Acta Scientific Dental Sciences

Volume 9 Issue 11 November 2025

Review Article

Nutrition and Oral Health - A Narrative Review of Interrelationships and Public Health Implications

Chetan Vinay Deshmukh[1], Vibhuti Dilip Mistry[2]*, Saloni Dnyaneshwar Wankhede[3], Ankita V Gadekar[3] and Benita Varghese[4]

[1]Assistant Professor, Public Health Dentistry, Nair Hospital Dental College, Mumbai and Ph.D. Scholar, Public Health Dentistry, ACPM Dental College, Maharashtra University of Health Sciences, Nashik, Maharashtra, India

[2]Assistant Professor, Department of Periodontology, JMF's ACPM Dental college, Dhule, Maharashtra, India

[3]Postgraduate Student, Public Health Dentistry, JMF's ACPM Dental College, Dhule, Maharashtra

[4]Postgraduate Student, Periodontology and Oral Implantology, JMF's ACPM Dental College, Dhule, Maharashtra, India

***Corresponding Author:** Vibhuti Dilip Mistry, Assistant Professor, Department of Periodontology, JMF's ACPM Dental college, Dhule, Maharashtra, India.

DOI: 10.31080/ASDS.2025.09.2065

Received: September 26, 2025

Published: October 23, 2025

Abstract

Nutrition plays a critical role in the maintenance of oral health throughout the life span. Dietary components influence the development and progression of major oral diseases, including dental caries, periodontal diseases, and oral cancer. Macronutrient intake, micronutrient deficiencies, and dietary patterns interact with oral microbiota, salivary function, and immune responses to impact oral tissues. Conversely, oral health conditions can significantly affect nutritional intake, particularly in vulnerable populations such as children and older adults. This narrative review explores the bidirectional relationship between nutrition and oral health, summarizes current evidence on dietary influences on oral diseases, and discusses the implications for clinical practice and public health. Integrating nutritional guidance into oral health care offers a valuable preventive strategy to combat the global burden of oral diseases.

Keywords: Nutrition; Oral Health; Dental Caries; Periodontal Diseases; Public Health Dentistry

Introduction

Oral health is a fundamental component of general health and well-being. It encompasses the ability to speak, smile, smell, taste, chew, and swallow without pain or disease of the mouth and related structures [1]. Globally, oral diseases affect over 3.5 billion people, with dental caries, periodontitis, and oral cancers being among the most prevalent noncommunicable diseases (NCDs) [2]. Simultaneously, malnutrition - both undernutrition and overnutrition - is increasingly recognized as a determinant of oral health. Diet influences the development and progression of oral diseases through its effects on microbial activity, immune response, and structural integrity of oral tissues.

The oral cavity is the initial site of interaction between food and the human body, rendering it highly susceptible to dietary influences. Excessive sugar consumption is a well-established risk factor for dental caries, while deficiencies in vitamins such as vitamin C and D have been linked to periodontal disease and bone loss [3]. Moreover, nutrition affects oral cancer risk, with antioxidant-rich diets offering protective effects.

Given this intricate relationship, understanding the impact of nutrition on oral health is imperative for both clinicians and public health professionals. This review aims to synthesize the evidence on how nutrition influences oral health and explore avenues for integrating dietary strategies into oral health promotion.

Nutritional determinants of oral health

Nutrition exerts both direct and indirect influences on oral health. Specific macronutrients and micronutrients play roles in the development, maintenance, and protection of oral tissues. Conversely, dietary excesses or deficiencies may compromise oral health, predisposing individuals to caries, periodontal disease, and other oral pathologies.

Macronutrients

Carbohydrates

Fermentable carbohydrates, particularly free sugars, are the primary dietary factor in the development of dental caries. Oral bacteria such as *Streptococcus mutans* metabolize these sugars to produce acids, leading to demineralization of enamel [4]. The frequency of sugar intake, more than the quantity, has been strongly associated with caries risk [5]. Sugary snacks and beverages, especially when consumed between meals, significantly increase the cariogenic potential of the diet.

Proteins and fats

Dietary proteins and fats are generally considered non-cariogenic. In fact, protein-rich foods like dairy and meats may have protective effects due to their buffering capacity and role in salivary stimulation [6]. Fats, particularly those from dairy sources, can form protective coatings on teeth, reducing sugar adhesion and bacterial colonization [7].

