

# TOOTHBRUSHING AND CARDIOVASCULAR HEALTH: A NARRATIVE REVIEW OF POPULATION-BASED EVIDENCE

CEPILLADO DENTAL Y SALUD CARDIOVASCULAR: UNA REVISIÓN  
NARRATIVA DE LA EVIDENCIA POBLACIONAL

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## ABSTRACT

Emerging evidence from population-based studies increasingly underscores a significant association between oral hygiene practices—specifically toothbrushing frequency—and cardiovascular health outcomes. This brief narrative review synthesizes epidemiologic and mechanistic data, demonstrating that infrequent toothbrushing is consistently linked to elevated risks of stroke, coronary artery disease, and heart failure. These associations appear partially mediated by systemic inflammation (e.g., hsCRP, IL-6), metabolic dysregulation (e.g., HbA1c), and transient bacteremia. Numerous large-scale studies and meta-analyses report that brushing twice or more daily is associated with significantly reduced cardiovascular risk. Importantly, these findings converge despite differences in study populations, methodologies, and endpoints. The evidence supports regular toothbrushing as a feasible, low-cost, and globally scalable intervention with measurable systemic benefits. Integration of oral hygiene promotion into public health frameworks may contribute meaningfully to cardiovascular disease prevention, particularly in underserved communities.

**Keywords:** cardiovascular diseases, oral hygiene, toothbrushing, stroke, myocardial infarction, prevention, review

## RESUMEN

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## INTRODUCTION

Growing evidence supports a link between oral hygiene and systemic health, with growing interest in the cardiovascular implications of daily toothbrushing habits. Chronic low-grade inflammation is now recognized as a unifying biological thread between local and systemic diseases, with the oral cavity serving as a plausible gateway. According to the World Health Organization (WHO), cardiovascular diseases (CVDs)—including coronary artery disease, stroke, and peripheral vascular disorders—remain the leading cause of death globally (1, 2). Recent studies suggest that inadequate oral hygiene, particularly infrequent toothbrushing, may increase cardiovascular risk (3).

A large-scale Korean population study recently demonstrated that individuals who neglected nighttime toothbrushing had significantly elevated CVD risk, independent of daytime brushing frequency—underscoring the importance of both timing and consistency in oral hygiene practices (4). The biological

plausibility of this association lies in mechanisms involving the oral microbiota and its downstream effects: persistent inflammation, microbial translocation, and immune activation—all increasingly acknowledged as key contributors to atherogenesis (5, 6). This narrative review synthesizes current epidemiological and mechanistic evidence to evaluate the impact of toothbrushing frequency on CVD risk and its relevance as a modifiable target in preventive cardiovascular strategies.

### Toothbrushing frequency and cardiovascular risk

Compelling epidemiological evidence indicates that infrequent toothbrushing is associated with an increased risk of CVD. A comprehensive meta-analysis of nine prospective cohort studies, encompassing over 800,000 participants, revealed that individuals who brushed their teeth regularly had a 15% lower risk of developing CVD compared with those with infrequent brushing habits (7). These associations are summarized in Table 1.

**Table 1.** Frequent toothbrushing is associated with reduced cardiovascular risk across populations

Study	Study design	Main Findings	Cardiovascular outcome
Isomura (2023; Japan)	Observational	Not brushing at night associated with increased CVD risk	All CVD
Liu (2025; Meta-analysis of 9 cohorts)	Systematic review	Brushing $\geq 2 \times$ /day associated with 15% lower CVD risk	All CVD
Zhuang (2021; China Kadoorie Biobank)	Prospective cohort	Brushing $\geq 2 \times$ /day associated with reduced risk of vascular disease	IHD, stroke, pulmonary heart disease
Kobayashi (2020; Japan)	Cohort	Brushing once daily linked to higher coronary heart disease and stroke risk	CHD, stroke
VanWormer (2013; USA, Wisconsin)	Cross-sectional	Infrequent brushing associated with higher cardiometabolic risk	Cardiometabolic disease
Kajikawa (2014; Japan)	Endothelial function	Brushing $< 1 \times$ /day associated with impaired flow-mediated dilation	Endothelial dysfunction
Chang (2021; Korea)	Cohort	Brushing $\geq 3 \times$ /day reduced risk of all stroke subtypes	Stroke (all subtypes)
de Oliveira (2010; Scotland, Health Survey)	National survey	Rare brushing associated with 70% increase in cardiovascular events	All CVD
Matsui (2022; Japan)	Prospective observational	Poor brushing behavior linked to increased cardiovascular events	All CVD
Moon (2024; Korea, KNHANES)	Cross-sectional	Infrequent brushing associated with ↑ hsCRP, LDL, HbA1c	Risk factor profile
Huh (2023; Korea, Diabetes cohort)	National cohort	Brushing $\geq 2 \times$ /day reduced heart failure risk by 10% in T2D patients	Heart failure

