : deepag@saveetha.com

destruction of connective tissue and dental bone support following an inflammatory host response secondary to infection by periodontal bacteria[2]. Almost all forms of periodontal disease occur as a result of mixed microbial infections within which specific groups of pathogenic bacteria coexist. Various risk factors are associated with periodontal disease which can be either modifiable and non modifiable. These include microorganisms, tobacco smoking, diabetes mellitus, cardiovascular disease, drug-induced disorders, stress, obesity, hematological disorders, host response, pregnancy, female hormonal alterations, and osteoporosis[3]

Cardiovascular diseases (CVD), including acute myocardial infarction and angina pectoris are major health problems in developing countries, and are considered amongst most common medical problems in the general population.[4] Smoking, serum cholesterol concentration, hypertension, diabetes and genetics are significant risk factors for the development of cardiovascular disease.[5] Other risk factors include viral and bacterial infection, which can precipitate a myocardial infarction (MI) in certain susceptible people. Evidence is now emerging that oral health, in particular the periodontal diseases, may also be a significant risk factor for the development of CVD[6].

Periodontitis associated with extensive plaque and calculus deposits are most prevalent and severe in developing countries and in populations with limited access to health education and dental care[7]. Mild forms of periodontal disease affect 75% of adults, and more severe forms affect 20 to 30% of adults. Since periodontal disease is common in the population, it may account for a significant portion of proposed infection-associated risk for CVD[8].

Cardiovascular disease affects millions of individuals globally with a marked increase in geriatric population. Since this population group is increasing in number and since more elderly individuals are dentate than in the past, there is also an increased incidence of periodontitis in this patient group[9].

This evidence coupled with recent evidence of linking periodontitis to coronary heart disease suggest the need to evaluate the extent to which the strength of this association has been established[10,11,12].

Previously our team had conducted numerous clinical trials [13,14,15,16,17,18], in-vitro studies [19,20,21] and systematic reviews [22,23,24,25,26,27] for the past five years. Now we are focussing on epidemiological studies. The idea for this study stemmed from the current interest in our community. Thus, the aim of this study was to evaluate the correlation between cardiovascular diseases and periodontitis.

MATERIALS AND METHODS

Study design and setting

This pilot retrospective study examined the records of patients who underwent treatment from June 2019 - April 2020 at a private dental college. Ethical approval was obtained from the Institutional Ethics Committee of the University (SDC/SIHEC/2020/DIASDATA/0619-0320). The study population included case records of patients who had a history of cardiovascular diseases, selected by non-probability purposive sampling. Patients without cardiovascular diseases, patients with other systemic illness, completely edentulous patients and denture wearers were excluded from the study.

Data collection

Case records of 3586 patients who had cardiovascular diseases were reviewed and analysed for the presence of periodontitis. Relevant data such as patient age, sex, type of cardiovascular disease and history of periodontitis were recorded. Repeated patient records and incomplete records were excluded. The final dataset consisted of 2288 patients of Indian origin who had a history of cardiovascular disease. Data was verified by an external reviewer.

Statistical analysis

Data was recorded in Microsoft Excel 2016 (Microsoft office 10) and later exported to the Statistical Package for Social Science (SPSS IBM version 20.0) and subjected to statistical analysis. Descriptive statistics and chi square test were employed with a level of significance set at $p < 0.05$.

RESULTS

The age group of cardiovascular disease patients included in the study were as follows, below 30 years - 8.22%, 30 to 60 years - 61.49%, 60 to 90 years - 30.29% [Figure 1].

About 46.11% were females and 53.89% were males, showing a male predilection towards CVD [Figure 2].

The various cardiovascular diseases prevalent among the patients were hypertension - 95.63%, Myocardial infarction - 4.15% and other cardiac diseases - 0.22% [Figure 3].

The prevalence of periodontitis among cardiovascular patients was 81.47% [Figure 4].

Among patients with CVD, 78.06% of hypertension patients, 3.41% of MI patients and 0.22% patients with other cardiac diseases had periodontitis. Chi square test showed a significant association between cardiovascular diseases and the prevalence of periodontitis ($p < 0.05$) [Figure 5].

About 7.04% of patients with CVD below 30 years, 50.44% of patients between 30 to 60 years and 23.99% of patients between 60 to 90 years had periodontitis. Chi square test showed that there was no significant association between age and the prevalence of periodontitis among CVD patients ($p > 0.05$). The prevalence of periodontitis was higher among CVD patients between 30 to 60 years of age [Figure 6].

