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Oral Health as a Modifiable Factor in Cognitive Decline: Periodontitis, Tooth Loss, and Dementia Risk in an Aging U.S. Population

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Abstract:
Background: *Alzheimer's disease and related dementias (ADRD) affect an estimated 7.2 million Americans aged 65 years or older, and their prevalence is projected to nearly double by 2060. Because no therapy yet cures these conditions, the identification of modifiable risk factors has become a national priority. Periodontitis, which affects about 42% of dentate U.S. adults aged 30 years or older, and tooth loss have emerged as candidate risk factors for cognitive decline.*
Materials and Methods: *A narrative review of the literature indexed in PubMed up to October 2026 was conducted, covering longitudinal cohorts, systematic reviews and meta-analyses, mechanistic studies and interventional evidence on periodontal health and dementia, as well as U.S. policy documents on ADRD and dental coverage for older adults.*

Results: *Meta-analyses of longitudinal studies consistently associate poor periodontal health with a 20% to 40% higher risk of dementia and indicate a dose-response relationship between tooth loss and cognitive impairment. U.S. cohorts (ARIC and NHANES III) reproduce these associations. Mechanistic studies have identified Porphyromonas gingivalis and its gingipains in Alzheimer's disease brains, and experimental oral infection induces neuroinflammation and amyloid production in animals. Interventional evidence remains limited, but a trial-emulation study suggested that periodontal treatment attenuates Alzheimer-related brain atrophy. People living with dementia, in turn, show high levels of plaque, periodontitis and unmet oral care needs, while traditional Medicare excludes routine dental care.*

Conclusion: *Periodontitis is a prevalent, inexpensive-to-treat and potentially modifiable contributor to cognitive decline. Integrating periodontal prevention and treatment into ADRD risk-reduction strategies is aligned with Goal 6 of the U.S. National Plan to Address Alzheimer's Disease and has substantial merit and national importance.*

Key Word: *Periodontitis; Tooth loss; Dementia; Alzheimer's disease; Cognitive decline; Older adults; Public health; National interest*

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I. Introduction

Population aging is one of the defining public health challenges of the twenty-first century in the United States. The Alzheimer's Association estimates that 7.2 million Americans aged 65 years or older live with Alzheimer's dementia and that, in the absence of medical breakthroughs, this number could reach 13.8 million by 2060[1]. Independent population modelling has produced convergent estimates, projecting an increase from 6.07 million people with clinical Alzheimer's disease in 2020 to 13.85 million in 2060, with disproportionate growth among Hispanic and Black Americans[2]. Health care, long-term care and hospice payments for older adults with dementia were estimated at US$384 billion in 2025, and nearly 12 million unpaid caregivers provided care valued at more than US$413 billion in 2024[1].

Because disease-modifying therapies remain limited, prevention has gained central importance. The 2024 report of the *Lancet* standing Commission on dementia prevention, intervention and care estimated that nearly half of dementia cases worldwide could theoretically be prevented or delayed by addressing 14 modifiable risk factors across the life course[3]. Periodontitis is not among those 14 factors, yet it shares several of their pathways, notably chronic systemic inflammation, diabetes and vascular injury, and a growing body of evidence suggests that it may constitute an additional, under-recognized and readily treatable contributor to cognitive decline.

Periodontitis is highly prevalent in the United States. Data from the National Health and Nutrition Examination Survey (NHANES) 2009–2014 indicate that 42% of dentate adults aged 30 years or older have periodontitis and 7.8% have severe periodontitis, with the highest prevalence of severe disease among adults aged 65 years or older[4]. The population exposed to periodontal inflammation is therefore precisely the one at greatest risk of dementia.

The federal government has formally recognized ADRD as a national priority through the National Alzheimer's Project Act (NAPA) of 2011[5], whose National Plan now includes a specific goal to accelerate action to promote healthy aging and reduce risk factors for ADRD[6]. The aim of this narrative review is to synthesize the epidemiological, mechanistic and interventional evidence on periodontitis, tooth loss and dementia, to discuss the bidirectional relationship between oral health and cognitive impairment, and to analyze the national importance of integrating oral health into U.S. dementia risk-reduction policy.

