NEUROLOGICAL

Year	Name of Study	Publication	Author(s)	Institution(s)	Conclusions
2022	Oral Health Status in Subjects with Amnestic Mild Cognitive Impairment and Alzheimer's Disease: Data from the Zabút Aging Project	*J Alzheimers Dis. 2022;87(1):173-183*	Panzarella V, Mauceri R, Baschi R, Maniscalco L, Campisi G, Monastero R.	Department of Surgical, Oncological, and Oral Sciences, Sector of Oral Medicine "Valerio Margiotta"; University of Palermo, Palermo, Italy	The decayed, missing, and filled teeth (DMFT) total score of Alzheimer's disease (AD) subjects was significantly higher than amnestic mild cognitive impairment [aMCI] (p = 0.009) and controls (p = 0.001). Furthermore, the "M" component of DMFT (i.e., the number of missing teeth) was significantly higher in AD than in aMCI (p < 0.001) and controls (p < 0.001). A Poisson regression model revealed that age (p < 0.001), male gender (p = 0.001), and AD (p = 0.001) were positively correlated with decayed, missing, and filled teeth (DMFT). Concerning oral microbial load, the presence of Fusobacterium nucleatum was significantly higher in AD than in controls (p = 0.02), and a higher load of Treponema denticola was found in aMCI than with AD (p = 0.004). OHR-QoL scores did not differ among the groups.
2021	Oral health of individuals with dementia and Alzheimer's disease: A review	*J Indian Soc Periodontol. Mar-Apr 2021;25(2):96-101.*	Hamza SA, Asif S, Bokhari SAH	Department of Oral Medicine, University Medical and Dental College, The University of Faisalabad, Faisalabad, Pakistan	The explored literature from 22 studies shows that oral health parameters of oral health and levels of oral inflammatory markers were deranged and exaggerated in patients suffering from AD and dementia. Many studies have observed poor oral hygiene as result of lack or irregularity in toothbrushing. Regarding decayed, missing, and filled teeth status in Alzheimer's disease (AD)/dementia populations, no significant difference is reported. Periodontal diseases have been noted at raised levels in AD and dementia patients and shown progression with aggravation in neurological disorders. Both edentulousness and low chewing efficacies are associated with low cognition. Stomatitis and coated tongue and other oral pathologies are significantly higher in AD patients. AD patients have demonstrated higher bacterial load and inflammation levels than controls, and consequently, inflammatory biomarker levels are also raised. AD patients have reduced salivary secretions and with low buffering capacity.
2021	Oral frailty and neurodegeneration in Alzheimer's disease	*Neural Regen Res. 2021 Nov;16(11):2149-2153*	Dibello V, Lozupone M, Manfredini D, Dibello A, Zupo R, Sardone R, Daniele A, Lobbezoo F, Panza F	Department of Orofacial Pain and Dysfunction, Academic Centre for Dentistry Amsterdam (ACTA), University of Amsterdam and Vrije Universiteit Amsterdam, Amsterdam, The Netherlands	Oral microbiota may influence Alzheimer's disease risk via circulatory or neural access to the brain and the interplay with periodontal disease, often causing tooth loss also linked to an increased Alzheimer's disease risk. On this bases, COR388, a bacterial protease inhibitor targeting Porphyromonas gingivalis implicated in periodontal disease, is now being tested in a double-blind, placebo-controlled Phase II/III study in mild-to-moderate Alzheimer's disease. Therefore, oral status may be an important contributor to general health, including Alzheimer's disease and late-life cognitive disorders, suggesting the central role of preventive strategies targeting the novel oral frailty phenotype and including maintenance and improvement of oral function and nutritional status to reduce the burden of both oral dysfunction and frailty.

2021	Alzheimer's Disease and Oral-Systemic Health: Bidirectional Care Integration Improving Outcomes	*Front Oral Health. 2021 Jul 5;2:674329.*	Rice AO	Oral Systemic Seminars, Conroe, TX, United States	Alzheimer's is associated with many etiologies and pathophysiological processes. These include cardiovascular health, smoking, sleep, inflammatory pathogens, and diabetes. In the United States, dental providers assess each of these factors daily and can be instrumental in educating patients on the influence of these factors for dementia prevention. Globally, by 2025, the number of people with Alzheimer's disease is expected to rise by at least 14%. Such increases will strain local and national health care systems, but for the US if Medicare were expanded to include dental services, many older adults could be spared needless suffering.
