10.5005/jp-journals-10029-1087

RESEARCH ARTICLE

Associations between Periodontal Disease Parameters and Coronary Heart Disease in Greek Adults: A Cross-sectional Study

[1]Nikolaos Andreas Chrysanthakopoulos, [2]Aggelos Antonios Oikonomou
[3]Panagiotis Andreas Chrysanthakopoulos, [4]Rajiv Saini

ABSTRACT

Aim: Several forms of periodontal disease have been associated with the development of coronary heart disease. The current retrospective study was conducted to investigate the possible relationship between periodontal disease parameters and defined coronary heart disease (CHD) in Greek adult patients.

Materials and methods: The study sample consisted of 880 individuals, 400 males and 480 females, aged 40 to 78 years. Data were collected by means of an interviewer administered questionnaire and an oral clinical examination. Statistical analysis of the questionnaire items was performed by using multiple regression analysis model in order to assess possible associations between coronary heart disease as dependent variable and epidemiological variables, biomarkers and periodontal disease parameters as independent variables.

Results: The occurrence of hypertension (OR = 0.01, 95% CI = 0.09-1.33), high level of triglycerides (OR = 0.08, 95% CI = 0.06-2.27) and total cholesterol (OR = 0.08, 95% CI = 0.07-1.27), low level of high-density lipoprotein (OR = 0.12, 95% CI = 0.09-3.70) and smoking (OR = 1.83, 95% CI = 0.38-8.88) were significantly associated with the presence of coronary heart disease, whereas the periodontal parameters examined were not associated with the occurrence of it.

Conclusion: No associations were observed between periodontal disease parameters and defined coronary heart disease. However, the recorded associations strengthen the role of hypertension, lipids and smoking as causative risk factors of coronary heart disease.

Keywords: Cardiovascular diseases, Periodontal disease, Adults.

[1]Private Practitioner, [2]Consultant Physician, [3]Director
[4]Associate Professor

[1]Department of Pathological Anatomy, Medical School University of Athens, Athens, Greece

[2]Private Practice, Greece

[3]Department of Neurosurgery, 417 NIMTS Military Hospital Athens, Greece

[4]Department of Periodontology, Pravara Institute of Medical Sciences, Ahmednagar, Maharashtra, India

Corresponding Author: Nikolaos Andreas Chrysanthakopoulos, Private Practitioner, Department of Pathological Anatomy, Medical School, University of Athens, Athens, Greece Phone: 00302610225288, e-mail: nikolaos_c@hotmail.com

How to cite this article: Chrysanthakopoulos NA, Oikonomou AA, Chrysanthakopoulos PA, Saini R. Associations between Periodontal Disease Parameters and Coronary Heart Disease in Greek Adults: A Cross-sectional Study. Int J Experiment Dent Sci 2015;4(1):4-10.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Cardiovascular diseases (CVDs) and especially coronary heart disease (CHD) consist major pathological conditions, as they are the main cause of mortality nowadays in industrialized countries and occur as a result of genetic, environmental and behavioral risk factors.[1] Coronary heart disease refers to atherosclerosis of the coronary arteries leading to insufficiency of the myocardial blood supply due to reduction of blood flow through one or more of the coronary arteries or its branches and includes myocardial infarction, angina pectoris and ischemic heart disease.[2] However, a significant percentage of CHD can not be explained by traditional risk factors[3] and it has been implicated chronic inflammation etiologically in CVD and CHD.[4]

Periodontitis is a progressive inflammation, leading to the destruction of the supporting tissue and alveolar bone loss. Previous studies have linked several risk factors to periodontal disease (PD) including diabetes mellitus, smoking, age, gender and low socioeconomic status.[5] In addition, PD is also associated with elevations of several markers of chronic inflammation[6] and because of evidence implicating chronic inflammation in the etiology of CHD, an etiologic relationship between both diseases has been hypothesized.[4]

Many case-control and cohort studies have reported a positive association between PD and the risk of CHD.[3,7-13] Periodontal disease and CHD have several common risk factors, such as smoking and diabetes mellitus.[14] It has been claimed that this might be one of the explanation for the association between both diseases.[15] Significant similarities also have been recorded in the pathogenetic processes of CVD and periodontitis.[16] Recently, other studies focused on suggesting that genetic factors influence biological processes involved in both diseases,

presenting a potential mechanism that may associate PD to CVD.[17]

On the other hand, no significant associations between PD and an increased risk of CHD have been recorded in similar reports,[18-20] and most of those results are from prospective studies.

