CARDIOVASCULAR

Year	Name of Study	Publication	Author(s)	Institution(s)	Conclusions
2022	Association Between Preventive Dental Care and Healthcare Cost for Enrollees With Diabetes or Coronary Artery Disease: 5-Year Experience	*Compend Contin Educ Dent. 2022 Mar;43(3):130-139*	Borah BJ, Brotman SG, Dholakia R, Dvoroznak S, Jansen MT, Murphy EA, Naessens JM	Mayo Clinic; University of Maryland School of Dentistry; Life and Specialty Ventures; Arkansas BlueCross BlueShield	Preventive dental care is strongly associated with significant savings for diabetes and CAD patients, and such savings were highest for diabetes + CAD patients, followed by patients with only CAD and only diabetes. Adherence with preventive dental care was associated with significant average yearly cost savings, ranging progressively higher for patients with only diabetes ($515 to $574), only CAD ($548 to $675), and CAD + diabetes ($866 to $1,718). Most of these savings originated in costs associated with inpatient admissions, which were between 25% and 36% for all disease classifications for all years.
2021	Severe Periodontal Disease Increases Acute Myocardial Infarction and Stroke: A 10-Year Retrospective Follow-up Study	*Journal of Dental Research. 2021;100(7):706-713*	Cho HJ, Shin MS, Song Y, Park SK, Park SM, Kim HD	Seoul National University; University of Adelaide;	This study aimed to evaluate the causal association of periodontal disease with acute myocardial infarction (AMI) and stroke, after controlling for various confounders among the Korean population. Our data confirmed that severe periodontal disease was causally associated with the new events of AMI and stroke.
2021	Oral Bacterial Signatures in Cerebral Thrombi of Patients With Acute Ischemic Stroke Treated With Thrombectomy	*Journal of the American Heart Association. 2019;8:e012330*	Patrakka O, Pienimäki JP, Tuomisto S, Ollikainen J, Lehtimäki T, Karhunen PJ, Martiskainen M	Tampere University (Finland)	Streptococcal bacteria, mostly of oral origin, may contribute to the progression and thrombotic events of cerebrovascular diseases. We found DNA of Streptococcus species, mainly the S mitis group, belonging to viridans streptococci, in most aspirated thrombi of the patients with AIS. This suggests that viridans streptococci may have a role in the cause of cerebrovascular disease. Regular dental care should be emphasized in the primary prevention of AIS.
2021	Oral Health in America: Advances and Challenges. NIDCR Report 2021.	*Oral Health in America - April 2022 Bulletin | National Institute of Dental and Craniofacial Research (nih.gov)*	National Institute of Dental and Craniofacial Research (NIDCR)	National Institute of Dental and Craniofacial Research (NIDCR)	Moderate to Severe Periodontitis is more prevalent in persons with Diabetes (49% than persons without (33%). [p.3A-4, Table 1] U.S. insurers have taken the initiative to implement cost-saving dental benefits for patients with chronic diseases, such as type 2 diabetes, coronary artery disease, and cardiovascular disease. When patients received nonsurgical periodontal treatment versus no treatment, there was a significant decrease in their C-reactive protein and leukocyte levels, which are blood serum markers for inflammation. [p. 3A-17] See Fact sheet for pages in sections 3A and 3B for review related to the impact of oral health on treatment for cancer, diabetes, heart disease, stroke, emphysema, dementia, Parkinson's Disease and hospital acquired pneumonia.
2019	Periodontal Disease: A Risk Factor for Diabetes and Cardiovascular Disease	*Int. J. Mol. Sci. 2019, 20(6), 1414*	Liccardo D, Cannavo A, Spagnuolo G, Ferrara N, Cittadini A, Rengo C, Rengo G	Federico II University of Naples; Temple University; Moscow State Medical University; Istituti Clinici Scientifici-ICS Maugeri S.p.A.; University of Siena	it is very plausible that preventing periodontitis has an impact on the onset or progression of CVD and diabetes. Several studies have suggested the existence of a bi-directional link between periodontal health and these pathologies. Periodontitis acts within the same chronic inflammatory model seen in cardiovascular disease (CVD), people with diabetes are more susceptible to infections than people without this syndrome, and cardiac disorders are worsened by periodontitis.