II. Materials and Methods

This study is a narrative review. The PubMed/MEDLINE database was searched up to October 2026 using combinations of the terms "periodontitis", "periodontal disease", "tooth loss", "Porphyromonas gingivalis", "gingipain", "dementia", "Alzheimer's disease", "cognitive decline", "cognitive impairment", "periodontal treatment", "oral hygiene", "nursing homes" and "Medicare". Priority was given to (i) systematic reviews and meta-analyses of longitudinal studies; (ii) large prospective cohorts, particularly U.S. cohorts; (iii) human post-mortem and imaging studies and experimental animal models addressing biological plausibility; (iv) interventional or quasi-experimental studies of periodontal treatment with cognitive or neuroimaging outcomes; and (v) studies on oral health and access to dental care among older adults and people living with dementia.

Federal documents (the National Alzheimer's Project Act and the National Plan to Address Alzheimer's Disease), the Alzheimer's Association annual report, and the ClinicalTrials.gov registry were consulted for policy and trial information. Bibliographic data of every reference were checked against PubMed or the primary source. The evidence was appraised qualitatively, distinguishing association from causation and considering consistency, temporality, dose-response and biological plausibility.

III. Epidemiological Evidence Linking Periodontal Health and Dementia

3.1 Prospective cohort studies

The Atherosclerosis Risk in Communities (ARIC) study provides some of the strongest U.S. evidence. Among 8,275 participants who underwent a full-mouth periodontal examination in 1996–1998 and were followed for an average of 18.4 years, those with severe periodontal disease had a 22% higher adjusted hazard of incident dementia (HR 1.22; 95% CI 1.01–1.47) compared with periodontally healthy participants, and edentulous participants had a similar point estimate (HR 1.21; 95% CI 0.99–1.48)[7]. Using NHANES III (1988–1994) linked to Medicare and National Death Index data with up to 26 years of follow-up, Beydoun and colleagues found that, among adults aged 65 years or older, probing depth and serum IgG titers against periodontal pathogens, including *P. gingivalis* and *Campylobacter rectus*, were associated with incident Alzheimer's disease and Alzheimer's mortality[8].

Comparable findings come from other health systems. In a Taiwanese population-based matched cohort of 9,291 patients with chronic periodontitis and 18,672 matched controls, ten years of exposure to chronic periodontitis was associated with a 1.7-fold higher risk of Alzheimer's disease (adjusted HR 1.707; 95% CI 1.152–2.528)[9]. In a six-month cohort of 60 community-dwelling people with mild to moderate Alzheimer's disease, periodontitis at baseline was associated with a six-fold increase in the rate of cognitive decline and with a relative increase in systemic pro-inflammatory markers[10], suggesting that periodontal inflammation may also accelerate progression after the diagnosis.

3.2 Systematic reviews and meta-analyses

The consistency of these associations has been tested in several meta-analyses (Table 1). Nadim et al. pooled cohort and case-control studies and obtained a relative risk of dementia of 1.38 (95% CI 1.01–1.90) among high-quality studies and of 1.18 (95% CI 1.06–1.31) among cohort studies[11]. In the most comprehensive review of longitudinal studies to date (47 studies), poor periodontal health — periodontitis, tooth loss, deep pockets or alveolar bone loss — was associated with both cognitive decline (OR 1.23; 95% CI 1.05–1.44) and dementia (HR 1.21; 95% CI 1.07–1.38), and tooth loss independently increased the risk of both outcomes[12].

Tooth loss, the end-stage consequence of untreated periodontitis and caries, shows a dose-response relationship with cognitive outcomes. A dose-response meta-analysis of cohort studies concluded that tooth loss is associated with an increased risk of dementia in a dose-dependent manner[13]. A second dose-response meta-analysis of 14 longitudinal studies (34,074 participants) found that participants with more tooth loss had a 1.48-fold higher risk of cognitive impairment and a 1.28-fold higher risk of dementia; importantly, the association was not significant among denture users (RR 1.10; 95% CI 0.90–1.11)[14], a finding that points to oral rehabilitation as a potential point of intervention.