Cardiovascular disease and PD consist widespread pathological conditions and, therefore, an association between them is an important scientific issue from a preventive point of view. These reasons have led to a strong interest in assessing whether PD is independently associated with CHD.

The aim of the present research was to investigate whether parameters of PD, such as gingival index (GI), probing pocket depth (PPD) and clinical attachment loss (CAL), are associated with defined CHD among middle-aged and old adults.

MATERIALS AND METHODS

Subject Population

Subject population consisted of 880 individuals, 400 males and 480 females, 40 to 78 years old. The participants were outpatients of a neurosurgery clinic of a military hospital (50%) and patients of two private practices, one dental (25%) and one medical (25%). This sample selection was applied in order to create a possible representative study sample. All the participants were completed a health questionnaire and underwent an oral clinical examination. The investigation was carried out between April and September 2013.

Selection Criteria

The selection criteria of the participants comprised age from 40 to 78 years old and a mean of 20 natural teeth, since large numbers of missing teeth could lead to over or underestimate the dental variables and the possible associations that are under consideration. None of the participants had received scaling and root planing procedures or periodontal treatment during the previous 6 months or receive prescription of systemic antibiotics or anti-inflammatory or other systemic drugs. These criteria were applied because of potential effects on the oral tissues. In order to avoid as much as possible, potential confounding influences on the study parameters, individuals with diabetes mellitus, rheumatoid arthritis, malignant diseases, acute infections, neoplasias, liver cirrhosis and concurrent medication with general glucocorticoids were also excluded from the study.

Questionnaire

Before the oral clinical examination, all participants filled a self-administered questionnaire that included variables, such as age, gender, smoking status (active smokers/no-smokers) and data regarding the general medical history of them with reference to medication and several chronic systemic disorders.

The basic criterion in order to be selected a subject in the current study was the question by a specific pathologist, 'Have you ever had coronary heart disease diagnosed by a medical doctor?' In case of a positive response, the selected individuals had to meet the following common characteristics in order to be included in the study: (A) they were suffering from some degree of ischemic heart disease, (B) they did not suffer from any other relevant systemic pathology, (C) their treatment was based on the use of calcium channel blockers (nifedipine or diltiazem), beta blockers and coumarin anticoagulants.[21] Hypertension was determined in a manner similar to the one described above, 'Have you ever had elevated blood pressure diagnosed by a medical doctor?'.

Medical biomarkers, such as serum total cholesterol, serum triglycerides and serum high-density lipoprotein (HDL), were determined by laboratory tests for the whole individuals 1 to 2 weeks after their examination. Categorization of serum total cholesterol, HDL-cholesterol and triglycerides were based on the scientific statement of the American Heart Association (AHA) and the American College of Cardiology (ACC).[22] In cases where the participants could not remember details of their medical history concerned, the mentioned or other medical variables, the additional data were collected by their own personal medical file.

Clinical Examination

The clinical examinations were performed at the neurosurgery clinic of the hospital and the mentioned private practices. One well trained and calibrated dentist performed the examinations. The clinical measurements concerned the following variables: on each tooth GI, PPD and CAL were measured by a William's PCP 12 probe (PCP10-SE, Hu-Friedy Mfg. Co. Inc., Chicago, IL, USA) at six sites per tooth (distofacial, facial, mesiofacial, distolingual, lingual and mesiolingual) of all teeth except for the 3rd molars and remaining roots. The severity of gingivitis classified as follows: score 0—normal gingiva/mild inflammation, slight change in color, slight edema, no bleeding on probing, which corresponds to Löe[23] classification as score 0 and 1 respectively; score 1—moderate inflammation, redness, edema and glazing, bleeding on probing/severe inflammation, marked redness and edema, ulceration, tendency to spontaneous bleeding, which corresponds to Löe classification as score 2 and 3 respectively. The presence of PPD classified as follows:[24] score

0— moderate periodontal pockets, 4 to 6.0 mm and score 1—advanced periodontal pockets, >6.0 mm. The severity of CAL classified as follows:[25] score 0—mild, 1 to 2.0 mm of attachment loss, and score 1—moderate/severe, ≥3.0 mm of attachment loss.

Reproducibility

A randomly chosen sample of 90 (10%) individuals was re-examined clinically by the same dentist in order to establish the intraexaminer variance. After consideration of the code numbers of the double-examined individuals, no differences were recorded between the 1st and 2nd clinical assessment (Cohen's kappa = 0.91).

