



The Impact of Nutrition on Oral Health: A Comprehensive Review

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ABSTRACT:

Oral health is a critical component of general health and well-being, influencing essential human functions such as eating, speaking, and social interaction. Poor oral health can lead to significant nutritional, psychological, and systemic consequences, particularly when associated with pain, tooth loss, or functional impairment. It is important to explore the interrelationship between nutrition and oral health, highlighting key biochemical pathways, dietary influences, and the public health relevance of nutritional practices. Understanding the nutritional determinants of oral diseases is crucial for developing effective interventions and integrating nutrition into oral health promotion strategies.

INTRODUCTION

Oral health is a critical component of general health and well-being, influencing essential human functions such as eating, speaking, and social interaction. According to the World Health Organization (WHO), health is defined as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."¹ Despite this, oral health is often overlooked in assessments of quality of life. Poor oral health can lead to significant nutritional, psychological, and systemic consequences, particularly when associated with pain, tooth loss, or functional impairment.² Nutrition plays a fundamental role in maintaining oral and systemic health. Macronutrients such as carbohydrates, proteins, and fats, as well as micronutrients like vitamins and minerals, are essential for the development and maintenance of oral tissues.³ Deficiencies or imbalances in these nutrients can compromise oral structures, increase susceptibility to diseases such as dental caries and periodontitis and impair healing.^{4,5} The relationship between diet and oral health is bidirectional. While

nutritional deficiencies can lead to oral pathologies, poor oral health can in turn impact nutritional intake by reducing masticatory efficiency and dietary diversity.⁶ Furthermore, high consumption of fermentable carbohydrates is a well-established risk factor for dental caries, the most common chronic disease globally.⁷ It is important to explore the interrelationship between nutrition and oral health, highlighting key biochemical pathways, dietary influences and the public health relevance of nutritional practices. The role of nutritional policies and education programs in India and globally is also examined. Understanding the nutritional determinants of oral diseases is crucial for developing effective interventions and integrating nutrition into oral health promotion strategies.

NUTRIENTS AND THEIR ROLE IN ORAL HEALTH

1. Carbohydrates

Carbohydrates are the primary source of dietary energy, but their excessive consumption—particularly



fermentable sugars—plays a major role in the etiology of dental caries. Simple sugars like sucrose are metabolized by oral bacteria such as *Streptococcus mutans*, producing acids that demineralize the enamel surface.³ Frequent consumption of sugary snacks, beverages and processed foods increases caries risk due to prolonged acid exposure. Diets high in complex carbohydrates, whole grains and fiber have a lower glycemic impact and are less cariogenic.⁷

2. Proteins

Proteins are essential for the growth, maintenance and repair of oral tissues. Deficiency in protein, especially during growth periods, can impair the development of oral structures and delay wound healing.⁸ Adequate protein intake supports immune function, which is critical for maintaining periodontal health. High-protein diets containing animal or plant sources have also been associated with improved gingival health due to their anti-inflammatory effects.⁹

3. Fats

Lipids serve as structural components of cell membranes and are precursors to signalling molecules that modulate inflammation. Certain dietary fats, especially omega-3 polyunsaturated fatty acids, possess anti-inflammatory properties beneficial in the management of periodontal disease.¹⁰ Fats may also reduce the cariogenic potential of the diet by creating a protective coating on tooth surfaces, which interferes with bacterial adherence.¹¹

4. Vitamins

Vitamins are vital in maintaining oral epithelial integrity, immune defence and collagen synthesis.

- **Vitamin A** is necessary for epithelial tissue maintenance and salivary gland function.
- **Vitamin C** plays a key role in collagen formation, essential for periodontal ligament health. Deficiency can lead to gingival bleeding and scurvy.
- **Vitamin D** is required for calcium homeostasis and bone metabolism. Inadequate levels are linked to delayed tooth eruption and increased susceptibility to periodontitis.

- **Vitamin B-complex** deficiencies can result in glossitis, stomatitis, and angular cheilitis.¹²⁻¹⁵

5. Minerals

Minerals, especially calcium and phosphorus, are integral to tooth mineralization and maintenance.