Micronutrients

Calcium and vitamin D

Calcium is essential for the mineralization of enamel and dentin, while vitamin D facilitates calcium absorption and supports bone metabolism. Inadequate intake or metabolism of these nutrients is associated with increased risk of dental caries and periodontal disease [8]. Studies have shown that supplementation with vitamin D and calcium improves periodontal attachment levels and reduces gingival inflammation [9].

Vitamin C

Vitamin C (ascorbic acid) is vital for collagen synthesis and immune function. Its deficiency impairs the integrity of gingival tissues and increases susceptibility to periodontal disease. Scurvy, a severe form of vitamin C deficiency, historically presents with bleeding gums and tooth loss [10].

B-Complex Vitamins

B vitamins, especially B2 (riboflavin), B3 (niacin), B6 (pyridoxine), and B12 (cobalamin), are important for maintaining healthy oral mucosa and promoting wound healing. Deficiencies can lead to glossitis, angular cheilitis, and stomatitis [11].

Iron and Zinc

Iron is essential for hemoglobin production and immune response. Iron deficiency anemia often presents with atrophic glossitis and increased vulnerability to oral infections. Zinc contributes to tissue repair and inflammation control; its deficiency may delay healing and exacerbate periodontitis [12].

Nutrition across the lifespan

Nutritional needs and their impact on oral health vary significantly across different life stages. Each stage-from prenatal development through old age-presents unique dietary challenges and oral health considerations. Understanding these dynamic interactions is essential for effective prevention and management of oral diseases.

Pregnancy

Maternal nutrition profoundly influences the development of the fetal dentition and oral structures. Deficiencies in calcium, vitamin D, and folic acid during pregnancy have been linked to enamel hypoplasia, delayed tooth eruption, and increased risk

of cleft lip or palate [13]. Furthermore, hormonal changes in pregnancy can predispose to gingivitis and periodontal disease, which may be exacerbated by poor dietary choices and increased sugar intake due to nausea or cravings [14].

Infancy and childhood

In early childhood, nutrition plays a critical role in craniofacial development and the eruption of primary teeth. Breastfeeding has been associated with lower risk of early childhood caries compared to prolonged bottle feeding with sugary liquids [15]. Frequent consumption of sweetened snacks and juices contributes significantly to the high global prevalence of dental caries in this age group [16]. Nutritional deficiencies, particularly in vitamin D, iron, and calcium, may also impair immune function and enamel formation.

Adolescence

Adolescence is marked by rapid growth and hormonal changes, often accompanied by poor dietary habits such as increased consumption of sugary beverages and fast food. These habits raise the risk of caries and periodontal inflammation. Orthodontic treatments common in this age group further complicate oral hygiene and require enhanced nutritional awareness to prevent demineralization and gingivitis [17].

Adulthood

In adults, nutritional imbalances may be compounded by lifestyle factors such as smoking, alcohol use, and stress, which negatively affect oral health. Periodontal disease often becomes more prevalent in this life stage, and diets lacking in antioxidants and essential micronutrients can exacerbate inflammation and tissue breakdown [18].

Older adults

Older individuals often experience reduced masticatory efficiency due to tooth loss, ill-fitting dentures, or xerostomia (dry mouth), leading to dietary restrictions and poor nutrient intake. This can result in a vicious cycle of malnutrition and worsening oral health [19]. Additionally, age-related reductions in taste and smell may lead to increased salt or sugar consumption, further impacting oral and systemic health.

Dietary patterns and oral diseases

Beyond individual nutrients, overall dietary patterns exert substantial influence on oral health. Shifting focus from isolated dietary components to broader patterns allows for a more realistic and holistic assessment of how eating behaviors affect the etiology and progression of oral diseases. Several common dietary patterns-both protective and detrimental-have been identified as having strong links to oral health outcomes.

Western diet

The Western diet, characterized by high intake of refined carbohydrates, added sugars, saturated fats, and processed foods, is strongly associated with poor oral health outcomes. It promotes acidogenic plaque microbiota, resulting in increased demineralization of enamel and the development of dental caries [20]. Additionally, such diets are low in fiber and micronutrients, exacerbating systemic inflammation and increasing susceptibility to periodontal diseases [21].