2016	Association of Endodontic Lesions with Coronary Artery Disease	*Journal of Dental Research*	Liljestrand, J., Mantyla, P., Paju, S., et al.	University of Helsinki and Helsinki University Hospital, Finland; Department of Dental Medicine, Karolinska Institutet, Sweden; University of Washington, Seattle; Laboratory of Periodontal Biology and Department of Oral Pathology and Medicine, University of Chile, Chile; Oulu Unisersity Hospital and University of Oulu, Finland	Subgingival P. endodontalis levels and serum immunoglobulin G were associated with a higher endodontic lesion scores. Having widened peiapical spaces were associated with stable CAD and highest endodontic lesion scores were associated with acute coronary syndrome. This association was especially notable in subjects with untreated teeth with apical rarefactions. These findings support the hypothesis that ELs are independently associated with CAD and in particular with ACS.
2016	Periodontitis Increases the Risk of a First Myocardial Infarction: A Report From the PAROKRANK Study	*Circulation, 133*(6), 576-583	Rydén, L., Buhlin, K., Klinge, B., et al.	Karolinska Institute, Sweden; KTH Royal Institute of Technology Center for Safety Research, Sweden; Malmö University Department of Periodontology, Sweden	The risk of a first MI was significantly increased in patients with PD even after adjustment for confounding factors, strengthening the possibility of an independent relationship between PD and MI.
2015	Gingipains from the Periodontal Pathogen Porphyromonas gingivalisPlay a Significant Role in Regulation of Angiopoietin 1 and Angiopoietin 2 in Human Aortic Smooth Muscle Cells	*Infection and Immunity, 83*(11), 4256-4265	Zhang, B., Khalaf, H., Sirsjö, A., & Bengtsson, T.	Örebro University School of Health Sciences, Sweden	P. gingivalis has been shown to cause and accelerate formation of coronary and aortic atherosclerosis.
2015	Cardiovascular Risks Associated with Incident and Prevalent Periodontal Disease	*Journal of Clinical Periodontology, 42*(1), 21–28	Yu, Y., Chasman, D., Buring, J., Rose, L., & Ridker, P.	Harvard School of Dental Medicine	Incidence rates of all CVD outcomes were higher in women with prevalent or incident periodontal disease. PD was associated with statistically significant increased risk for future cardiovascular events after accounting for traditional risk factors and physical activities. New cases of periodontal disease, not just those that are pre-existing, place women at significantly elevated risks for future cardiovascular events.
2015	The Potential for Glycemic Control Monitoring and Screening for Diabetes at Dental Visits Using Oral Blood	*American Journal of Public Health., 105*(4)	Strauss, S., Rosedale, M., Pesce, M., et al.	NYU Langone Medical Center; NYU College of Dentistry; NYU College of Nursing; Columbia University Medical Center; Graduate School and University Center of the City of New York	Gingival crevicular blood collected at the dental visit can be used to screen for diabetes and monitor glycemic control for many at-risk patients.

2014	The Infection Hypothesis Revisited: Oral Infection and Cardiovascular Disease	*Epidemiology Research International*	Haheim, L.	Institute of Oral Biology and Institute of Basic Medical Sciences, University of Oslo, Norway	Long time exposure to active non-treated infections of oral cavity presents opportunity for bacteria, bacterial products, and viruses to enter circulation. Toxic bacterial & their products enter circulation, affecting atherosclerosis, causing platelet adhesiveness that results in clot formation and establishing cardiac vegetation, including periodontitis and peri-implantitis. Pathology has identified oral bacteria in heart valves, aortic aneurysms, and arterial walls. PD is an independent risk factor for CVDs.