Among patients with CVD, about 43.84% of males and 37.63% of female patients had periodontitis. Chi square test showed that there was no significant association between gender and the prevalence of periodontitis among CVD patients ($p > 0.05$). Male patients with CVD had a higher prevalence of periodontitis when compared to females [Figure 7].

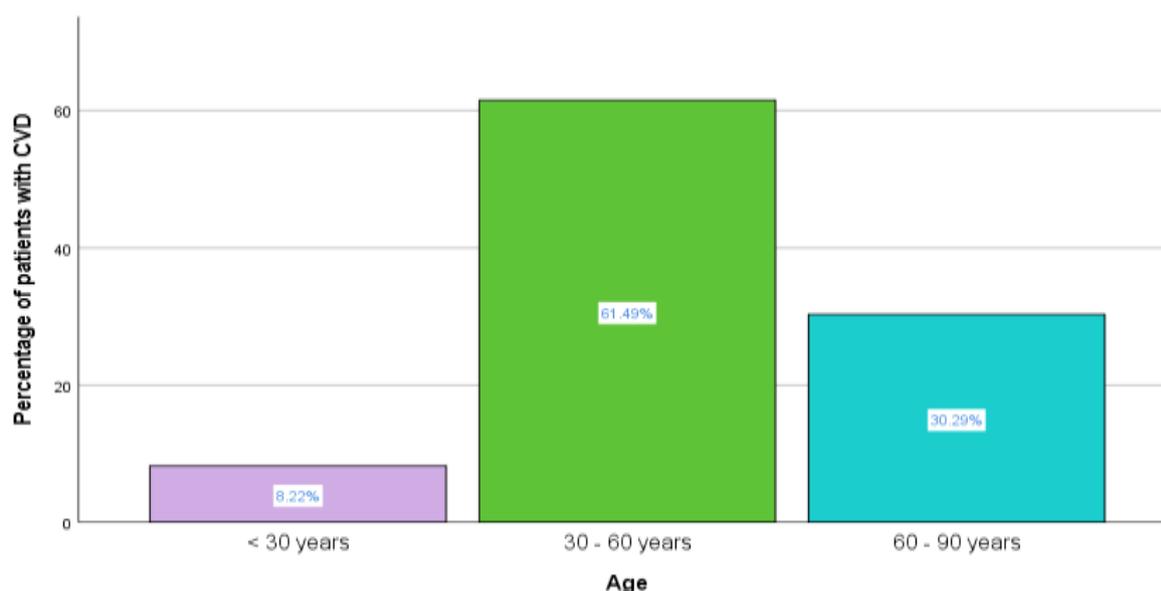


Figure 1 : Bar graph representing the age distribution of patients included in this study. X axis represents the age and Y axis represents the percentage of patients of CVD included in this study. The age group of cardiovascular

disease patients included in the study were as follows, below 30 years - 8.22%, 30 to 60 years - 61.49%, 60 to 90 years - 30.29%.