ETHICAL CONSIDERATION

The present study was not an experimental one. In Greece, only experimental studies must be reviewed and approved by authorized committees (Dental Schools, Greek Dental Associations, Ministry of Health, etc.). Participants who agreed to participate in the present study signed an informed consent form.

STATISTICAL ANALYSIS

For each individual, the worst values of GI, PPD and CAL at the six sites per tooth were recorded. Statistical analysis of questionnaire items was performed by using the multiple logistic regression analysis model to identify which variables were best associated with CHD. A stepwise procedure was used to investigate the influence of possible risk factors to the outcome of CHD. A two-step approach was used for this aim. First, bivariate analysis was used to test the relationship between CHD and the associated factors. Unadjusted and adjusted odds ratios (OR) with 95% CI were assessed as well. The data analysis was performed using the statistical package of social sciences (SPSS) ver. 17.0 (SPSS Inc., Chicago, IL, USA).

A p-value less than 5% ($p < 0.05$) was considered to be statistically significant.

RESULTS

The total number of the participants who met the selection criteria were 933. However, 880 of them accepted the invitation to take part in the study and met the inclusion criteria giving a response rate 94.3%. Four hundred and forty-five patients were outpatients of the specialist hospital clinic, 222 patients visited a private medical practice and 213 visited a private dental practice.

The mean age of the sample of the study was 58.6 ± 3.6 years.

Current cigarette smokers reported 318 (36.1%) of them, 137 males and 181 females, while 562 (63.9%) were nonsmokers, 263 males and 299 females.

A total of 80 patients, 47 males and 33 females, were diagnosed as having CHD according to the mentioned criteria, giving an overall prevalence of 9.1%, 11.8% in males and 6.8% in females.

The results showed that occurrence of CHD, hypertension and inflammatory markers were associated with PPD, GI and CAL according to the bivariate analysis (Table 1). The factors that were associated with the presence of CHD and unadjusted OR and 95% confidence interval (CI) are shown in Table 2.

The examined variables entered the backward method, and the adjusted OR with 95% confidence interval (CI) with the significant levels were assessed (Table 2).

The results of the stratified multivariate logistic regression model are presented in Table 3 and showed that the examined periodontal parameters were not associated with the presence of CHD after adjustment for several risk factors, such as male gender, low income, low educational level and smoking.

DISCUSSION

The results of the current study were showed no association between presence of CHD and gender despite the fact that previous studies suggested that males showed a greater risk of developing CHD.[26,27]

The lack of physical exercise is another environmental risk factor for CHD;[28] however, the present findings did not confirm such an association, similar to a previous study.[13]

No association was recorded between socioeconomic status and the presence of CHD, finding that was in accordance with those from previous reports.[3,13] However, other reports recorded a positive association.[28,29]

Several observational studies showed that poor oral health status is associated with an increased risk of CHD.[10] Similar findings were recorded in previous prospective studies regarding the link between poor oral health and CHD.[3,11] However, in the current study no association was found between tooth brushing frequency and CHD and between frequency of dental follow-up and CHD, variables that could indicate the oral hygiene level. Hung et al[29] observed that periodontal indices, such as CAL, PPD or GI, could be indicators for traditional risk factors for CHD, whereas the most plausible explanation for the finding was that periodontal indices are associated with poor oral hygiene, which in turn are associated with oral hygiene-related cardiovascular risks as presence