2021	Oral Health Status and Nutritional Habits as Predictors for Developing Alzheimer's Disease	*Med Princ Pract. 2021;30(5):448-454*	Popovac A, Čelebić A, Peršić S, Stefanova E, Milić Lemić A, Stančić I.	Clinic for Prosthodontics, School of Dental Medicine, University of Belgrade, Belgrade, Serbia	Variables with significant differences between groups, which were analyzed by using the binary regression analysis, were marital status, residence, number of total functional tooth units (FTUs) (no matter whether the contacts were between natural teeth or dentures), eating meat/fish and fruits/vegetables, food consistency, and serum albumin level. Logistic regression analysis showed that being single/widowed/divorced, eating more meat/fish or fruit/vegetable, eating blended/mashed/liquid food, having low levels of serum albumin, and having less FTUs were significant predictors for developing dementia. Having fewer occlusal contacts, consumption of soft food, and lower serum albumin levels can be considered as associated risk factors for Alzheimer's disease (AD).
2021	Oral and Periodontal Health in Patients with Alzheimer's Disease and Other Forms of Dementia - A Cross-sectional Pilot Study	*Oral Health Prev Dent. 2021 Jan 7;19(1):255-261*	Laugisch O, Johnen A, Buergin W, Eick S, Ehmke B, Duning T, Sculean A	Department of Periodontology and Peri-Implant Diseases, Philipps University, Marburg, Germany	Periodontitis was diagnosed in all patients. Patients with Alzheimer's disease (AD) presented mean bleeding-on-probing (BOP) of 54.7 ± 31.1% and radiographic bone loss of 42.5 ± 25.3%; the mean BOP of those with other forms of dementia (noAD/DEM) was 52.0 ± 23.7% and radiographic bone loss was 40.9 ± 32.3%. There was also no statistically significant difference regarding other periodontal and dental parameters.
2021	Profiling the oral microbiomes in patients with Alzheimer's disease	*Oral Dis. 2021 Dec 21*	Guo H, Li B, Yao H, Liu D, Chen R, Zhou S, Ji Y, Zeng L, Du M.	The State Key Laboratory Breeding Base of Basic Science of Stomatology (Hubei-MOST) and Key Laboratory of Oral Biomedicine Ministry of Education, School and Hospital of Stomatology, Wuhan University, Wuhan, Hubei, China	The predominant bacterium of salivary microbiome and periodontal microbiome from AD patients was Streptococcus oralis and Porphyromonas gingivalis, respectively. With respect to β diversity analysis, there was a significance difference in periodontal microbiome between AD patients and cognitively intact subjects. The relative abundance of Veillonella parvula significantly increased in oral microbiomes from AD patients. Interestingly, the dominant species were different between early-onset AD and late-onset AD patients. Moreover, the predominant species were changed as the clinical severity of AD. Furthermore, the correlation analysis revealed that V. parvula was associated with AD in both saliva and GCF and that P. gingivalis was associated with AD only in GCF. In this study, the microbiome community of oral microbes was altered in AD patients and periodontal microbiome was sensitive to cognition changes. Moreover, V. parvula and P. gingivalis were associated with AD.

2021	Association Between Oral Health and the Medical Costs of Dementia: A Longitudinal Study of Older Japanese	*Am J Alzheimers Dis Other Demen. 2021 Jan-Dec; 36:15333175219 96142.*	Saito M, Shimazaki Y, Nonoyama T, Ohsugi K.	Department of Preventive Dentistry and Dental Public Health, School of Dentistry, Aichi Gakuin University, Nagoya, Japan	Individuals with fewer teeth or with poor periodontal condition had significantly higher medical costs ratios for dementia independent of other confounding variables. The adjusted medical costs ratios of dementia were 4.13 (95% CI [confidence interval]; 1.79-9.56) for those with ≤9 teeth compared with those with ≥20 teeth and 3.48 (95% CI; 1.71-7.08) for those with personal CPI code 4 compared with those with personal CPI code 0-2.