2014	Invasion of Oral and Aortic Tissues by Oral Spirochete Treponema Fenticola in ApoE(-/-) Mice Causally Links Periodontal Disease and Atherosclerosis	*Infection and Im munity, 82*(5), 1959-1967	Chukkapalli, S., Rivera, M., Velsko, I., et al.	American Society For Microbiology	T. denticola causes atherosclerosis.
2013	Bacterial Signatures in Thrombus Aspirates of Patients With Myocardial Infarction	*Circulation, 127*(11), 1219-1228	Pessi, T., Karhunen, V., Karjalainen, P., et al.	Tampere University School of Medicine, Finland	Dental infection with oral bacteria account for 47% of acute coronary thrombosis. Heart attacks are associated with periapical abscesses and periodontal bacteria. Treating acute and chronic infections should be a major goal of preventive efforts to prevent heart attacks.
2013	Changes in Clinical and Microbiological Periodontal Profiles Relate to Progression of Carotid Intima-Media Thickness: The Oral Infections and Vascular Disease Epidemiology Study (INVEST)	*Journal of the American Heart Association, 2*(6)	Desvarieux, M., Demmer, R. T., Jacobs, D. R., Papapanou, P. N., Sacco, R. L., & Rundek, T.	Columbia University Mailman School Of Public Health	Patients with specific bacteria show strongest relevant adverse change in subclinical atherosclerotic vascular disease (ASVD). Identifying periodontal bacterial exposure (Aa, Pg, Tf, Td) in periodontal infections is more systemically relevant to ASVD and subsequent events.
2013	Polymicrobial Infection with Major Periodontal Pathogens Induced Periodontal Disease and Aortic Atherosclerosis in Hyperlipidemic ApoEnull Mice	*PLoS One, 8*(2), 1-11	Rivera, M., Lee, J., Aneja, M., et al.	University of Florida College of Dentistry	Pg, Tf, and Td induce periodontal disease and aortic atherosclerosis.
2012	Interleukin-6 Receptor Pathways in Coronary Heart Disease: A Collaborative Meta-Analysis of 82 Studies	*Lancet, 379*(9822), 1205-1213	Sanwar, N., Butterworth, A., Freitag, D., et al.	IL6R Genetics Consortium Emerging Risk Factors Collaboration	Inflammation is causal of coronary heart disease. CAD, also known as atherosclerotic heart disease, atherosclerotic cardiovascular disease, coronary heart disease, or ischemic heart disease, is the most common type of heart disease and cause of heart attacks. The disease is caused by plaque building up alonog the inner walls of the arteries of the heart. Inflammation within the plaque causes destabilization of plaque and eventual plaque rupture.

2012	Periodontal Disease and Atherosclerotic Vascular Disease: Does the Evidence Support an Independent Association? A Scientific Statement From the American Heart Association	*Circulation, 125*(20), 2520-2544	Lockhart, P., Bolger, A., Papapanou, P., et al.	American Heart Association	An association between PD and ASVD is supported by evidence that meets standards for Level of Evidence A (Level A: the highest standard for independent risk factors). Evidence supports that the service improves health outcomes; therefore, it is recommended that clinicians routinely provide the service to eligible patients. The relation between periodontal disease (PD) and atherosclerotic vascular disease (ASVD) is of great public health importance because of their high prevalence. Extensive review of the literature indicates that PD is associated with ASVD independent of known confounders.