Table 1: Descriptive characteristics of the study population

	Gingival index			*Probing pocket depth*			*Clinical attachment loss*		
Periodontal parameters	*0*	*1*		*0*	*1*		*0*	*1*	
Variables	*N (%)*	*N (%)*	*p-value*	*N (%)*	*N (%)*	*p-value*	*N (%)*	*N (%)*	*p-value*
Socioeconomic factors									
Gender: Males	100 (25.0)	300 (75.0)	NS	114 (28.5)	286 (71.5)	NS	110 (27.5)	290 (72.5)	NS
Females	130 (27.1)	350 (72.9)		156 (32.5)	324 (67.5)		150 (31.3)	330 (68.7)	
Income: Low	66 (18.9)	284 (81.1)	**	103 (29.4)	247 (70.6)	NS	99 (28.3)	251 (71.7)	NS
High	164 (64.3)	366 (35.7)		167 (31.5)	363 (68.5)		161 (30.4)	369 (69.6)	
Education: Low	103 (25.8)	297 (74.2)	NS	137 (34.3)	263 (65.7)	*	116 (29.0)	284 (71.0)	*
High	127 (26.9)	353 (73.1)		133 (27.7)	347 (72.3)		144 (30.8)	336 (69.2)	
Health habits									
Smoking status: Smokers	45 (14.3)	273 (85.7)	**	78 (24.6)	240 (75.4)	**	71 (22.3)	247 (77.7)	**
Nonsmokers	185 (72.2)	377 (27.8)		192 (34.1)	370 (65.9)		189 (33.6)	373 (66.4)	
Physical exercise:									
≥4 times/week	109 (37.5)	181 (62.5)	**	128 (44.3)	162 (55.7)	**	127 (43.8)	163 (56.2)	**
≤4 times/week	121 (23.6)	469 (76.4)		142 (26.6)	448 (73.4)		133 (22.5)	457 (77.5)	
Tooth brushing:									
≥2 times/day	97 (16.7)	483 (83.3)	**	200 (34.5)	380 (65.5)	**	212 (36.6)	368 (63.4)	**
≤2 times/day	133 (27.6)	167 (72.4)		70 (23.3)	230 (76.7)		48 (16.0)	252 (84.0)	
Dental check-ups:									
2 times/year	138 (28.6)	346 (71.4)	NS	145 (29.9)	339 (70.1)	NS	155 (32.1)	329 (67.9)	NS
Less than 2 times/year	92 (25.0)	304 (75.0)		125 (31.6)	271 (68.4)		105 (26.5)	291 (73.5)	
General health									
Diagnosed CHD: Yes	30 (37.5)	50 (62.5)	*	33 (41.3)	47 (58.7)	*	35 (43.8)	45 (56.2)	**
No	200 (25.0)	600 (75.0)		237 (29.6)	563 (70.4)		225 (28.1)	575 (71.9)	
Diagnosed hypertension:									
Yes	108 (55.6)	86 (44.4)	**	99 (51.0)	95 (49.0)	**	85 (43.8)	109 (56.2)	**
No	122 (18.6)	564 (81.4)		171 (24.9)	515 (75.1)		175 (25.5)	511 (74.5)	
Inflammatory markers									
Total cholesterol: Low	153 (29.0)	375 (71.0)	*	144 (27.3)	384 (72.7)	**	136 (25.8)	392 (74.2)	**
High	77 (19.2)	275 (80.8)		126 (35.8)	226 (64.2)		124 (34.1)	228 (65.9)	
HDL cholesterol: High	154 (25.0)	383 (75.0)	*	180 (33.5)	357 (66.5)	*	144 (26.8)	393 (73.2)	*
Low	76 (37.5)	267 (62.5)		90 (26.2)	253 (73.8)		116 (33.8)	227 (66.2)	
Triglycerides: Low	133 (23.9)	427 (76.1)	*	156 (27.8)	404 (72.2)	*	142 (25.4)	418 (74.6)	**
High	97 (33.3)	223 (66.7)		114 (35.6)	206 (64.4)		118 (36.9)	202 (63.1)	

p-value derived from the Chi-square test: *p < 0.05; **p < 0.001; NS: No statistical difference