2021	The oral manifestations of Huntington's disease: A systematic review of prevalence	*Oral Dis. 2021 Nov 12.*	Munhoz L, Jabbar AQ, Silva Filho WJE, Nagai AY, Arita ES.	Department of Stomatology, School of Dentistry, São Paulo University, São Paulo, Brazil	The oral manifestations of HD were found to be associated with the advance of the disease in that the more severe the HD, the worse the alterations affecting the oral cavity. Dysphagia, dysarthria, masticatory problems, oral health impairment, and choreiform movements involving the tongue and other orofacial muscles were the main manifestations of HD in the oral cavity.
2020	Association of oral health-related quality of life and Alzheimer disease: A systematic review	*J Prosthet Dent. 2020 Aug;124(2):168-175*	Ming Y, Hsu SW, Yen YY, Lan SJ	Department of Healthcare Administration, Asia University, Taichung City, Taiwan, Republic of China	A statistical analysis was conducted with 4 studies that reported Geriatric Oral Health Assessment Index (GOHAI) scores, and no significant differences were found in GOHAI scores between participants with AD and controls (standard mean difference: 0.09; 95% confidence interval: -0.66 to 0.85). All studies that explored factors affecting Oral health-related quality of life (OHRQoL) showed different associations between cognitive impairment, oral health conditions, and OHRQoL. One study showed that cognitive impairment was negatively associated with OHRQoL. Three studies found oral health conditions (including periodontitis, gingival bleeding, probing depth >4 mm, and number of natural teeth) impaired the OHRQoL of participants with Alzheimer disease (AD). Three studies reported that prosthetic type and quality positively affected OHRQoL among participants with AD. OHRQoL may not fully represent actual oral health problems of patients with AD.
2020	Is there an association between oral health-related quality of life and Alzheimer's disease?	*Evid Based Dent. 2020 Dec;21(4):124-125*	Plessas A, Paisi M.	Peninsula Dental School, University of Plymouth, Plymouth, UK	When the results of four studies which used the Geriatric Oral Health Assessment Index (GOHAI) were pooled together in a meta-analysis, no statistically significant differences in the GOHAI scores between patients with Alzheimer's disease and controls were found (SMD = 0.09; 95%CI: -0.66 to 0.85).The results of this review showed no significant difference in OHRQoL between patients with Alzheimer's disease and healthy controls.
2020	Clinical and Bacterial Markers of Periodontitis and Their Association with Incident All-Cause and Alzheimer's Disease Dementia in a Large National Survey.	*J Alzheimers Dis. 2020;75(1):157-172.*	Beydoun MA, Beydoun HA, Hossain S, El-Hajj ZW, Weiss J, Zonderman AB	National Institutes on Aging; Fort Belvoir Community Hospital; McGill University; University of Pennsylvania	Microbial agents including periodontal pathogens have recently appeared as important actors in Alzheimer's disease (AD) pathology. This study provides evidence for an association between periodontal pathogens and AD, which was stronger for older adults.

2020	U.S. state correlations between oral health metrics and Alzheimer's disease mortality, prevalence and subjective cognitive decline prevalence	*Sci Rep. 2020 Dec 1;10(1):20962*	Scherer RX, Scherer WJ	University of Central Florida, The Burnett Honors College, 12778 Aquarius Agora Drive, Orlando, FL	Given the association between periodontal disease (PdD) and Alzheimer's disease (AD), we examined correlations between states' age-adjusted AD mortality rates, AD prevalence, subjective cognitive decline (SCD) prevalence, and oral health data. Pearson (r) or Spearman (rs) correlation coefficients were generated and evaluated. AD mortality rates correlate with dental visits (r = - 0.50, p = 0.0003), partial (r = 0.39, p = 0.005) or total (r = 0.44, p = 0.001) edentulism, WalletHub.com (rs = 0.30, p = 0.03) and Toothbrush.org (rs = 0.35, p = 0.01) rankings. AD prevalence correlates with dental visits (r = - 0.30, p = 0.03), partial (r = 0.55, p = 0.00003) or total (r = 0.46, p = 0.0009) edentulism, prevalence of any (r = 0.38, p = 0.006) or severe-stage (r = 0.46, p = 0.0009) PdD, and WalletHub.com (rs = 0.38, p = 0.006) rankings. SCD prevalence in adults aged ≥ 45 years correlates with dental visits (r = - 0.69, p < 0.00001), partial (r = 0.33, p = 0.02) or total (r = 0.37, p = 0.008) edentulism, prevalence of any (r = 0.53, p = 0.0001) or severe-stage (r = 0.57, p = 0.00002) PdD, WalletHub.com (rs = 0.53, p = 0.00008) and Toothbrush.org (rs = 0.60, p < 0.00001) rankings.