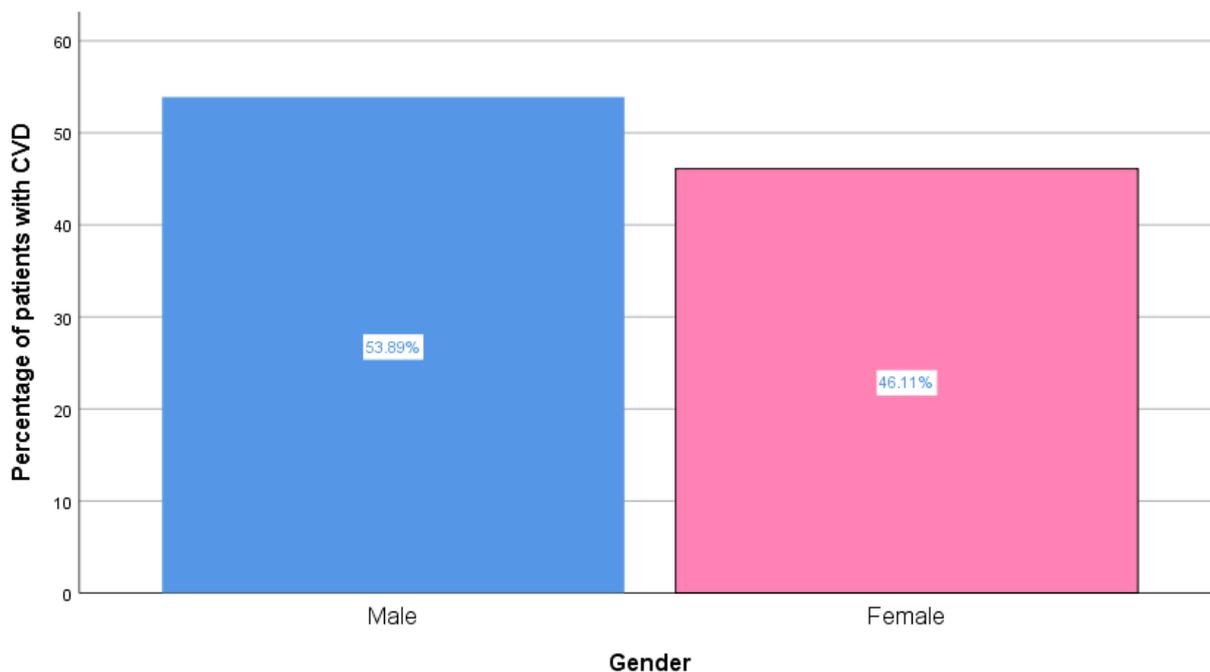


Figure 2 : Bar graph representing the gender distribution among patients. X axis represents the gender and Y axis represents the percentage of patients with CVD included in this study. About 46.11% were females and 53.89% were males, showing a male predilection towards CVD.

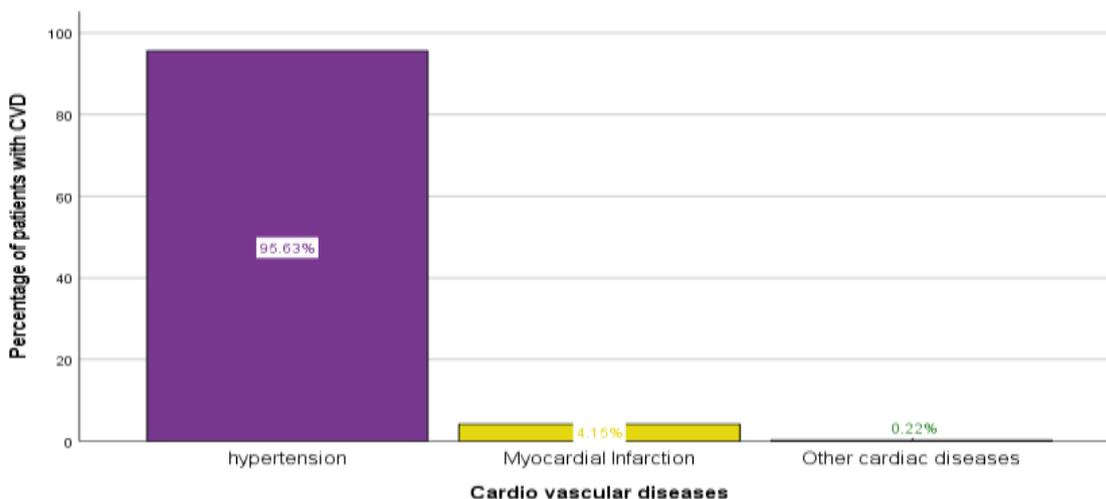


Figure 3 : Bar graph representing the prevalence of various cardiovascular diseases. X axis represents the various cardiovascular diseases and Y axis represents the percentage of patients with CVD included in this study. The various cardiovascular diseases prevalent among the patients were hypertension - 95.63%, Myocardial infarction - 4.15% and other cardiac diseases - 0.22%.