Mediterranean diet

The Mediterranean diet emphasizes fruits, vegetables, legumes, whole grains, nuts, olive oil, and moderate intake of fish and poultry. This pattern is rich in antioxidants, omega-3 fatty acids, and polyphenols, which have been shown to reduce inflammation and oxidative stress-key mediators in the pathogenesis of periodontal disease [22]. Adherence to the Mediterranean diet has also been associated with improved periodontal health and lower risk of tooth loss [23].

Plant-based and vegetarian diets

Plant-based diets can offer protective benefits for oral health due to their high content of fiber, vitamins, and phytochemicals. However, strict vegetarian or vegan diets may pose risks if not properly planned. These diets can be deficient in vitamin B12,

calcium, and vitamin D-nutrients vital for maintaining healthy oral and bone structures [24]. Studies have reported increased risk of enamel erosion and periodontal disease among vegans with unbalanced diets [25].

Sugar-free and low-glycemic index diets

Dietary approaches that reduce free sugar consumption and emphasize low-glycemic index foods are effective in minimizing caries risk. Low-glycemic foods do not lead to rapid spikes in blood glucose, thereby reducing substrate availability for cariogenic bacteria [26]. Additionally, these diets help modulate systemic inflammation, potentially contributing to better periodontal outcomes.

Oral health conditions impacting nutrition

Oral health not only reflects nutritional status but also directly affects an individual's ability to consume a balanced diet. Various oral diseases and conditions-such as caries, periodontal disease, tooth loss, and oral cancers-can impair mastication, swallowing, taste, and saliva production, resulting in compromised nutritional intake. This bidirectional relationship highlights the need for integrated dental and nutritional care.

Dental caries and tooth loss

Advanced dental caries can lead to pain, sensitivity, and ultimately tooth extraction, all of which reduce masticatory efficiency. Individuals with significant tooth loss often shift to soft, easily chewable foods that are typically low in fiber and essential nutrients such as vitamins A, C, and B12, calcium, and protein [27]. These dietary modifications may result in deficiencies that further exacerbate oral and general health problems.

Periodontal disease

Chronic periodontitis is associated with inflammation, gingival recession, and tooth mobility. Pain and discomfort during chewing can lead to food avoidance, particularly fibrous fruits and vegetables, nuts, and meats-foods crucial for micronutrient and protein intake. Studies have linked periodontitis with altered dietary patterns and lower intake of key nutrients such as vitamin C, vitamin D, and omega-3 fatty acids [28,29].

Xerostomia (dry mouth)

Saliva plays a key role in taste perception, bolus formation, and enzymatic digestion. Conditions such as Sjögren's syndrome, medication use (e.g., antihypertensives, antidepressants), or radiation therapy for head and neck cancers can lead to xerostomia. Dry mouth complicates chewing and swallowing, making it difficult to consume dry, rough, or spicy foods, often leading to monotonous diets lacking in variety and nutrients [30].

Oral cancer and mucositis

Oral cancers and their treatments (surgery, radiotherapy, chemotherapy) can profoundly impair oral function. Patients frequently experience mucositis, dysphagia, taste alterations, and nausea, all of which contribute to reduced food intake and significant weight loss. Malnutrition is a common complication in oral cancer patients, often requiring enteral or parenteral nutritional support [31].

Edentulism and denture use

Complete tooth loss (edentulism) drastically reduces bite force and masticatory performance. Although dentures can partially restore function, they rarely match the efficiency of natural dentition. Studies show that denture wearers consume fewer fresh fruits and vegetables and more saturated fats and processed foods compared to dentate individuals [19].

Public health perspectives and integration

The intersection of nutrition and oral health presents critical opportunities for public health intervention. Diet and oral hygiene are modifiable risk factors with significant potential to reduce the burden of oral diseases at the population level. Implementing

policy changes, community-based programs, and integrated care models can substantially improve both oral and general health outcomes.

Health promotion and education

Public health campaigns that emphasize the relationship between healthy eating and oral health can shift behaviors, particularly among high-risk groups. School-based interventions, such as nutrition education and fluoride programs, have demonstrated success in reducing caries prevalence and promoting healthier dietary habits [32]. Integrating oral health messages into existing nutritional campaigns (e.g., sugar reduction initiatives) can amplify their impact [33].