2020	Oral health and cognitive status in the Concord Health and Ageing in Men Project: A cross-sectional study in community-dwelling older Australian men	*Gerodontology. 2020 Dec;37(4):353-360.*	Takehara S, Wright FAC, Waite LM, Naganathan V, Hirani V, Blyth FM, Le Couteur DG, Seibel MJ, Handelsman DJ, Cumming RG.	Centre for Education and Research on Ageing, Concord Clinical School, The University of Sydney, and the Ageing and Alzheimer's Institute, Concord Repatriation General Hospital, Sydney Local Health District, Concord, Concord, NSW, Australia	Overall, 67.5% of participants reported that they could chew all 11 listed food items. Participants with fewer than 20 teeth were statistically significantly more likely to have cognitive impairment (unadjusted odds ratio (OR) 1.87; 95% confidence interval (CI) 1.25-2.79, adjusted OR 1.62; 95% CI 1.07-2.43). Participants with limited chewing capacity were also more likely to have cognitive impairment (unadjusted OR 1.91; 95% CI 1.25-2.94, adjusted OR 1.61; 95% CI 1.03-2.49).
2020	Parkinson's Disease, Periodontitis and Patient-Related Outcomes: A Cross-Sectional Study	*Medicina (Kaunas). 2020 Jul 30;56(8):383.*	Lyra P, Machado V, Proença L, Domingos J, Godinho C, Mendes JJ, Botelho J.	Clinical Research Unit (CRU), Centro de Investigação Interdisciplinar Egas Moniz (CiiEM), Instituto Universitário Egas Moniz, 2829-511 Caparica, Portugal	We performed full-mouth periodontal examination and gathered information on self-perceived quality of life in PD, oral health impact profile (OHIP-14) and xerostomia. Results: The prevalence of periodontitis was 75.0% and most cases were identified as severe (46.4%). Upper extremity rigidity, hand posture and kinetic tremors were significantly correlated with worse periodontal status. PDQ-8 showed to be correlated with self-perceived oral health-related quality of life and xerostomia levels. Conclusions: This group of people with PD had a high prevalence of periodontitis. Deteriorated levels of the upper extremities in advanced stages of PD were associated with worse periodontal status and hygiene habits. Quality of life in PD appears to be associated with self-perceived OHRQoL and xerostomia.
2019	Oral diseases and inflammatory burden and Alzheimer's disease among subjects aged 75 years or older	*Spec Care Dentist. 2019 Mar;39(2):158-165*	Tiisanoja A, Syrjälä AM, Tertsonen M, Komulainen K, Pesonen P, Knuuttila M, Hartikainen S, Ylöstalo P	Unit of Oral Health Sciences Research, University of Oulu, Oulu, Finland.	Dental caries, the presence of ≥3 carious teeth (RR: 3.47, 95% CI: 1.09-11.1) and the number of carious teeth (RR: 1.24, CI: 1.11-1.39), and inflammatory burden (RR: 1.44, CI: 1.04-2.01) were associated with a higher likelihood of having AD. Also, periodontal disease and stomatitis were associated, although nonstatistically, with AD and dementia. The risk estimates for any type of dementia were in most cases lower than for AD. Oral diseases and the related inflammatory burden were in most cases associated more strongly with diagnosed AD than dementia in general. Of the oral diseases studied, the strongest association was between dental caries and AD.