2012	Systemic Infections Cause Exaggerated Local Inflammation in Atherosclerotic Coronary Arteries	*Circulation, 125*(9), 1147-1156	Arbab-Zadeh, A., Nakano, M., Virmani, R., & Fuster, V.	Johns Hopkins University School of Medicine, Division of Cardiology; CVPath Institute; Mount Sinai School of Medicine Zena and Michael A. Wiener Cardiovascular Institute; Fundaciôn Centro Nacional de Investigaciones Cardiovasculares Carlos III	Patients with periodontal disease have an increased rate of coronary and cerebral events: (thus, aggressive anti-inflammatory Rx). Aggressive anti-inflammatory treatment may be indicated for patients who develop an infection anywhere in the body, including new indications for antimicrobial, anti-inflammatory, and antithrombotic medications; and closer monitoring of at-risk patients. The treatment of acute & chronic infections offers a new therapeutic target for preventing heart attacks in high-risk patients.
2012	Increased Atherosclerosis Associated with Periodontal Disease Is Mediated by CD36	*Arteriosclerosis, Thrombosis, and Vascular Biology, (32)*	Febbraio, M., & Brown, P.	Cleveland Clinic	Atherosclerosis is mediated by cellular inflammatory responses to Porphyromonas gingivalis (Pg) by CD36 macrophages and TLRs. Physicians evaluating heart patients need to consider patients' oral health as this is important potential risk factor. Both physicians and dentists should educate patients and advise them that periodontal infections increase risk for atherosclerosis. The patient must be evaluated as a whole as infection in the gums affects blood vessels and the heart.
2011	Positron Emission Tomography Measurement of Periodontal 18F-fluorodeoxyglucose Uptake is Associated with Histologically Determined Carotid Plaque Inflammation	*Journal of the American College of Cardiology, 57*(8), 971-976	Fifer, K., Qadir, S., Subramanian, S., et al.	Massachusetts General Hospital; Harvard Medical School	FDG-PET measurements of metabolic activity within periodontal tissue correlate with macrophage infiltration within carotid plaques. These findings provide direct evidence for an association between periodontal disease and atherosclerotic inflammation.

2011	Oral Biofilm-associated Diseases: Trends and Implications for Quality of Life, Systemic Health and Expenditures	*Periodontology 2000, 55*(1), 87-103	Beikler, T., & Flemming, T.		There is evidence to support that periodontal treatment may improve glycemic control, reduce inflammatory biomarkers, improve surrogate measures of vasuclar endothelial function, and reduce risk for cardiovascular or cerebrovascular diseases.
2011	*Porphyromonas gingivalis* Lipopolysaccharide Alters Atherosclerotic-related Gene expression in Oxidized Low-density-lipoprotein-induced Macrophages and Foam Cells	*Journal of Periodontal Research, 46*(4), 427-437	Lei, L., Li, H., Yan, F., Li, Y., & Xiao, Y.	Fujian Medical University School and Hospital of Stomatology, China	P gingivalis endotoxins stimulated atherosclerosis-related gene expression in foam cells and also stimulated transcription of pro inflammatory cytokines, adhesion molecules & growth factors.
2010	Pathogen-induced Inflammation at Sites Distant from Oral Infection: Bacterial Persistence and Induction of Cell-specific Innate Immune Inflammatory Pathways	*Molecular Oral Microbiology, 25*(5), 305-316	Hayashi, C., Gudino, C., Gibson, F., & Genco, C.	Boston University School of Medicine	Immune cells activated by P. gingivalis drive modification of low-density lipoproteins to forms such as ox-LDL that are taken up by macrophages, leading to foam cell formation. These atherosclerotic lesions progress, develop a necrotic core, and when ruptured form an occlusive thrombus leading to a downstream ischemic event. Experimental vaccination also mitigates P. gingivalis acceleration of atherosclerosis. Use of antibiotics as part of aggressive periodontal clinical treatment effectively reduces the overall pathogen burden at the site of treatment and would result in lowering the risk for development of atherosclerosis.