Regulation of sugar and food labeling

Excessive consumption of free sugars is a well-established risk factor for dental caries. Public health strategies such as taxing sugar-sweetened beverages (SSBs), enforcing front-of-pack labeling, and restricting advertising of sugary foods to children have shown effectiveness in reducing sugar intake [3,34]. Countries that implemented SSB taxes (e.g., Mexico, UK) reported reduced consumption and projected improvements in dental and metabolic health [35].

Integration of oral health into nutritional policies

Incorporating oral health considerations into national nutrition and noncommunicable disease (NCD) strategies ensures that dietary guidelines reflect the importance of oral health. For example, the World Health Organization (WHO) advocates for integrated health promotion models that address shared risk factors for NCDs and oral diseases, such as poor diet, tobacco use, and alcohol consumption [36].

Community-based programs

Programs that deliver preventive dental care and nutritional support in underserved populations can bridge access gaps. Mobile dental clinics, community kitchens, and school meal programs fortified with essential micronutrients have been linked to improved oral health indicators, especially among children and the elderly [37]. Culturally tailored programs are particularly effective in encouraging dietary changes in Indigenous and marginalized communities [38].

Interdisciplinary collaboration

Promoting collaboration among dental professionals, dietitians, primary care providers, and public health workers enhances patient education and outcomes. Training dentists in basic nutritional counseling and incorporating oral health assessments into nutritional consultations can foster comprehensive, patient-centered care [39].

Limitations of existing literature

Despite a growing body of evidence supporting the interrelationship between nutrition and oral health, several limitations in the existing literature hinder the development of robust, evidence-based public health strategies and clinical guidelines. These gaps highlight the need for more comprehensive, longitudinal, and interdisciplinary research.

Lack of longitudinal and interventional studies

Much of the current literature is derived from cross-sectional studies, which are limited in their ability to establish causality between dietary factors and oral health outcomes. Longitudinal and interventional studies are essential to understand the long-term effects of specific dietary patterns and nutrient intake on the progression or prevention of oral diseases [40].

Heterogeneity in dietary assessment methods

There is significant variability in the tools used to assess dietary intake, ranging from food frequency questionnaires to 24-hour recalls and diet diaries. This heterogeneity contributes to inconsistent results across studies and complicates meta-analyses. Standardized, validated instruments are needed to improve the accuracy and comparability of dietary data [41].

Underrepresentation of vulnerable populations

Vulnerable groups-including the elderly, socioeconomically disadvantaged populations, and ethnic minorities-are often underrepresented in nutrition and oral health research. These populations frequently face higher burdens of both malnutrition and oral disease, and their exclusion limits the generalizability of findings and impedes the development of equitable interventions [42].

Limited research on emerging dietary patterns

While traditional dietary patterns such as the Western or Mediterranean diets have been studied in relation to oral health, newer and increasingly popular patterns-such as intermittent fasting, ketogenic diets, or plant-based alternatives-remain poorly explored. Understanding the impact of these modern diets on oral tissues, saliva composition, and microbiota is a pressing research need [43].

Insufficient mechanistic and microbiome research

Few studies investigate the underlying mechanisms by which nutrition affects oral health at the cellular, molecular, or microbiome level. There is growing interest in how nutrients modulate oral inflammation, tissue regeneration, and microbial dysbiosis, but further mechanistic research is necessary to support dietary recommendations grounded in biological plausibility [44].

Disconnect between dental and nutritional research

Oral health and nutrition are often studied in isolation, with limited interdisciplinary collaboration. This siloed approach has contributed to fragmented knowledge and missed opportunities for integrated preventive strategies. Bridging this gap requires fostering joint research efforts between dental professionals, dietitians, and public health experts [39].

Conclusion

The intricate relationship between nutrition and oral health is increasingly recognized as a cornerstone of comprehensive health promotion and disease prevention. Nutritional status directly influences oral tissue development, immune responses, and the risk for common oral diseases such as dental caries, periodontal disease, and oral cancer. Conversely, poor oral health can impair dietary intake and nutritional status, creating a bidirectional cycle of deterioration that affects overall health and quality of life.