Year	Title	Journal	Authors	Affiliation	Summary
2018	Oral hygiene and oral health in older people with dementia: a comprehensive review with focus on oral soft tissues	*Clin Oral Investig. 2018 Jan;22(1):93-108*	Delwel S, Binnekade TT, Perez RSGM, Hertogh CMPM, Scherder EJA, Lobbezoo F.	Faculty of Behavioral and Movement Sciences, Department of Clinical Neuropsychology, VU University, Amsterdam, The Netherlands	The searches yielded 549 unique articles, of which 36 were included for critical appraisal and data extraction. The included studies suggest that older people with dementia had high scores for gingival bleeding, periodontitis, plaque, and assistance for oral care. In addition, candidiasis, stomatitis, and reduced salivary flow were frequently present in older people with dementia. The studies included in the current systematic review suggest that older people with dementia have high levels of plaque and many oral health problems related to oral soft tissues, such as gingival bleeding, periodontal pockets, stomatitis, mucosal lesions, and reduced salivary flow.
2018	Oral health in Alzheimer's disease: a multicenter case-control study	*Clin Oral Investig. 2018 Dec;22(9):3061-3070*	Aragón F, Zea-Sevilla MA, Montero J, Sancho P, Corral R, Tejedor C, Frades-Payo B, Paredes-Gallardo V, Albaladejo A.	Department of Surgery, Faculty of Medicine and Dentistry, University of Salamanca, Campus Miguel de Unamuno, Calle Alfonso X El Sabio s/n, 37007, Salamanca, Spain	Alzheimer's patients exhibited, as compared to the control group, (1) fewer teeth (10.9 ± 10.5 vs 23.7 ± 6.5), (2) fewer obturations (2.2 ± 3.4 vs 6.6 ± 5.6), (3) fewer periodontally healthy sextants (0.1 ± 0.4 vs 1.4 ± 2.2), (4) worse oral hygiene (43.1 vs 72.2% brushed), (5) greater use of removable prostheses (47.8 vs 8.4%), (6) higher incidence of candida infection (11.8 vs 0.0%) and cheilitis (15.9 vs 0.0%), (7) lower salivary flow (0.6 ± 0.6 vs 1.1 ± 0.6), and (8) lower buffering capacity (46 vs 80%). After taking into account the influence of age, Alzheimer's patients had worse oral health (caries and periodontal disease), more mucosal lesions (cheilitis and candidiasis), and worse saliva quantity and quality.
2018	Oral Health Status in Alzheimer's Disease Patients: A Descriptive Study in an Italian Population	*J Contemp Dent Pract. 2018 May 1;19(5):483-489*	D'Alessandro G, Costi T, Alkhamis N, Bagattoni S, Sadotti A, Piana G.	Department of Biomedical and Neuromotor Sciences Dental School, Alma Mater Studiorum, Universita di Bologna Bologna, Italy	Statistically more AD patients (91.7%) were under pharmacological therapy and their physical status was more severe (ASA 2, ASA 3) compared with control subjects (p < 0.001). Moreover, they presented numbers of D, CPI, and GI significantly higher (p ≤ 0.005). In the institutionalized subgroup, statistically more moderate and severe AD cases were detected and more patients were edentulous (p < 0.001). Noninstitutionalized patients presented DF/T ratio, CPI, and GI significantly lower (p ≤ 0.024). A significant weak negative correlation (r = -0.121 to -0.372) between epidemiologic indices and AD severity was observed. Alzheimer's disease patients show a low oral health status that decreases progressively as the disease severity aggravates. Therefore, further studies are necessary to investigate oral health care interventions for AD patients.