Table 1. Main longitudinal studies and meta-analyses on periodontal health, tooth loss and dementia

Study	Design / population	Exposure	Main finding
Demmer et al., 2020[7]	ARIC cohort, USA; n = 8,275; mean follow-up 18.4 y	Severe periodontal disease; edentulism	Dementia HR 1.22 (1.01–1.47); edentulism HR 1.21 (0.99–1.48)
Beydoun et al., 2020[8]	NHANES III linked to Medicare, USA; up to 26 y	Probing depth; IgG to periodontal pathogens	Associated with incident AD and AD mortality (≥65 y)
Chen et al., 2017[9]	Matched cohort, Taiwan; 9,291 exposed vs 18,672 controls	Chronic periodontitis ≥10 y	AD adjusted HR 1.707 (1.152–2.528)
Nadim et al., 2020[11]	Meta-analysis; 5 cohorts, 7 case-control	Periodontal disease	RR 1.38 (1.01–1.90); cohorts RR 1.18 (1.06–1.31)
Asher et al., 2022[12]	Meta-analysis; 47 longitudinal studies	Poor periodontal health; tooth loss	Dementia HR 1.21 (1.07–1.38); cognitive decline OR 1.23 (1.05–1.44)
Qi et al., 2021[14]	Dose-response meta-analysis; 14 studies, 34,074 participants	Tooth loss	Dementia RR 1.28 (1.09–1.49); not significant in denture users

AD: Alzheimer's disease; HR: hazard ratio; OR: odds ratio; RR: relative risk; values in parentheses are 95% confidence intervals.

IV. Biological Plausibility: The Oral–Brain Axis

Several non-mutually exclusive mechanisms may explain how periodontitis contributes to neurodegeneration. The first is systemic inflammation. Periodontitis is a chronic, dysbiotic inflammatory disease whose local mediators and disseminated pathogens can reach the circulation, induce a systemic acute-phase response and even reprogram bone-marrow haematopoietic progenitors toward a pro-inflammatory phenotype, a process termed trained innate immunity[15]. In people with Alzheimer's disease, plasma TNF-α and elevated antibodies against periodontal bacteria are independently associated with the diagnosis and improve its discrimination from cognitively normal controls[16].

The second mechanism is direct microbial invasion of the brain. Lipopolysaccharide from *P. gingivalis* was detected in four of ten Alzheimer's disease brains and in none of ten matched controls[17]. Dominy et al. subsequently identified *P. gingivalis* and its neurotoxic cysteine proteases, the gingipains, in the brains of

Alzheimer's patients, with gingipain levels correlating with tau and ubiquitin pathology; in mice, oral infection resulted in brain colonization and increased production of amyloid-β, and small-molecule gingipain inhibitors reduced bacterial load, neuroinflammation and neuronal loss[18]. Chronic oral application of *P. gingivalis* to wild-type mice for 22 weeks likewise produced neuroinflammation, neurodegeneration and intra- and extracellular amyloid-β and tau pathology[19].

The third line of evidence comes from human neuroimaging. In cognitively normal older adults, clinical attachment loss of 3 mm or more was associated with higher amyloid-β deposition on Pittsburgh compound B positron emission tomography in Alzheimer-vulnerable brain regions, independently of age, apolipoprotein E genotype and smoking[20]. Together with the epidemiological data, these findings satisfy several classical criteria for causal inference — temporality, consistency, dose-response and biological plausibility — although confounding by shared risk factors and reverse causation cannot yet be excluded.

V. Does Treating Periodontitis Protect Cognition? Interventional Evidence

The decisive question for public health is whether preventing or treating periodontitis changes cognitive trajectories. Randomized trials with dementia endpoints are not yet available, partly because of the long latency of dementia. The most informative study so far used a trial-emulation design in the German SHIP-TREND and GANI_MED cohorts: 177 periodontally treated patients were compared with 409 untreated participants over a median of 7.3 years, and periodontal treatment had a favorable effect on Alzheimer-related brain atrophy on magnetic resonance imaging, corresponding to a shift from the 50th to the 37th percentile of the outcome distribution[21].

Pharmacological targeting of the oral pathogen has also been attempted. The phase 2/3 GAIN trial (NCT03823404) tested the oral gingipain inhibitor atuzaginstat (COR388) in people with mild to moderate Alzheimer's disease[22]. According to the sponsor's topline report, the trial did not meet its co-primary endpoints in the overall population, and development was interrupted because of hepatic safety concerns; this outcome does not refute the periodontal hypothesis, but it shows that the mechanical and preventive control of the periodontal biofilm — which is safe, inexpensive and already part of routine dental practice — remains the most realistic intervention to be tested. Recent reviews converge on the view that periodontal therapy is a biologically coherent and low-risk strategy whose cognitive benefits must now be confirmed in adequately powered trials[23], and that periodontal tissues and fluids routinely removed during treatment could even provide matrices for the early detection of Alzheimer's disease[24].