This table summarizes observational and cohort evidence linking toothbrushing frequency with cardiovascular outcomes across various populations. Studies differ in design, population characteristics, and specific endpoints, but consistently suggest that regular toothbrushing ( $\geq 2 \times$ /day) is associated with reduced cardiovascular and metabolic risk. Frequency thresholds and brushing timing (e.g. night brushing) vary between studies. CVD, cardiovascular disease; IHD, ischemic heart disease; CHD, coronary heart disease; hsCRP, high-sensitivity C-reactive protein; LDL, low-density lipoprotein; HbA1c, glycated hemoglobin; T2D, type 2 diabetes; KNHANES, Korean National Health and Nutrition Examination Survey.

Large-scale population studies conducted in East Asia have reinforced this association. In the China Kadoorie Biobank, Zhuang and colleagues reported that individuals who brushed their teeth  $\geq 2$  times per day had significantly reduced risk of major vascular outcomes—including ischaemic heart disease, stroke, and pulmonary heart disease—compared to those who rarely or never brushed (8). Using data from the Korean National Health and Nutrition Examination Survey, Hwang *et al.* found that brushing less than three times daily was independently associated with an elevated 10-year Framingham CVD risk score (adjusted OR 1.33), even after accounting for socioeconomic status, comorbidities, and health behaviors (9).

Further support comes from a Japanese longitudinal study, which demonstrated a dose-dependent relationship between toothbrushing frequency and CVD events: participants who brushed their teeth only once daily exhibited a significantly higher incidence of coronary heart disease and stroke compared with those who brushed after every meal (10).

Moreover, evidence from the Survey of the Health of Wisconsin revealed that individuals who brushed less frequently were at greater risk of cardiometabolic disease, reinforcing the value of oral hygiene as a proxy of broader health behaviors relevant to cardiovascular outcomes (11).

Together, these findings underscore toothbrushing frequency as a readily modifiable behaviour with systemic health implications. Incorporating oral hygiene promotion, particularly regular and frequent brushing—into cardiovascular prevention frameworks may offer population-level benefit, especially in settings with limited access to dental care.

### Biological mechanisms linking toothbrushing to cardiovascular disease

The association between poor oral hygiene and CVD is increasingly supported by mechanistic insights involving systemic inflammation, microbial dissemination, and endothelial dysfunction. Inadequate toothbrushing

facilitates the accumulation of dental plaque, leading to periodontal disease—a chronic inflammatory condition that triggers elevations in circulating pro-inflammatory mediators such as interleukin-6 (IL-6) and C-reactive protein (CRP) (12, 13). These mediators are pivotal in the initiation and progression of atherosclerosis, the pathological hallmark of most CVDs.

At the vascular level, decreased toothbrushing frequency has been directly linked to impaired endothelial function. Kajikawa *et al.* demonstrated that individuals who brushed less than once daily exhibited significantly reduced flow-mediated dilation (FMD), a marker of endothelial responsiveness, suggesting early vascular injury and increased atherogenic potential (14).

One plausible conduit between oral dysbiosis and systemic pathology is transient bacteremia. In the context of inflamed periodontal tissues, daily activities such as chewing and brushing can introduce oral pathogens into the bloodstream, where they may induce endothelial activation and contribute to vascular inflammation and plaque formation (12, 15).