2017	Oral health and orofacial pain in older people with dementia: a systematic review with focus on dental hard tissues	*Clin Oral Investig. 2017 Jan;21(1):17-32*	Delwel S, Binnekade TT, Perez RS, Hertogh CM, Scherder EJ, Lobbezoo F.	Faculty of Behavioral and Movement Sciences, Department of Clinical Neuropsychology, VU University, Amsterdam, The Netherlands	The search yielded 527 articles, of which 37 were included for the quality assessment and quantitative overview. The median NOS score of the included studies was 5, and the mean was 4.9 (SD 2.2). The heterogeneity between the studies was considered too large to perform a meta-analysis. An equivalent prevalence of orofacial pain, number of teeth present, decayed missing filled teeth index, edentulousness percentage, and denture use was found for both groups. However, the presence of caries and retained roots was higher in older people with dementia than in those without. Older people with dementia have worse oral health, with more retained roots and coronal and root caries, when compared to older people without dementia. Little research focused on orofacial pain in older people with dementia.

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2017	Self-assessment of oral health, dental health care and oral health-related quality of life among Parkinson's disease patients	*Gerodontology. 2017 Mar;34(1):135-143*	Barbe AG, Bock N, Derman SH, Felsch M, Timmermann L, Noack MJ.	Department of Operative Dentistry and Periodontology, Centre of Dental Medicine, University of Cologne, Köln, Germany	Participants experienced xerostomia (49%), drooling (70%) & dysphagia (47%) and suffered from a limited ability to perform oral hygiene (29%). The oral symptoms xerostomia, drooling and dysphagia impaired the OH-related QoL [OHIP total score 14.6 (9.7)-16.8 (11.4) compared to 11.3 (9.9) in participants without symptoms]. In total, 91.8% of participants had their own dentist. Only 6.1% of participants with xerostomia received advice regarding management. In this study, patients with PD suffered from OH-related symptoms (xerostomia, drooling, and dysphagia) that impaired their OH-related QoL. Participants felt that they received adequate dental health care; however, dental advice regarding management of PD-related OH problems was often lacking.
2017	Association between chronic periodontitis and the risk of Alzheimer's disease: a retrospective, population-based, matched-cohort study	*Alzheimers Res Ther. 2017 Aug 8;9(1):56*	Chen CK, Wu YT, Chang YC	Chung Shan Medical University; Kaohsiung Armed Forces General Hospital; National Defence Medical Centre	Chronic gum inflammation increases the risk of developing Alzheimer's disease. As oral bacteria breaks into the bloodstream through the gums, it can travel to organs throughout the body, including the brain. Patients with chronic periodontitis had a higher prevalence of hyperlipidemia, depression, traumatic brain injury and co-morbidities.
2012	Dementia and oral health among subjects aged 75 years or older	*Gerodontology. 2012 Mar;29(1):36-42.*	Syrjälä AM, Ylöstalo P, Ruoppi P, Komulainen K, Hartikainen S, Sulkava R, Knuuttila M	Department of Periodontology, Institute of Dentistry, University of Oulu, Finland	This cross-sectional study is based on the Geriatric multi-disciplinary strategy (Gems) study that included 76 demented and 278 non-demented subjects. The data were collected by means of an interview and an oral clinical examination. The type of dementia was diagnosed according to DSM-IV criteria. Poisson's and logistic regression models were used to determine relative risks (RR), odds ratios (OR) and 95% confidence limits (CI). Our results showed that patients with Alzheimer's disease and those with other types of dementia had an increased likelihood of having carious teeth, teeth with deep periodontal pockets, and poor oral and denture hygiene, compared with non-demented persons. The results showed that the type of dementia does not seem to be an essential determinant of oral health.
2010	Oral health in Alzheimer's disease: a review	*Curr Alzheimer Res. 2010 Jun;7(4):368-73*	Mancini M, Grappasonni I, Scuri S, Amenta F.	Centro di Ricerche Cliniche, Dipartimento di Medicina Sperimentale e Sanità Pubblica, Università di Camerino, 62032 Camerino, Italy	Appropriate dental interventions in adult-onset dementia disorders will decrease pain and oral pathology and consequently could contribute to maintain enough oral and nutritional health in these patients. Dental treatment in early stages of the disease are important and should be finalized at producing a stable oral condition. This could improve the quality of life and contribute to decrease worsening of oral situations in the later stages of the disease when dental treatment may be difficult. The problem of awareness of good oral health for keeping quality of life more acceptable in adult-onset dementia disorders is discussed.