Table 2: Factors associated with the presence of coronary heart disease

	Coronary heart disease presence			
Variables	*N*	*%*	*OR (95% CI) (unadjusted)*	*OR (95% CI) (adjusted)*
Gender				
Females	33	6.9	0.55 (0.35-0.95)**	0.81 (0.34-1.05)
Males	47	11.8	1.00	1.00
Income				
High	48	11.7	1.80 (1.13-2.87)**	0.65 (0.32-2.25)
Low	32	6.8	1.00	1.00
Education				
High	54	23.5	7.36 (4.48-12.12)*	2.02 (0.43-9.55)
Low	26	4.0	1.00	1.00
Smoking status				
Smokers	48	15.1	2.94 (1.83-4.75)*	1.83 (0.38-8.88)*
Nonsmokers	32	5.7	1.00	1.00
Physical exercise				
≥4 times/week	18	7.4	0.74 (0.43-1.29)	0.28 (0.17-2.94)
≤4 times/week	62	9.7	1.00	1.00
Tooth brushing				
≥2 times/day	16	6.3	0.59 (0.33-1.07)	0.81 (0.29-8.33)
≤2 times/day	64	10.3	1.00	1.00
Dental check-ups				
2 times/year	24	9.6	1.09 (0.66-1.81)	0.72 (0.22-2.65)
Less than 2 times/year	56	8.9	1.00	1.00
Hypertension				
No	30	4.3	0.12 (0.07-0.19)*	0.01 (0.09-1.33)*
Yes	50	2.8	1.00	1.00
Total cholesterol				
Low	36	5.8	0.30 (0.19-0.48)*	0.08 (0.07-1.27)*
High	44	16.9	1.00	1.00
HDL cholesterol				
High	28	5.5	0.35 (0.21-0.57)*	0.12 (0.09-3.70)*
Low	52	14.2	1.00	1.00
Triglycerides				
Low	28	4.4	0.17 (0.10-0.27)*	0.08 (0.06-2.27)*
High	52	21.7	1.00	1.00
Gingival index				
Low	34	6.4	0.44 (0.27-0.71)*	0.14 (0.02-0.22)
Severe	46	13.3	1.00	1.00
Probing pocket depth				
Low	22	7.9	0.80 (0.48-1.33)	0.74 (0.04-1.22)
Severe	58	9.7	1.00	1.00
Clin attachment L				
Low	28	6.6	0.54 (0.34-0.89)	0.67 (0.44-3.70)
Severe	52	11.4	1.00	1.00

*p < 0.001; **p < 0.05

Table 3: Associations of GI, PPD and CAL with the presence of CHD according to the stratified multivariate logistic regression model

	Gingival index			*Probing pocket depth*			*Clinical attachment loss*		
Stratified analyses	*OR*	*95% CI*	*p-value*	*OR*	*95% CI*	*p-value*	*OR*	*95% CI*	*p-value*
Gender									
Males	0.34	0.15-0.82	NS*	1.16	0.84-1.47	NS	1.22	0.58-1.65	NS
Females	0.57	0.43-1.12	NS	1.38	0.77-1.84	NS	1.46	0.88-1.72	NS
Smoking status									
Smokers	0.97	0.62-1.35	NS	0.78	0.45-0.94	NS	1.12	0.72-1.47	NS
Nonsmokers	1.12	0.75-1.46	NS	1.22	0.92-1.84	NS	1.34	0.84-1.93	NS
Socioeconomic status									
Low	0.48	0.33-1.15	NS	0.32	0.15-0.47	NS	0.87	0.61-1.19	NS
High	0.76	0.52-1.04	NS	0.84	0.72-1.21	NS	1.15	0.73-1.42	NS

*NS: No statistical difference

of worse periodontal indices, i.e. deep pockets, severe CAL. Cigarette smoking is an important risk factor for CHD according to the literature as impacts all phases of atherosclerosis from endothelial dysfunction to acute clinical events,[13,27] findings that are in agreement with those of the present study.

Periodontal diesase, as mentioned, is associated with elevations of several markers of chronic inflammation, such as lipoproteins, C-reactive protein, etc.[6] In addition, Ridker et al[4] implicated chronic inflammation etiologically in CHD and CVD and, because of this suggestion, an etiological relationship between PD and CHD has been hypothesized. Significant associations were found between serum levels of triglycerides, total cholesterol and HDL cholesterol and the presence of CHD. These findings were in agreement with those of previous reports;[12,30] however, it is not clear whether periodontitis causes an increase in hyperlipidemia or whether periodontitis and CVD share hyperlipidemia as a common risk factor.[12]

Hypertension is an important risk factor for CHD and that increases the risk for CHD, occurrence, progression and mortality according to a previous study.[31] In the current and a previous similar report,[13] hypertension was significantly associated with the presence of CHD.

The principle finding of the current study was that no relations were recorded between the examined periodontal indices and the presence of CHD. These findings were in agreement with those of previous studies.[19,20] Little[17] observed that none of the studies from 2005 to 2008 have shown a cause-and-effect relationship between both diseases. In contrary, previous reports[3,7-13] showed that PD was associated with CHD. A meta-analysis of 22 case-control and cross-sectional studies and 12 cohort studies conluded that the risk for ischemic CVD was significantly higher among individuals with PD.[8]