Transcriptomic analyses offer further mechanistic support. In individuals with severe periodontitis, gene expression profiles show marked upregulation of inflammatory cytokines (e.g. IL6, TNF) and endothelial stress markers—establishing a molecular bridge between chronic oral inflammation and cardiovascular remodeling (9).

Crucially, intervention studies and longitudinal cohorts have underscored the clinical relevance of these mechanisms. Regular and thorough toothbrushing reduces bacterial load and gingival inflammation, thereby mitigating the risk of systemic bacterial dissemination and downstream vascular insults (16). Moreover, persistent periodontal disease has been independently associated with a 4% increase in incident CVD events in large Korean cohort studies, reinforcing the long-term cardiovascular implications of unmanaged oral inflammation (17). Findings from the Tromsø Study corroborate these mechanisms, revealing that individuals with periodontitis face significantly increased risk of cardiovascular disease, even when controlling for

traditional confounders, thus strengthening the case for oral inflammation as an independent risk factor (18).

While these mechanisms provide a compelling biological rationale, distinguishing correlation from causation remains challenging. Much of the available evidence is observational and often relies on self-reported oral hygiene behaviors, which may be confounded by factors such as smoking, diet, socioeconomic status, and access to care. Future mechanistic studies integrating microbiome profiling, systemic biomarkers, and vascular imaging will be essential to elucidate causal pathways and validate oral hygiene as a modifiable cardiovascular risk factor.

### **Toothbrushing and stroke risk**

Among cardiovascular outcomes, stroke has shown one of the most consistent and robust associations with oral hygiene behaviors. Multiple large-scale cohort studies suggest that regular toothbrushing may significantly reduce the risk of cerebrovascular events, likely through modulation of systemic inflammation and vascular health.

In a nationwide Korean cohort, individuals who brushed their teeth three or more times per day exhibited a 22% lower risk of stroke, including subtypes such as cerebral infarction, cerebral hemorrhage, and subarachnoid hemorrhage (19). Notably, this association remained significant after adjustment for conventional vascular risk factors, underscoring the potential of oral hygiene as a modifiable protective behavior.

These findings align with long-term data from the Korean National Health and Nutrition Examination Survey, where individuals with severe periodontal disease—and typically lower brushing frequency—faced a significantly elevated risk of stroke over a 10-year follow-up (9).

Further supporting this association, the Scottish Health Survey revealed that individuals who rarely or never brushed their teeth had a 70% increased risk of cardiovascular events, a substantial proportion of which were cerebrovascular in nature (20). These results are

echoed by Japanese population data indicating that infrequent brushing may particularly exacerbate stroke risk in smokers—already a high-risk group (10).

Collectively, these observations suggest that stroke is particularly sensitive to variations in oral hygiene behavior. The consistency of findings across diverse populations strengthens the rationale for integrating oral hygiene promotion into public health strategies aimed at stroke prevention. Given the low cost and accessibility of toothbrushing, its reinforcement as a population-level intervention may offer scalable benefit in reducing cerebrovascular disease burden.

### **Toothbrushing and heart failure**

Emerging evidence suggests that suboptimal oral hygiene, particularly infrequent toothbrushing, may contribute not only to atherosclerotic disease but also to impaired cardiac function and the development of heart failure.

In a prospective observational study, individuals with poor toothbrushing habits demonstrated significantly higher incidence of major cardiovascular events, including heart failure, independent of traditional risk factors and comorbidities (21). This association appears to be mediated in part by chronic systemic inflammation and metabolic dysfunction. Indeed, Moon *et al.* reported that infrequent brushing was associated with elevated levels of high-sensitivity C-reactive protein (hs-CRP), low-density lipoprotein (LDL), and glycated hemoglobin (HbA1c) in Korean adults, especially those with underlying metabolic risk (22).