Micronutrients like calcium, vitamin D, vitamin C, and antioxidants play critical roles in maintaining the structural integrity and defense mechanisms of oral tissues, while macronutrients and dietary patterns modulate inflammation and microbial ecology. The modern diet-often rich in free sugars and processed foods-exacerbates risks for both systemic and oral diseases, particularly among vulnerable populations. Moreover, specific oral conditions such as tooth loss, xerostomia, and oral mucositis have profound effects on dietary choices and nutritional adequacy.

Public health approaches that integrate oral health with nutritional policy-such as sugar reduction initiatives, school meal programs, and interdisciplinary care models-offer significant promise for addressing shared risk factors. However, the existing literature is constrained by methodological limitations, underrepresentation of key populations, and a lack of mechanistic and longitudinal research. Addressing these gaps requires coordinated efforts between dental researchers, nutritionists, public health professionals, and policymakers.

In conclusion, promoting optimal nutrition is both a preventive and therapeutic strategy in oral healthcare. Strengthening this connection through evidence-based guidelines, community interventions, and interdisciplinary education is essential to improving health outcomes and reducing disparities in both nutrition and oral health.

Bibliography

1. Glick M., *et al*. "A new definition for oral health developed by the FDI World Dental Federation opens the door to a universal definition of oral health". *Journal of the American Dental Association* 147.12 (2016): 915-917.

2. World Health Organization. Oral health (2022).

3. Moynihan PJ and Kelly SAM. "Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines". *Journal of Dental Research* 93.1 (2014): 8-18.

4. Fejerskov O and Kidd EAM. "Dental Caries: The Disease and Its Clinical Management. 2nd edition". Wiley-Blackwell (2008).

5. Sheiham A and James WP. "A reappraisal of the quantitative relationship between sugar intake and dental caries: the need for new criteria for developing goals for sugar intake". *BMC Public Health* 14 (2014): 863.

6. Rugg-Gunn AJ. "Nutrition, diet and dental public health". *Community Dental Health* 29.2 (2012): 97-103.

7. Lingström P., *et al*. "Food starches and dental caries". *Critical Reviews in Oral Biology and Medicine* 11.3 (2000): 366-380.

8. Krall EA., *et al*. "Calcium and vitamin D supplements reduce tooth loss in the elderly". *The American Journal of Medicine* 111.6 (2005): 452-456.

9. Dietrich T., *et al*. "Association between serum concentrations of 25-hydroxyvitamin D and gingival inflammation". *The American Journal of Clinical Nutrition* 82.3 (2005): 575-580.

10. Thomas JE., *et al*. "Oral manifestations of scurvy". *The Journal of Oral Pathology* 5.2 (1976): 81-86.

11. Seymour GJ., *et al*. "Relationship between periodontal infections and systemic disease". *Clinical Microbiology and Infection* 13.4 (2007): 3-10.

12. Prasad AS. "Zinc in human health: effect of zinc on immune cells". *Molecular Medicine* 14.5-6 (2008): 353-357.

13. Araujo AC., *et al*. "Use of folic acid during pregnancy and risk of orofacial clefts: a population-based study in southern Brazil". *The Revista de Saúde* Pública 50 (2006): 59.

14. Silk H., *et al*. "Oral health during pregnancy". *American Family Physician* 77.8 (2008):1139-1144.

15. Tham R., *et al*. "Breastfeeding and the risk of dental caries: a systematic review and meta-analysis". *Acta Paediatrica* 104.467 (1952): 62-84.

16. Moynihan P. "The role of diet and nutrition in the etiology and prevention of oral diseases". *Bull World Health Organ* 83.9 (2005): 694-699.

17. Bishara SE and Ostby AW. "White spot lesions: formation, prevention, and treatment". *Seminars in Orthodontics* 14.3 (2008): 174-182.

18. Van der Velden U. "Effect of age on the periodontium". *Journal of Clinical Periodontology* 11.5 (1984): 281-294.

19. Nowjack-Raymer RE and Sheiham A. "Association of edentulism and diet and nutrition in US adults". *Journal of Dental Research* 82.2 (2003): 123-126.