Over the last few years, a great deal of studies with different designs, such as case-control, retrospective and prospective observational, meta-analysis, were developed, and were produced contradictory results when estimating the association between both diseases. The large sample sizes of the mentioned studies provide a good reason for caution with regard to the examined association. However, a major limitation of these studies stems from the self-reported nature of PD assessment in which participants were asked by a means of a questionnaire whether they had a history of CHD or of other traditional risk factors for CHD, such as hypertension or diabetes mellitus, or whether they had a history of PD and data collected without an oral clinical examination. One of the great difficulties in comparing different studies about this subject is the lack of a consistent classification for PD. Based on published data, it is difficult to reach a conclusion whether there is or not an association between PD and CVD. In the current study, we made a point of evaluating all teeth to prevent any bias in data collection. Furthermore, our classification sought to aggregate the most important PD parameters, such as probing depth, since periodontal pockets are a reservoir for microorganisms with direct access to the connective tissue and circulatory system, CAL, because periodontal recession is the record of history of PD and its remissions and GI as an indicator of infective burden. Another important factor that may be taken into account during the design process of such studies, is the epidemiological phenomenon that is known as 'confounding.' Both diseases, PD and CHD share common risk factors, such as socioeconomic status and smoking; consequently, a correlation between both diseases would be expected even if a causal link did not exist. In addition, in case of association, this could be a result of confounding by mutual risk factors. Confounding may also occurs through unknown factors, e.g. a genetic predisposition. However, the question still remains whether the association between PD and CVD is causal or is confounded by unmeasured factors. In the current study, after controlling for known risk factors, such as male gender, low educational level, low incomes and smoking, no associations were found between GI, PPD and CAL and the presence of CHD.

The current study has some limitations that should be taken into account before any benchmarking with similar studies. First, the majority of the study population was residents of Athens with different levels of educational and socioeconomic background which in many cases appeared to be low. In Greece, individuals with higher socioeconomic and educational background prefer and receive medical care from private hospitals. Second, in a retrospective study, like the present, the reliability is not as high as for prospective studies since the inter-examiner variability is most likely higher. Furthermore, the results of the present study were based on self-reported data regarding the diagnosis of CHD, systemic health conditions and other epidemiological aspects. The response outcomes to the questionnaire items may, therefore, suffer from inaccuracy. Respondents may under-report, over-report or choose not to report. Despite the fact that the personal medical file of the individuals could solve this problem, this factor may lead to limitations regarding the validity when interpreting the results in this study. In conclusion, the sample of the present study was not randomly selected from a normal population but as mentioned consisted of outcome patients of a special hospital clinic and private practices.

In addition, the decision on including older individuals who have at least 20 remaining natural teeth, may lead to an underestimation of older individuals with previous PD and who may have had teeth extracted for periodontal reasons.

Another limitation is that it is difficult to make a causal statement because of temporal ambiguity related to a retrospective study design, meaning that we did not even know whether gingivitis and periodontitis precede CHD. On the condition that these precede CHD, we have to be aware that the time period from exposure to disease is at best short in relation to cardiovascular alterations.