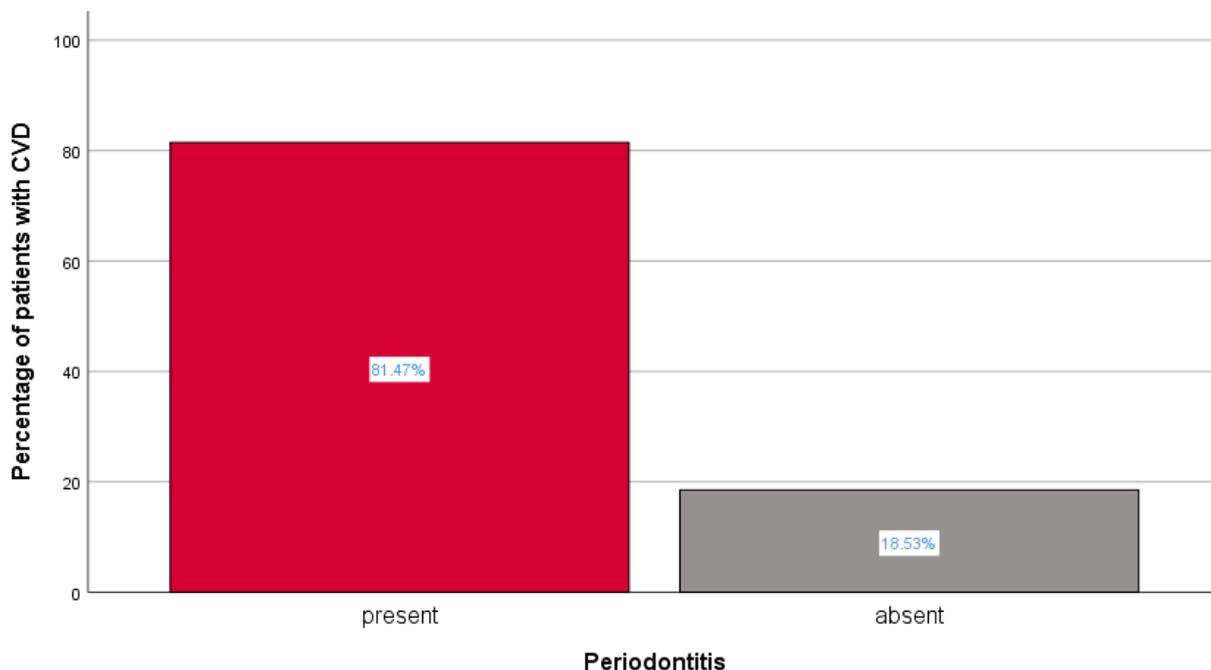


Figure 4 : Bar graph representing the prevalence of periodontitis among CVD patients. X axis represents the prevalence of periodontitis and Y axis represents the percentage of patients with CVD included in this study. The prevalence of periodontitis among cardiovascular patients was 81.47%.

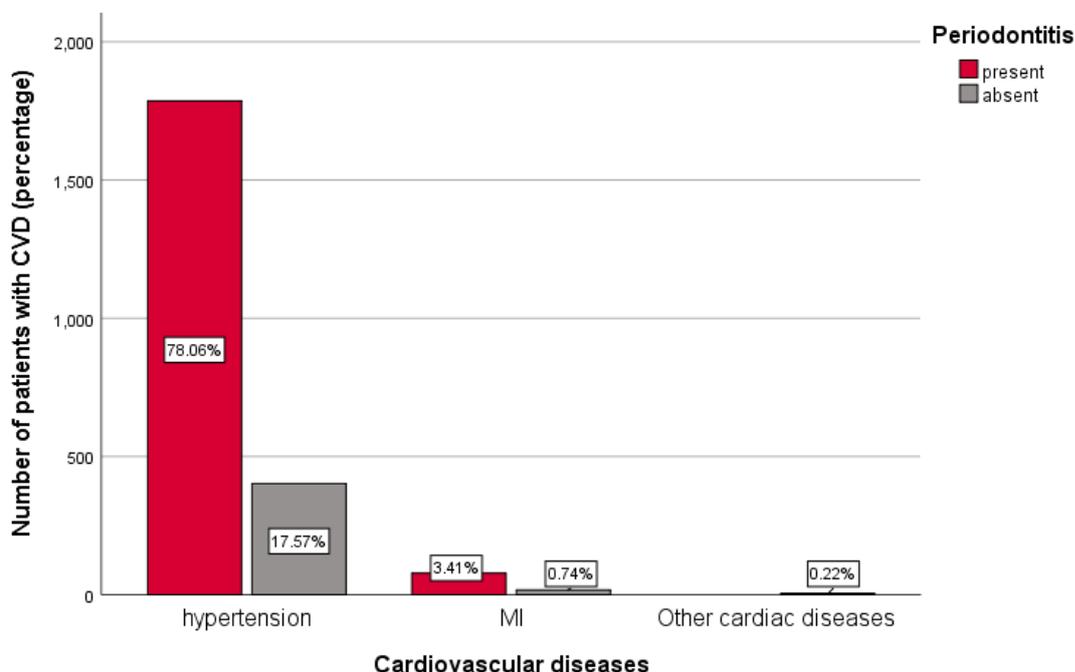


Figure 5 : Bar graph representing the association between cardiovascular diseases and periodontitis. X axis represents the various cardiovascular diseases and Y axis represents the number of patients with CVD (percentage). The prevalence of periodontitis was higher in patients with hypertension, followed by patients with MI and patients with other cardiac diseases. There was a significant association between cardiovascular

diseases and the prevalence of periodontitis (Chi square test). Pearson Chi square value = 22.043; p-value = 0.000