- **Calcium** is essential for enamel and alveolar bone integrity. Inadequate intake can lead to demineralization and increased risk of dental caries.
- **Phosphorus**, in coordination with calcium, strengthens the crystal structure of enamel.
- **Fluoride** is a trace mineral that enhances enamel resistance to acid dissolution by forming fluorapatite. It also inhibits bacterial metabolism.
- **Zinc and iron** contribute to taste perception, salivary gland function, and immune responses, and their deficiencies are associated with oral mucosal lesions.¹⁶⁻¹⁸

NUTRITIONAL FACTORS IN ORAL DISEASES

Nutrition exerts a profound influence on the initiation and progression of common oral diseases such as dental caries, periodontal disease, oral mucosal lesions, and enamel erosion. These conditions share dietary risk factors like high sugar intake, acidic food and beverages and deficiencies of essential vitamins and minerals.

A. Dental Caries

Dental caries is a biofilm-mediated, sugar-driven disease resulting in the demineralization of tooth enamel and dentin. The key nutritional risk factor for dental caries is fermentable carbohydrate intake, especially sucrose, which is metabolized by cariogenic bacteria to produce acids that lower the pH in dental plaque, promoting demineralization.³

Frequent snacking on sugary or starchy foods increases the duration of acidic exposure on the tooth surface. The frequency and form of carbohydrate consumption (e.g. sticky sweets, sugary beverages) are more critical than the total amount.⁷ Conversely, non-cariogenic foods such as dairy products and fibrous vegetables can stimulate salivary flow and help neutralize acids.¹⁹



B. Periodontal Disease

Periodontal disease involves the destruction of the supporting structures of the teeth and is influenced by systemic and nutritional factors. Vitamin C deficiency impairs collagen synthesis and compromises the integrity of the periodontal ligament and gingival tissues, leading to bleeding, inflammation and delayed wound healing.²⁰

Similarly, low dietary intake of calcium and vitamin D has been associated with increased periodontal attachment loss and alveolar bone resorption. Antioxidant nutrients, such as vitamins A, C, and E and flavonoids found in fruits and vegetables help modulate oxidative stress and inflammation in periodontal tissues.²¹

C. Enamel Erosion

Enamel erosion is the loss of enamel caused by acid not derived from bacteria. Dietary acids—such as those in citrus fruits, carbonated drinks and sports beverages—can lower oral pH to critical levels and erode enamel over time.²² The buffering capacity of saliva plays a critical role in counteracting these acidic challenges. Erosion is exacerbated by habits such as frequent consumption of acidic drinks, swishing or holding the drink in the mouth or brushing immediately after consuming acidic foods.²³

D. Oral Mucosal Lesions and Deficiencies

Micronutrient deficiencies can present with various **oral manifestations**:

- **Vitamin B-complex** deficiencies lead to glossitis, angular cheilitis and burning mouth syndrome.
- **Iron deficiency** is associated with pallor of oral mucosa and increased risk of candidiasis.
- **Zinc deficiency** affects taste perception and wound healing.

These manifestations highlight the importance of **nutritional screening** as part of oral examinations, especially in vulnerable populations.²⁴

NUTRITION ACROSS LIFE STAGES AND ITS IMPACT ON ORAL HEALTH

Nutritional needs and vulnerabilities vary significantly across different stages of life. These changes influence not only general health but also oral development, disease susceptibility and healing capacity. Understanding these age-specific interactions between diet and oral health is essential for designing targeted interventions.

1. Infants and Young Children

Early childhood nutrition is vital for the development of teeth, oral tissues and jawbones. Inadequate intake of calcium, phosphorus and vitamin D during infancy may impair the mineralization of enamel and dentin, increasing susceptibility to early childhood caries (ECC).²⁵ Prolonged bottle feeding with sugary liquids, night-time feeding and frequent snacking with fermentable carbohydrates are major risk factors for ECC. Breastfeeding has protective effects, but prolonged and frequent nocturnal feeding beyond 12 months may increase caries risk, especially when oral hygiene is poor.²⁶

2. School-Age Children and Adolescents

Children in this age group undergo mixed dentition and significant growth spurts. Adequate intake of energy, protein, calcium, iron and vitamins A and C is crucial for maintaining oral and systemic health.⁶ Dietary habits formed during adolescence, including increased consumption of carbonated beverages, junk food and skipped meals, can negatively impact oral health and contribute to obesity and metabolic diseases. Peer influence and media exposure often promote unhealthy dietary patterns, making nutrition education in schools critical.²⁷

3. Adults

In adulthood, lifestyle factors and occupational stress influence dietary behaviours. Micronutrient deficiencies, especially of antioxidants like vitamins C and E, are associated with an increased risk of chronic periodontal disease.⁸ Diets high in saturated fats, processed sugars, and low in fiber not only contribute to oral inflammation but also elevate the risk for non-communicable diseases