2010	Periodontal Bacteria and Hypertension: The Oral Infections and Vascular Disease Epidemiology Study (INVEST)	*Journal of Hypertension, 28*(7), 1413-1421	Desvarieux, M., Demmer, R., Jacobs, D., et al.	Columbia University Mailman School of Public Health	There is a direct relationship between the levels of subgingival periodontal bacteria and both systolic and diastolic blood pressure, as well as hypertension prevalence. Data provides evidence of a direct relationship between the levels of these subgingival periodontal bacteria (Aa, Pg, Tf, Td) and both SBP and DBP as well as hypertension prevalence. Etiologic bacterial burden is positively associated with both BP and prevalent hypertension.
2010	Cardiovascular Disease and the Role of Oral Bacteria	*Journal of Oral Microbiology, 2*	Leishman, S., Do, H., & Ford, P.	Schools of Medicine and Dentistry, Brisbane, QLD, Australia	Red Complex (Aa, Pg, Tf, Td) induces strong expression cytokines and MMPS, strongly suppresses innate immune cellular responses to phagocytize & produce enzymes that kill bacteria, effectively evade host immune mechanisms & establish persistent infection, and act synergistically in causing disease. Orange Complex induced strong responses in supression to kill, but less than Red Complex. Non-pathogenic produced weak responses to supress innate immune reaction with high antimicrobial and phagocytosis by neutrophils.

2010	Periodontal Disease and Recurrent Cardiovascular Events in Myocardial Infarction Survivors: The Western New York Acute MI Study	*Journal of Periodontology, 81*(4), 502-511	Dorn, J., Genco, R., Grossi, S., et al.	University at Buffalo School of Public Health and Health Professions	Severe PD was more than two times likely to have a re-current event in never smokers. Findings indicate that PD may be an important factor in determining recurrent cardiovascular events in MI patients, and not merely a marker for the effects of smoking .
2009	Clinical Periodontal and Microbiologic Parameters In Patients With Acute Myocardial Infarction	*Journal of Periodontology, 80*(1), 1581-1589	Stein, J., Kuch, B., Conrads, G., et al.	University Hospital Aachen, Germany	After adjustment for age, gender, smoking, BMI, hypertension, plaque index, statin intake, and ratio of cholesterol to high-density lipoprotein, Pg remained a significant predictor for AMI. Pg was 14 times more likely to be detected in the AMI group than in the control group. The results confirm an association between Periodontitis and AMI in which periodontal destruction was correlated with the presence of periodontal pathogens. Pg might be considered a potential risk indicator for AMI.
2009	Infection & Inflammation: The Link Between Periodontal and Cardiovascular Diseases	*Future Cardiology. 5*(1), 5-9	Seymour, G., Ford, P., Cullinan, M., Leishman, S., West, M., & Yamazaki, K.	University of Otago, New Zealand; University of Queensland, Austrailia; Niigata University, Japan	The mouth is a significant contributor to both total burden of infection & total burden of inflammation: hence, to overall health & well-being. Individuals with severe chronic periodontitis have a significantly increased risk for CVD, atherosclerosis, MI and stroke, after adjusting for traditional risk factors. Over 50 studies reviewd demonstrated a significant positive association between tooth loss levels and fatal coronary events, carotid artery plaque, and periperal arterial disease.
2009	Treatment of Periodontal Disease Results in Improvements in Endothelial Dysfunction and Reduction of the Carotid Intima-Media Thickness	*The FASEB Journal, 23,* 196-1204	Piconi, S., Trabattoni, D., Luraghi, C. et al.	Hospital Luggi Sacco, Italy; University of Milan, Italy; Immunoclin Limited, United Kingdom; Don C. Gnocchi Foundation, Italy	Results of periodontal treatment: o Significant reduction of the total inflammation biomarkers and of adhesion and activation proteins. Notably, intima-media thickness was significantly diminished after treatment and positively influenced by periodontal treatment o Reduction of oral bacterial load results in modification of anatomical parameters directly responsible for atherosclerosis. Perio disease therapy alone or supplemented by local or systemic antibiotics results in improvement of endothelial function as well as in significant reductions of CRP and other inflammatory immune parameters. The results of the clinical trial sheds light on the pathogenesis of atherosclerosis and could have practical implications for public health. Findings clearly indicate that a strict association exists between periodontal disease and systemic endothelial inflammati and onffer further support to the hypothesis that PD predisposes to atherosclerosis and reinforces idea that atherosclerosis is an immune-mediated disease.