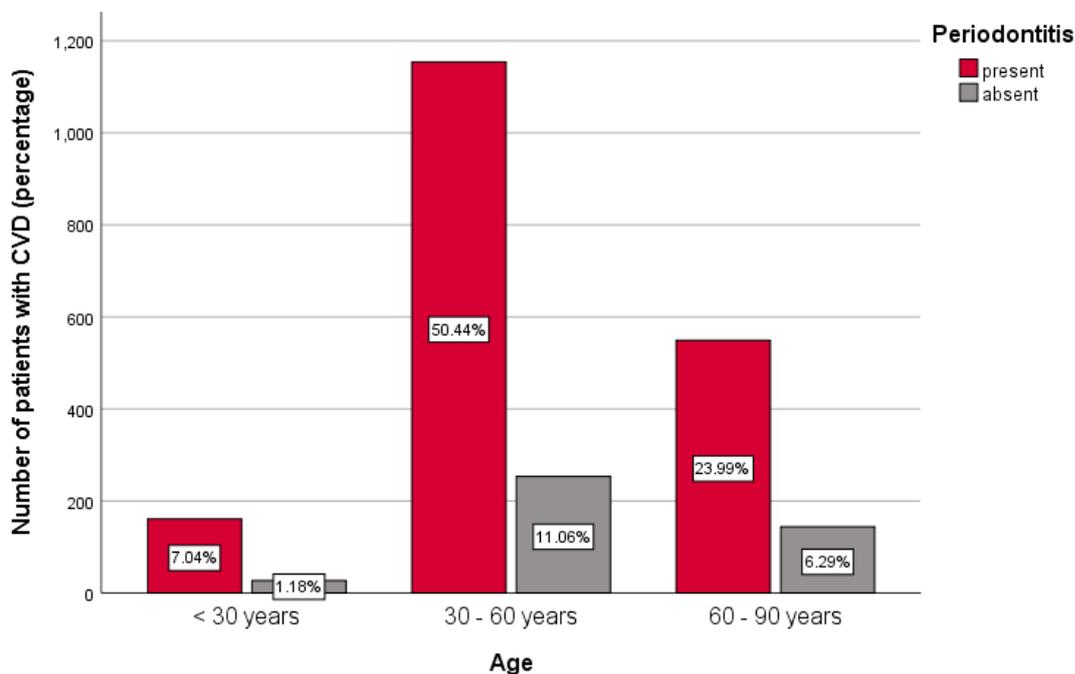


Figure 6 : Bar graph representing the association between age and the prevalence of periodontitis among patients with CVD. X axis represents the age and Y axis represents the number of patients with CVD (percentage). The prevalence of periodontitis was higher among CVD patients between 30 to 60 years of age and least among patients below 30 years. However, there was no significant association (Chi square test). Pearson Chi square value = 4.766; p-value = 0.092

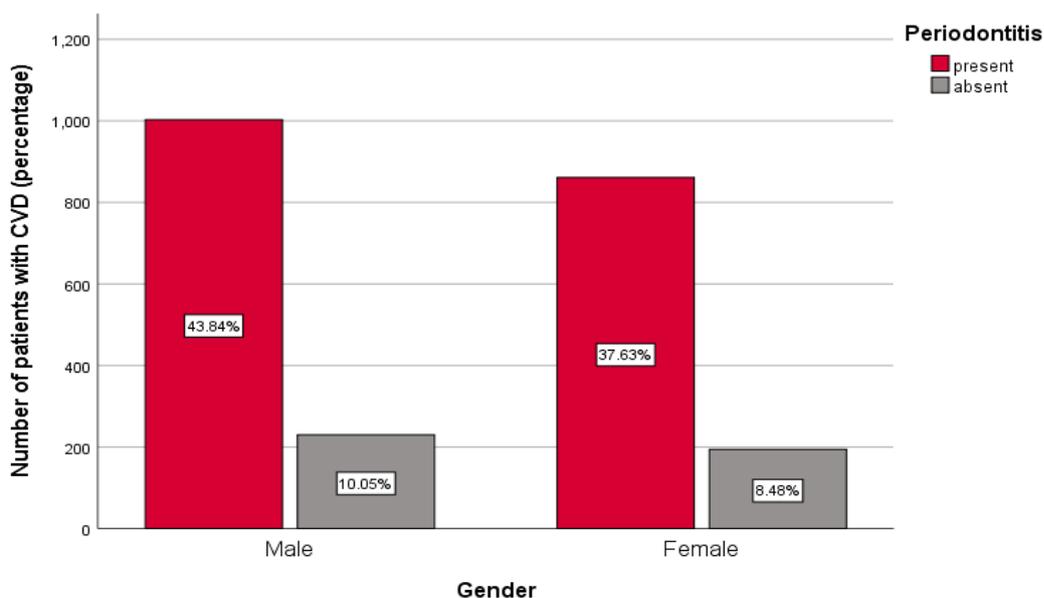


Figure 6 : Bar graph representing the association between gender and the prevalence of periodontitis among patients with CVD. X axis represents the gender and Y axis represents the number of patients with CVD

(percentage). There was no significant association between gender and the prevalence of periodontitis among CVD patients (Chi square test). Pearson Chi square value = 0.026; p-value = 0.871.