VI. The Bidirectional Relationship: Oral Health in People Living with Dementia

The relationship between oral health and dementia is bidirectional. As cognitive and motor functions decline, the ability to perform oral hygiene and to cooperate with dental treatment deteriorates. A comprehensive review found that older people with dementia have high levels of plaque, gingival bleeding, periodontal pockets, stomatitis, mucosal lesions and reduced salivary flow, and frequently depend on assistance for oral care[25]. Untreated periodontal inflammation may, in turn, accelerate cognitive decline[10], creating a vicious cycle.

Poor oral hygiene in frail older adults also has immediate systemic consequences. A systematic review of randomized controlled trials in hospitals and nursing homes showed that mechanical oral hygiene prevents pneumonia and respiratory tract infection, with absolute risk reductions of 6.6% to 11.7% and numbers needed to treat of 8.6 to 15.3[26]. Since aspiration pneumonia is a frequent cause of hospitalization and death among people with advanced dementia, structured oral care is not merely a matter of comfort but a component of quality dementia care.

Access to dental care, however, is restricted precisely in this population. The Medicare statute excludes services in connection with the care, treatment, filling, removal or replacement of teeth[27]. In 2012, 74% of low-income Medicare beneficiaries had received no dental care in the previous twelve months, and high-income beneficiaries were almost three times as likely to have received care[28]. Low-income adults also lose dental coverage and dental use when they transition from Medicaid to Medicare at age 65 years[29], and beneficiaries whose incomes slightly exceed Medicaid thresholds face a "dental coverage cliff"[30]. Older adults at the highest risk of dementia are therefore those least likely to receive periodontal prevention and treatment.

VII. Clinical and Public Health Implications

The evidence supports several practical measures. First, periodontal screening and treatment should be incorporated into the routine care of middle-aged and older adults, with particular emphasis on those with diabetes, cardiovascular disease or a family history of dementia. Second, preservation of the natural dentition and prosthetic rehabilitation of edentulous spaces should be framed as components of healthy brain aging, given the attenuated association observed among denture users[14]. Third, dental professionals should be trained to

recognize early cognitive changes, such as missed appointments or a sudden deterioration of oral hygiene, and to refer patients for medical assessment.

Fourth, for people already living with dementia, care plans should include individualized daily oral hygiene performed or supervised by caregivers, periodic professional periodontal maintenance, and preventive treatment planned while the patient can still cooperate. Fifth, long-term care facilities should adopt structured oral care protocols, given their demonstrated effect on respiratory infections[26]. Finally, interprofessional collaboration among dentists, physicians, nurses and caregivers is essential, because oral health in dementia is determined largely outside the dental office.

VIII. National Interest and Significance

The topic addressed in this review has substantial merit and national importance for the United States, in the sense adopted by U.S. immigration precedent to evaluate endeavors of national interest[31]. Its significance can be organized in five complementary axes.

8.1 A federally recognized problem of national scale

Alzheimer's disease and related dementias are the object of a specific federal statute[5] and of a National Plan coordinated by the Department of Health and Human Services, which was reauthorized by Congress in 2024[6]. The disease affects 7.2 million older Americans, costs an estimated US$384 billion per year in formal care and depends on nearly 12 million unpaid caregivers[1]. Its burden is projected to double by 2060 and to grow fastest among Hispanic and Black Americans[2], which also makes it a health-equity issue. The problem is therefore neither local nor regional: it concerns every state and the sustainability of Medicare and Medicaid, whose per-person payments for beneficiaries with dementia are, respectively, almost three and more than twenty-two times higher than for those without dementia[1].

8.2 Direct alignment with Goal 6 of the National Plan

Goal 6 of the National Plan calls for accelerating action to promote healthy aging and reduce risk factors for ADRD[6]. Periodontitis fulfils the attributes sought for a public health risk-reduction target: it is highly prevalent in the at-risk age group[4], it is consistently associated with dementia in U.S. and international cohorts[7,8,12], it is biologically plausible[18,20], and it is preventable and treatable with low-cost, safe and widely available procedures. Adding oral health to the risk-reduction agenda complements, rather than competes with, the 14 factors highlighted by the *Lancet* Commission[3], because local treatment of periodontitis has been shown to ameliorate surrogate markers of cardio-metabolic comorbidities that are themselves linked to dementia[15].