(NCDs) like diabetes and cardiovascular disease, which are interlinked with periodontal health.²⁸

4. Pregnant and Lactating Women

Pregnancy induces hormonal and metabolic changes that increase nutritional demands. Calcium, iron, folic acid and vitamin D are particularly important during gestation to support fetal skeletal development and prevent maternal deficiencies. Pregnant women are also at increased risk for pregnancy gingivitis, which can be aggravated by poor nutrition and hormonal changes. Cravings for sugary or acidic foods, morning sickness-induced vomiting and poor oral hygiene may further contribute to enamel erosion and caries.²⁹

5. Older Adults

Older individuals are at risk of both undernutrition and oral health deterioration. Tooth loss, ill-fitting dentures, xerostomia (dry mouth) and reduced taste or chewing ability can impair food choices and nutritional intake. Deficiencies in vitamin B12, calcium, vitamin D and protein are common and may contribute to oral mucosal lesions, delayed healing, and bone resorption. Moreover, medications for chronic illnesses can influence salivary flow and nutrient absorption.³⁰

PUBLIC HEALTH AND DIETARY GUIDELINES FOR ORAL HEALTH

Oral health is increasingly recognized as a key component of public health, with diet and nutrition playing a central role in both the prevention and management of oral diseases. Public health efforts globally and nationally have emphasized dietary guidance, health promotion and education as strategies to reduce the burden of oral disease.

Global Dietary Guidelines and Oral Health

International bodies such as the World Health Organization (WHO) and the FAO have provided dietary recommendations that directly impact oral health. The WHO emphasizes reducing free sugar intake to less than 10%—ideally 5%—of total energy intake to minimize the risk of dental caries throughout the life course.³¹ The Unified Dietary Guidelines, endorsed by major health organizations like the American Heart Association,

American Cancer Society and American Diabetes Association, promote a diet high in fruits, vegetables, whole grains and low in saturated fats and sugars—an approach that aligns with preventive oral health principles.³²

National Nutritional Programs in India

India's nutritional and public health programs address both systemic and oral health indirectly by targeting nutritional deficiencies and promoting healthy eating:

- **Integrated Child Development Services (ICDS)** offers supplementary nutrition to children under six and pregnant/lactating mothers.
- **Mid-Day Meal Scheme (MDM)** provides nutritious lunches to school-going children, improving dietary diversity and combating micronutrient deficiencies.
- **National Iron Plus Initiative and Vitamin A prophylaxis programs** aim to tackle anaemia and deficiency-related health issues, including oral manifestations like glossitis and angular cheilitis.

While these programs are systemic in focus, their impact on oral health is significant—particularly in addressing early childhood caries, enamel hypoplasia and mucosal lesions caused by malnutrition.³³

Food Labelling, Taxation and Policy

Public health interventions that regulate food environments—such as mandatory front-of-pack labelling, sugar taxes, and restrictions on marketing sugary foods to children—are gaining momentum globally. Countries like Mexico and the UK have successfully reduced sugary beverage consumption using fiscal policies, contributing indirectly to oral disease prevention.³⁴ India has yet to implement similar comprehensive regulations for oral health-related dietary risks. However, the Food Safety and Standards Authority of India (FSSAI) has taken steps to improve food labelling and regulate trans fats and salt content.³⁵



Health Education and Behaviour Change

Oral health education campaigns that include diet counselling, label reading and awareness of sugar content in foods have shown success in improving oral hygiene and dietary practices. The common risk factor approach (CRFA), widely endorsed in global oral health strategy, identifies shared lifestyle risk factors (e.g. diet, tobacco, alcohol) between oral and systemic diseases. Targeting diet through CRFA offers a cost-effective, cross-cutting approach to public health improvement.⁷

CONCLUSION

Nutrition plays a foundational role in oral health, influencing the development, integrity and disease resistance of oral tissues throughout the life span. Understanding this relationship calls for a dual approach: promoting nutrient-rich, low-cariogenic diets while simultaneously addressing oral conditions that impair food intake. Integration of oral health into national nutritional programs and school-based health services can significantly amplify preventive efforts. At the policy level, adoption of regulatory measures such as front-of-pack labelling, sugar taxation and food marketing restrictions, alongside robust health education are necessary to create environments that support both systemic and oral well-being. To ensure holistic health, oral health must be recognized as a core component of nutrition-related health strategies, supported by interdisciplinary collaboration among dentists, dietitians, public health professionals and policymakers.

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