DISCUSSION

The data for this retrospective study was based on residents of Chennai seeking treatment at a private dental college in Chennai. Currently there are very few existing studies investigating the association between periodontitis and CVD in the South Indian population.

The results of this study show that the overall prevalence of periodontitis among cardiovascular patients was 81.47% and that there was a significant correlation between CVD and periodontitis. This is in accordance with previous literature. A study by Ketabi et al, showed a strong association between parameters of periodontal disease with cardiovascular disease[28]. Also a study by Heaton B et al[29] and Hyvärinen K et al[30] have proven periodontal infection as a potential risk factor for cardiovascular disease and, in particular, atherosclerosis.

However, a cross-sectional study from Sweden by Frisk et al, reported no such relation between dental infections and cardiovascular disease[31]. The American Heart Association supports the hypothesis that there is an association between periodontitis and atherosclerotic vascular disease, independent of their confounders[32].

Few studies have also shown the association between extent and severity of periodontitis with extent and severity of cardiovascular disease (CVD). Kodovazenitis et al, in a case-control study showed a consistent association between periodontitis and acute MI. The strength of the association increased concomitantly with the robustness of the criteria used to define periodontitis[33].

In a cross-sectional and analytical study by Marfil-Alvarez et al, it was reported the extent and severity of periodontitis is positively associated with the size of Acute Myocardial Infarction in patients who underwent diagnostic coronary angiography[34].

Holmlund and Lind concluded in their investigation that the number of missing teeth was inversely correlated with the number of carotid arteries with atherosclerotic plaques[35].

The results of this study has to be interpreted with the geographic limitation of the study population and the sample size selected. Hence it cannot be generalized to other populations of geographic and cultural variation.

CONCLUSION

Within the limits of this study, there was a significant correlation between CVD and periodontitis ($p=0.000$), with a higher prevalence among hypertension patients. Therefore, proper treatment and good periodontal maintenance could have a positive effect on the stability, severity, and extent of cardiovascular diseases.

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AUTHORS CONTRIBUTION

Padmaharish V contributed to the study conception and design, data collection, analysis and interpretation and drafted the work. Deepika R contributed to data interpretation, study design and data collection. Deepa G contributed to study conception, design and data collection. All authors critically reviewed the manuscript and approved the final version.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