20. Hujoel PP. "Dietary carbohydrates and dental-systemic diseases". *Journal of Dental Research* 88.6 (1999): 490-502.

21. Van Dyke TE and Dave S. "Risk factors for periodontitis". *International Academy of Periodontology* 7.1 (2005): 3-7.

22. Woelber JP., *et al*. "The influence of an anti-inflammatory diet on gingivitis: a randomized controlled trial". *Journal of Clinical Periodontology* 46.5 (2019): 481-490.

23. Pussinen PJ., *et al*. "Periodontitis and cardiometabolic disorders: the role of diet". *Periodontology 2000* 62.1 (2013): 162-182.

24. Waldmann A., *et al*. "German vegan study: diet, life-style factors, and cardiovascular risk profile". *Annals of Nutrition and Metabolism* 49.6 (2005): 366-372.

25. Smits KP and Listl S. "The impact of dietary choices on oral health: a narrative review". *Community Dentistry and Oral Epidemiology* 48.6 (2020): 471-477.

26. Touger-Decker R, van Loveren C. Sugars and dental caries". *The American Journal of Clinical Nutrition* 78.4 (2003): 881S-892S.

27. Sheiham A., *et al*. "The impact of oral health on stated ability to eat certain foods; findings from the National Diet and Nutrition Survey of older people in Great Britain". *Gerodontology* 16.1 (1999): 11-20.v

28. Chapple IL and Genco R. "Diabetes and periodontal diseases: consensus report of the Joint EFP/AAP Workshop on Periodontitis and Systemic Diseases". *Journal of Periodontology* 84.4 (2013): S106-112.

29. Preshaw PM., *et al*. "Periodontitis and diabetes: a two-way relationship". *Diabetologia* 55.1 (2012): 21-31.

30. Villa A., *et al*. "Diagnosis and management of xerostomia and hyposalivation". *Therapeutics and Clinical Risk Management* 11 (2015): 45-51.

31. Capuano G., *et al*. "Pre-treatment body mass index and weight loss in head and neck cancer patients undergoing chemoradiotherapy". *Nutrition and Cancer* 60.6 (2008): 686-694.

32. Petersen PE and Kwan S. "Equity, social determinants and public health programmes – the case of oral health". *Community Dentistry and Oral Epidemiology* 39.6 (2011): 481-487.

33. Watt RG and Sheiham A. "Integrating the common risk factor approach into a social determinants framework". *Community Dentistry and Oral Epidemiology* 40.4 (2012): 289-296.

34. Taillie LS., *et al*. "Do high vs. low purchasers respond differently to a nonessential energy-dense food tax? Two-year evaluation of Mexico's SSB and nonessential food taxes". *Preventive Medicine* 105 (2017): S37-42.

35. Briggs ADM., *et al*. "Health impact assessment of the UK soft drinks industry levy: a comparative risk assessment modelling study". *Lancet Public Health* 1.1 (2016): e15-22.

36. World Health Organization. "Oral Health: Action Plan for Promotion and Integrated Disease Prevention". Geneva: WHO (2012).

37. Dye BA., *et al*. "Assessing the relationship between children's oral health status and that of their mothers". *Journal of the American Dental Association* 142.2 (2011): 173-183.

38. Jamieson LM., *et al*. "Preventive oral health care experiences of Indigenous Australian children and their families". *International Journal of Paediatric Dentistry* 20.5 (2020): 349-355.

39. Touger-Decker R and Mobley CC. "Position of the American Dietetic Association: oral health and nutrition". *Journal of the American Dietetic Association* 107.8 (2007): 1418-1428.

40. Moynihan P. "The relationship between nutrition and systemic and oral well-being in older people". *Journal of the American Dental Association* 138 (2007): 20S-5S.

41. Willett W. "Nutritional Epidemiology. 3rd edition". Oxford: Oxford University Press (2012).

42. Sabbah W., *et al*. "Social gradients in oral and general health". *Journal of Dental Research* 86.10 (2007): 992-996.

43. Aljuraiban GS., *et al*. "The impact of dietary patterns on oral health outcomes: a systematic review". *Nutrients* 14.3 (2022): 593.

44. Belstrøm D. "The salivary microbiota in health and disease". *Journal of Oral Microbiology* 12.1 (2020): 1723975.