8.3 Correction of a structural gap in coverage for older adults

The exclusion of routine dental care from traditional Medicare[27] produces a paradox: the program bears most of the cost of dementia care but does not finance one of the few inexpensive preventive measures that may reduce dementia risk. The documented access gaps among low-income beneficiaries[28-30] mean that the population at highest risk is the least protected. Evidence such as that synthesized here is necessary to inform policy options for dental benefits in Medicare, Medicare Advantage and Medicaid, and the design of integrated medical-dental care models for older adults.

8.4 Potential national benefits and cost containment

Even modest reductions in dementia incidence or delays in its onset would yield large aggregate benefits, given the size and cost of the affected population. Nadim et al. projected that a 50% reduction in the prevalence of periodontal disease could prevent about 850,000 cases of dementia worldwide[11]. In addition, structured oral care in long-term care facilities reduces pneumonia, with numbers needed to treat as low as 8.6[26], offering immediate savings in preventable hospitalizations among people living with dementia. These benefits extend beyond individual patients to families, caregivers, employers and public payers.

8.5 The role of the periodontal specialist

Translating this evidence into practice requires professionals with advanced training in periodontology, experience in public health and community-based care, and the capacity to produce and disseminate research. Periodontists and public health dentists are well positioned to lead chairside screening and treatment of periodontitis in older adults, to design oral care protocols for long-term care facilities, to train caregivers and dental teams in the management of patients with cognitive impairment, and to conduct the pragmatic trials still needed to establish whether periodontal therapy changes cognitive trajectories. Table 2 summarizes the alignment of these actions with U.S. national priorities.

Table 2. Alignment of oral health and dementia actions with U.S. national priorities

National priority	Federal reference	Contribution of periodontal / oral health care
Reduce risk factors for ADRD	NAPA, National Plan Goal 6[6]	Periodontitis as a prevalent, modifiable and low-cost risk-reduction target
Optimize care quality and efficiency	National Plan Goal 2[6]	Oral care protocols for people living with dementia; prevention of aspiration pneumonia
Support people with ADRD and their families	National Plan Goal 3[6]	Caregiver training in daily oral hygiene and early dental planning
Sustainability of public payers	Medicare / Medicaid[1,27]	Fewer preventable hospitalizations; evidence for dental benefit design
Health equity	Disparities in ADRD burden and dental access[2,28]	Targeting low-income and minority older adults with the highest combined risk

ADRD: Alzheimer's disease and related dementias; NAPA: National Alzheimer's Project Act.

IX. Limitations and Research Agenda

This narrative review did not follow a registered systematic protocol, and the selection of studies may be subject to bias. Most of the epidemiological evidence is observational, and residual confounding by socioeconomic position, smoking, diabetes and access to care is possible; reverse causation is also plausible, since prodromal cognitive decline impairs oral self-care. Definitions of periodontitis and tooth loss varied across studies.

Future research should prioritize: (i) pragmatic randomized trials of intensive periodontal treatment and maintenance in middle-aged adults with periodontitis, using validated cognitive, biomarker and neuroimaging outcomes; (ii) analyses of U.S. claims and cohort data to estimate the cost-effectiveness of periodontal care as a dementia risk-reduction strategy; (iii) implementation studies of oral care protocols in U.S. long-term care facilities; and (iv) evaluation of the effect of dental benefit expansions in Medicare Advantage and Medicaid on oral and cognitive outcomes of older adults.

X. Conclusion

Consistent epidemiological associations, dose-response relationships with tooth loss and converging mechanistic evidence indicate that periodontitis is a plausible and potentially modifiable contributor to cognitive decline and dementia. Although randomized evidence on cognitive outcomes is still lacking, periodontal prevention and treatment are safe, inexpensive and beneficial for general health in their own right. Incorporating oral health into dementia risk-reduction strategies, ensuring access to dental care for older Americans and preparing the dental workforce to care for people living with dementia are measures of substantial merit and national importance for the United States, fully aligned with the goals of the National Plan to Address Alzheimer's Disease.

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