2009	Connection Found Between History of Periodontitis And Cerebrovascular Disease in Men	*Annals of Neurology, 66*(4)	Jimenez, M., Krall, E., Garcia, R. Vokonas, P. & Dietrich, T.	Boston University Goldman School of Dental Medicine; Boston University School of Medicine; Harvard School of Public Health; Harvard School of Dental Medicine; University of Brimingham School of Dentistry, United Kingdom	There is a significant association between periodontal bone loss and the incidence of stroke or TIA, independent of cerebrovascular risk factors. Periodontal bone loss was significantly associated with an increased hazard rate of CVD. Results support an association between history of periodontitis and incidence of CVD in men, independent of established CVD risk factors
2007	Treatment of Periodontitis and Endothelial Function	*The New England Journal of Medicine, 356*	Tonetti, M., D'Aiuto, F., Nibali, L., et al.		6 months after therapy, intensive periodontal treatment and its benefits in oral health were associated with improvement in endothelial function.
2006	Role of Periodontal Bacteria and Importance of Total Pathogen Burden in the Coronary Event and Periodontal Disease (CORODONT) Study	*Archives of Internal Medicine, 166*(5), 554-559	Spahr, A., Klein, E., Khuseyinova, N., et al.	University of Ulm Medical Center, Germany	There is a significant statistical association between total pathogen burden in periodontal pockets and the presence of CHD.
2005	Periodontal Disease and Heart Disease: A Reappraisal of Exposure	*Circulation, 112*(1), 19-24	Beck, J., Eke, P., Heiss, G., et al.	University of North Carolina Department of Dental Ecology	Systemic antibody response (to specific bacterial patterns) was associated with CHD in ever and never smokers. Specific bacterial patterns in PD patients increased risk for CHD by 50 – 100% depending on IgG response to specific bacterial patterns. The quality and quantity of the host response to oral bacteria more relevant to systemic atherothrombotic coronary events than clinical measures.
2005	Periodontal Microbiota and Carotid Intima-Media thickness: The Oral Infections and Vascular Disease Epidemiology Study (INVEST)	*Circulation, 111*(5), 576-582	Desvarieux, M., Demmer, R., Rundek, T., et al.	University of Minnesota School of Public Health	Overall periodontal bacterial burden was related to carotid IMT. Data provides evidence of a direct relationship between etiological periodontal microbiology and subclinical atherosclerosis independent of CRP. This relationship was specific to causative bacterial burden and the dominance of etiologic bacteria (A.a., P.g., T.f. T.d.).
2004	Atherosclerosis and the Immune System	*Acta Paediatrica Supplement, 93*(446), 63-69	Hansson, G., & Berne, G.	Karolinska Institute, Sweden	Both the innate and adaptive arms of the immune system lead to inflammation in the developing atherosclerotic lesion. Innate immunity (macrophages, etc.) is directly activated by microbial components and lipids and proteins (initiated by disease-related antigens, including oxidized lipoproteins, heat shock proteins and microbial molecules). Adaptive immunity in the artery walls leads to Th1 responses, characterized by secretion of proinflammatory cytokines and activation of macrophages and vascular cells.
2002	Clinical Cardiology: New Frontiers	*Circulation, 105*, 1135-1143	Libby, P., Ridker, P., & Maseri, A.	Brigham and Women's Hospital; Hardvard Medical School; University Vita-Salute San Raffaele, Italy	Elevation in markers of inflammation predicts outcomes of patients with acute coronary syndromes, independently of myocardial damage.