1. Li Y, Lee S, Hujuel P, Su M, Zhang W, Kim J, et al. Prevalence and severity of gingivitis in American adults. *Am J Dent*. 2010 Feb;23(1):9–13.
2. Zheng Y. Genetic risks of periodontal disease [Internet]. Available from: http://dx.doi.org/10.5353/th_b5801679
3. Ostberg AL, Halling A, Lindblad U. Gender differences in knowledge, attitude, behavior and perceived oral health among adolescents. *Acta Odontol Scand*. 1999 Aug;57(4):231–6.
4. AlJehani YA. Risk factors of periodontal disease: review of the literature. *Int J Dent*. 2014 May 20;2014:182513.
5. Armitage GC. Development of a classification system for periodontal diseases and conditions. *Ann Periodontol*. 1999 Dec;4(1):1–6.
6. Salvi GE, Lawrence HP, Offenbacher S, Beck JD. Influence of risk factors on the pathogenesis of periodontitis. *Periodontol* 2000. 1997 Jun;14:173–201.
7. Seymour RA, Steele JG. Is there a link between periodontal disease and coronary heart disease? [Internet]. Vol. 184, *British Dental Journal*. 1998. p. 33–8. Available from: <http://dx.doi.org/10.1038/sj.bdj.4809536>
8. Armitage GC. Periodontology/Oral Medicine: Periodontal infections and cardiovascular disease-how strong is the association? [Internet]. Vol. 6, *Oral Diseases*. 2008. p. 335–50. Available from: <http://dx.doi.org/10.1111/j.1601-0825.2000.tb00126.x>
9. Noack B, Genco RJ, Trevisan M, Grossi S, Zambon JJ, De Nardin E. Periodontal Infections Contribute to Elevated Systemic C-Reactive Protein Level [Internet]. Vol. 72, *Journal of Periodontology*. 2001. p. 1221–7. Available from: <http://dx.doi.org/10.1902/jop.2000.72.9.1221>
10. Baelum V, Fejerskov O, Karring T. Oral hygiene, gingivitis and periodontal breakdown in adult Tanzanians [Internet]. Vol. 21, *Journal of Periodontal Research*. 1986. p. 221–32. Available from: <http://dx.doi.org/10.1111/j.1600-0765.1986.tb01454.x>
11. Genco R, Offenbacher S, Beck J. Periodontal disease and cardiovascular disease [Internet]. Vol. 133, *The Journal of the American Dental Association*. 2002. p. 14S – 22S. Available from: <http://dx.doi.org/10.14219/jada.archive.2002.0375>
12. Kinane DF. Periodontal Diseases' Contributions to Cardiovascular Disease: An Overview of Potential Mechanisms [Internet]. Vol. 3, *Annals of Periodontology*. 1998. p. 142–50. Available from: <http://dx.doi.org/10.1902/annals.1998.3.1.142>
13. Chaitanya NC, Muthukrishnan A, Babu DBG, Kumari CS, Lakshmi MA, Palat G, et al. Role of Vitamin E and Vitamin A in Oral Mucositis Induced by Cancer Chemo/Radiotherapy- A Meta-analysis. *J Clin Diagn Res*. 2017 May;11(5):ZE06–9.
14. Subashri A, Uma Maheshwari TN. Knowledge and attitude of oral hygiene practice among dental students [Internet]. Vol. 9, *Research Journal of Pharmacy and Technology*. 2016. p. 1840. Available from: <http://dx.doi.org/10.5958/0974-360x.2016.00375.9>
15. Steele JC, Clark HJ, Hong CHL, Jurge S, Muthukrishnan A, Ross Kerr A, et al. World Workshop on Oral Medicine VI: an international validation study of clinical competencies for advanced training in oral medicine [Internet]. Vol. 120, *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*. 2015. p. 143–51.e7. Available from: <http://dx.doi.org/10.1016/j.oooo.2014.12.026>
16. Subha M, Arvind M. Role of Magnetic Resonance Imaging in Evaluation of Trigeminal Neuralgia with its Anatomical Correlation [Internet]. Vol. 12, *Biomedical and Pharmacology Journal*. 2019. p. 289–96. Available from: <http://dx.doi.org/10.13005/bpj/1640>
17. Muthukrishnan A, Kumar LB. Actinic cheilosis: early intervention prevents malignant transformation [Internet]. *BMJ Case Reports*. 2017. p. bcr2016218654. Available from: <http://dx.doi.org/10.1136/bcr-2016-218654>
18. Choudhury P. Vanishing Roots: First Case Report of Idiopathic Multiple Cervico–Apical External Root Resorption [Internet]. *JOURNAL OF CLINICAL AND DIAGNOSTIC RESEARCH*. 2015. Available from: <http://dx.doi.org/10.7860/jcdr/2015/11698.5668>
19. Warnakulasuriya S, Muthukrishnan A. Oral health consequences of smokeless tobacco use [Internet]. Vol. 148, *Indian Journal of Medical Research*. 2018. p. 35. Available from: http://dx.doi.org/10.4103/ijmr.ijmr_1793_17