REFERENCES

1. Hegele RA. The pathogenesis of atherosclerosis. Clin Chim Acta 1996;246(1-2):21-38.
2. Labarthe DR, Dunbar SB. Global cardiovascular health promotion and disease prevention: 2011 and beyond. Circulation 2012;125(21):2667-2676.
3. Cabrera C, Hakeberg M, Ahlqwist M, et al. Can the relation between tooth loss and chronic disease be explained by socioeconomic status? A 24-year follow-up from the population study of women in Gothenburg, Sweden. Eur J Epidemiol 2005;20(3):229-236.
4. Ridker PM, Hennekens CH, Buring JE, Rifai N. C-reactive protein and other markers of inflammation in the prediction of cardiovascular disease in women. New Engl J Med 2000; 342(12):836-843.
5. Genco RJ. Current view of risk factors for periodontal diseases. J Periodontol 1996;67(suppl 10):1041-1049.
6. Wu T, Trevisan M, Genco RJ, Falkner KL, Dorn JP, Sempos CT . Examination of the relation between periodontal health status and cardiovascular risk factors: serum total and high-density lipoprotein cholesterol, C-reactive protein and plasma fibrinogen. Am J Epidemiol 2000;151(3):273-282.
7. Shrihari TG. Potential correlation between periodontitis and coronary heart disease an overview. Gen Dent 2012;60(1): 20-24.
8. Blaizot A, Vergnes JN, Nuwwareh S, Amar J, Sixou M. Periodontal diseases and cardiovascular events: meta-analysis of observational studies. Int Dent J 2009;59(4):197-209.
9. Pejcic A, Kesic L, Brkic Z, Pesic Z, Mirkovic D. Effect of periodontal treatment on lipoproteins levels in plasma in patients with periodontitis. South Med J 2011;104(8):547-552.
10. Sikka M ,Sequeira PS, Acharya S, Bhat M, Rau A, Nagaraj A. Poor oral health in patients with coronary heart disease: a case-control study of Indian adults. NZ Med J 2011; 124(1347):53-62.
11. Mucci L, Hsiech CC, Williams PL, et al. Do genetic factors explain the association between poor oral health and cardiovascular disease? A prospective study among Swedish twins. Am J Epidemiol 2009;170(5):615-621.
12. Losche W, Karapetow F, Pohl A, Pohl C, Kocher T. Plasma lipid and blood glucose levels in patients with destructive periodontal disease. J Clin Periodontol 2000;27(8):537-541.
13. Chrysanthakopoulos NA, Chrysanthakopoulos PA. Clinically classified periodontitis and its association in patients with pre-existing coronary heart disease. J Oral Dis 2013;ID 243736. DOI: org/10.1155/2013/243736.
14. Haffajee AD, Socransky SS. Relationship of cigarette smoking to attachment level profiles. J Clin Periodontol 2001;28(4): 283-295.
15. Ylostalo PV, Knuutila ML. Confounding and effect modification; possible explanation for variation in the results on the association between oral and systemic diseases. J Clin Periodontol 2006;33(2):104-108.
16. Glurich I, Grossi S, Albini B, et al. Systemic inflammation in cardiovascular and periodontal disease: comparative study. Clin Diagn Lab Immunol 2002;9(2):425-432.
17. Kornman KS, Duff GW. Candidate genes as potential links between periodontal and cardiovascular diseases. Ann Periodontol 2001;6(1):48-57.
18. Little JW. Periodontal disease and heart disease: are they related? Gen Dent 2008;56(7):733-737, quiz 738-9,768.
19. Holmlund A, Holm G, Lind L. Number of teeth as a predictor of cardiovascular mortality in a cohort of 7,674 subjects followed for 12 years. J Periodontol 2010;81(6):870-876.
20. Bokhari SA, Khan AA. The relationship of periodontal disease to cardiovascular diseases—review of literature. J Pak Med Assoc 2006;56(4):177-181.
21. Machuca G, Segura-Egea JJ, Jiménez-Beato G, Lacalle JR, Bullón P. Clinical indicators of periodontal disease in patients with coronary heart disease: a 10 years longitudinal study. Med Oral Patol Oral Cir Bucal 2012;17(4):e569-e574.
22. Smith SC Jr, Blair SN, Bonow RO, et al. AHA/ACC scientific statement: AHA/ACC guidelines for preventing heart attack and death in patients with atherosclerotic cardiovascular disease: 2001 update: a statement for health care professionals from the American Heart Association and the American College of Cardiology. Circulation 2001;104:1577-1579.
23. Loe H. The gingival index, the plaque index, and the retention index systems. J Periodontol 1967;38(6):610-616.
24. Knowles J, Burgett F, Morrison E, Nissle R, Ramfjord S. Comparison of results following three modalities of periodontal therapy related to tooth type and initial pocket depth. J Clin Periodontol 1980;7(1):32-47.
25. Wiebe CB, Putnins EE. The periodontal disease classification system of the American Academy of Periodontology: an update. J Can Dent Assoc 2000;66:594-597.
26. Metha J. Endothelium, coronary vasodilatation and organic nitrates. Am Heart J 1995;129(2):382-391.
27. Moeintaghari A, Haerian-Ardakani A, Talebi-Ardakani M, Tabatabaie I. Hyperlipidemia in patients with periodontitis. J Contemp Dent Pract 2005;6(3):78-85.
28. 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;33(2):92-101.
29. Hung HC, Colditz G, Joshipura KJ. The association between tooth loss and the self-reported intake of selected cardiovascular disease-related nutrients and foods among US women. Comm Dent Oral Epidemiol 2005;33(3):167-173.
30. Gau GT, Wright RS. Pathophysiology, diagnosis and management of dyslipidemia. Curr Probl Cardiol 2006;31(7): 445-486.
31. Keil V. Coronary artery disease: the role of lipids, hypertension and smoking. Basic Res Cardiol 2000;95(Suppl 1): 152-158.