Large-scale cohort data further support these observations. In a nationwide study of individuals with type 2 diabetes—a population at increased risk for both periodontal disease and cardiac complications—those who brushed their teeth at least twice daily exhibited a 10% lower risk of developing heart failure compared to less frequent brushers (23). Additionally, findings from a Korean national cohort demonstrated that enhanced oral hygiene care—including frequent toothbrushing—was associated with reduced incidence

of both atrial fibrillation and heart failure, expanding the cardioprotective scope of oral hygiene practices (24). This inverse association remained significant after adjustment for demographic and clinical covariates, underscoring the potential cardioprotective role of routine oral hygiene practices in vulnerable populations.

Moreover, data from the same Korean population indicate that enhanced oral hygiene care, including frequent toothbrushing, is associated not only with reduced heart failure risk but also with decreased incidence of atrial fibrillation—a major arrhythmic precursor to cardiac decompensation (19). These findings collectively suggest that maintaining good oral hygiene may exert broader beneficial effects on cardiovascular health beyond atherosclerosis, potentially by mitigating systemic inflammation, microbial translocation, and endothelial dysfunction.

Nonetheless, compared to outcomes such as stroke, the association between toothbrushing frequency and heart failure risk appears somewhat more variable, likely reflecting heterogeneity in study designs, baseline comorbidities, and underlying pathophysiological mechanisms. Future longitudinal studies with standardized assessments of oral health and cardiac function will be essential to clarify causality and further delineate the scope of this relationship.

### Public health implications and conclusion

A growing body of epidemiological, mechanistic, and clinical data supports the role of toothbrushing frequency as a modifiable behaviour with systemic repercussions—most notably in the prevention of CVDs. Across diverse cohorts, individuals who brush their teeth at least twice daily consistently show a reduced risk of cardiovascular events, an effect plausibly mediated through attenuation of local and systemic inflammation, preservation of endothelial function, and reduced microbial translocation.

Beyond brushing frequency, emerging evidence suggests that timing also matters: skipping nighttime brushing has been independently linked to higher

cardiovascular risk—even among individuals who brush in the morning—underscoring the biological relevance of mitigating nocturnal microbial overgrowth and associated inflammatory burden (4).

From a public health standpoint, toothbrushing represents an exceptionally low-cost, scalable intervention requiring minimal infrastructure. Unlike pharmacological strategies, it is universally accessible, carries negligible risk, and may be deployed across socioeconomic strata—including populations with limited access to dental or cardiovascular care. These attributes make toothbrushing a uniquely equitable tool for health promotion and chronic disease prevention.

Longitudinal cohort studies reinforce this potential, showing that individuals who maintain good oral hygiene habits over time exhibit significantly reduced cardiovascular mortality during extended follow-up (25). As such, toothbrushing transcends its conventional role in oral health, emerging as a promising behavioural target in systemic disease prevention.

Future strategies should integrate oral hygiene education into broader chronic disease prevention frameworks, particularly in underserved communities. While the association between oral hygiene and cardiovascular outcomes is compelling, causal relationships have yet to be definitively established. To advance the field, mechanistic studies and interventional trials—anchored in rigorous oral health assessments and systemic biomarker profiling—are urgently needed.

Ultimately, toothbrushing is more than a hygienic habit—it is a globally actionable behaviour that connects personal care with systemic disease prevention. Realising its full preventive potential will require interdisciplinary efforts spanning dentistry, cardiovascular medicine, and public health, supported by evidence-based policy and inclusive health messaging.

In a global context marked by escalating cardiometabolic disease, the promotion of oral hygiene may constitute an overlooked yet highly impactful public health intervention. This aligns with contemporary calls to elevate oral hygiene as a pillar of self-care in health

systems worldwide, as exemplified in the WHO Global Oral Health Action Plan and recent scholarship advocating for a broader preventive role for dentistry (26).

## DECLARATIONS

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**Authors' contributions:** C.R., L.G-P., and FM-M. contributed to data acquisition, interpretation and critically revised the manuscript. C.R. contributed to conception, design, project supervision, performed all final analyses, and interpretations. C.R., L.G-P., and FM-M., drafted the manuscript. All authors gave their final approval and agreed to be accountable for all aspects of the work.

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