20. Patil SR, Maragathavalli G, Araki K, Al-Zoubi IA, Sghaireen MG, Gudipaneni RK, et al. Three-Rooted Mandibular First Molars in a Saudi Arabian Population: A CBCT Study [Internet]. Vol. 18, *Pesquisa Brasileira em Odontopediatria e Clínica Integrada*. 2018. p. e4133. Available from: <http://dx.doi.org/10.4034/pboci.2018.181.87>
21. Rohini S, Jayanth Kumar V. Incidence of dental caries and pericoronitis associated with impacted mandibular third molar-A radiographic study [Internet]. Vol. 10, *Research Journal of Pharmacy and Technology*. 2017. p. 1081. Available from: <http://dx.doi.org/10.5958/0974-360x.2017.00196.2>
22. Venugopal A, Maheswari TNU. Expression of matrix metalloproteinase-9 in oral potentially malignant disorders: A systematic review [Internet]. Vol. 20, *Journal of Oral and Maxillofacial Pathology*. 2016. p. 474. Available from: <http://dx.doi.org/10.4103/0973-029x.190951>
23. Maheswari TNU, Venugopal A, Sureshbabu N, Ramani P. Salivary micro RNA as a potential biomarker in oral potentially malignant disorders: A systematic review [Internet]. Vol. 30, *Tzu Chi Medical Journal*. 2018. p. 55. Available from: http://dx.doi.org/10.4103/tcmj.tcmj_114_17
24. Misra SR, Shankar YU, Rastogi V, Maragathavalli G. Metastatic hepatocellular carcinoma in the maxilla and mandible, an extremely rare presentation. *Contemp Clin Dent*. 2015 Mar;6(Suppl 1):S117–21.
25. Chaitanya NC, Muthukrishnan A, Krishnaprasad CMS, Sanjuprasanna G, Pillay P, Mounika B. An Insight and Update on the Analgesic Properties of Vitamin C. *J Pharm Bioallied Sci*. 2018 Jul;10(3):119–25.
26. Dharman S, Muthukrishnan A. Oral mucous membrane pemphigoid – Two case reports with varied clinical presentation [Internet]. Vol. 20, *Journal of Indian Society of Periodontology*. 2016. p. 630. Available from: http://dx.doi.org/10.4103/jisp.jisp_155_16
27. Muthukrishnan A, Kumar LB, Ramalingam G. Medication-related osteonecrosis of the jaw: a dentist's nightmare [Internet]. *BMJ Case Reports*. 2016. p. bcr2016214626. Available from: <http://dx.doi.org/10.1136/bcr-2016-214626>
28. Ketabi M, Meybodi F, Asgari M. The association between periodontal disease parameters and severity of atherosclerosis [Internet]. Vol. 13, *Dental Research Journal*. 2016. p. 250. Available from: <http://dx.doi.org/10.4103/1735-3327.182185>
29. Heaton B, Applebaum KM, Rothman KJ, Brooks DR, Heeren T, Dietrich T, et al. The influence of prevalent cohort bias in the association between periodontal disease progression and incident coronary heart disease [Internet]. Vol. 24, *Annals of Epidemiology*. 2014. p. 741–6. Available from: <http://dx.doi.org/10.1016/j.annepidem.2014.07.006>
30. Hyvärinen K, Mäntylä P, Buhlin K, Paju S, Nieminen MS, Sinisalo J, et al. A common periodontal pathogen has an adverse association with both acute and stable coronary artery disease [Internet]. Vol. 223, *Atherosclerosis*. 2012. p. 478–84. Available from: <http://dx.doi.org/10.1016/j.atherosclerosis.2012.05.021>
31. Frisk F, Hakeberg M, Ahlqwist M, Bengtsson C. Endodontic variables and coronary heart disease [Internet]. Vol. 61, *Acta Odontologica Scandinavica*. 2003. p. 257–62. Available from: <http://dx.doi.org/10.1080/00016350310005510>
32. Lockhart PB, Bolger AF, Papapanou PN, Osinbowale O, Trevisan M, Levison ME, et al. Periodontal Disease and Atherosclerotic Vascular Disease: Does the Evidence Support an Independent Association? [Internet]. Vol. 125, *Circulation*. 2012. p. 2520–44. Available from: <http://dx.doi.org/10.1161/cir.0b013e31825719f3>
33. Kodovazenitis G, Pitsavos C, Papadimitriou L, Vrotsos IA, Stefanadis C, Madianos PN. Association between periodontitis and acute myocardial infarction: a case-control study of a nondiabetic population [Internet]. Vol. 49, *Journal of Periodontal Research*. 2014. p. 246–52. Available from: <http://dx.doi.org/10.1111/jre.12101>
34. Farhat Yaasmeen Sadique Basha , Rajeshkumar S , Lakshmi T ,Anti-inflammatory activity of Myristica fragrans extract . *Int. J. Res. Pharm. Sci.*, 2019 ;10(4), 3118-3120 DOI: <https://doi.org/10.26452/ijrps.v10i4.1607>
35. Marfil-Álvarez R, Mesa F, Arrebola-Moreno A, Ramírez-Hernández JA, Magán-Fernández A, O'Valle F, et al. Acute Myocardial Infarct Size Is Related to Periodontitis Extent and Severity [Internet]. Vol. 93, *Journal of Dental Research*. 2014. p. 993–8. Available from: <http://dx.doi.org/10.1177/0022034514548223>
36. Holmlund A, Lind L. Number of Teeth Is Related to Atherosclerotic Plaque in the Carotid Arteries in an Elderly Population [Internet]. Vol. 83, *Journal of Periodontology*. 2012. p. 287–91. Available from: <http://dx.doi.org/10.1902/jop.2011.110100>