OPEN ACCESS

Saudi Journal of Medical and Pharmaceutical Sciences
Abbreviated Key Title: Saudi J Med Pharm Sci
ISSN 2413-4929 (Print) | ISSN 2413-4910 (Online)
Scholars Middle East Publishers, Dubai, United Arab Emirates
Journal homepage: https://saudijournals.com

Review Article **Dentistry**

Nutrition Education in Dental Curricula and its Impact on Oral Health Care: An Evidence-Based Review

Alanoud Hamad Alasadi[1]*, Asma sayer AlAqidi[2], Salma Fahhat Almotrafy Alenazi[3], Alaa Abdullah Alnami[2], Lulwah Ibrahim Al Ashi[4], Maram Fahad Almarzouqi[5], Mohrah Nawwash Alanazi[6], Dawlah Ibrahim Al Alashi[7], Ekram Ahmed Adam Somali[7]

[1] Laboratory Specialist, Prince Sultan Military Medical city, Riyadh, Saudi Arabia
[2] Laboratory Technician, Prince Sultan Military Medical city, Riyadh, Saudi Arabia
[3] Medical Laboratory Technologist, Prince Sultan Cardiac Center, Riyadh, Saudi Arabia
[4] Social Worker, Prince Sultan Military Medical city, Riyadh, Saudi Arabia
[5] Microbiology Technician, Prince Sultan Military Medical city, Riyadh, Saudi Arabia
[6] Food and Nutrition Technologist, Prince Sultan Military Medical city, Riyadh, Saudi Arabia
[7] Dental Assistant, Prince Sultan Military Medical city, Riyadh, Saudi Arabia

DOI: https://doi.org/10.36348/sjmps.2025.v11i09.007 | **Received:** 16.07.2025 | **Accepted:** 13.09.2025 | **Published:** 15.09.2025

***Corresponding author:** Alanoud Hamad Alasadi
Laboratory Specialist, Prince Sultan Military Medical city, Riyadh, Saudi Arabia

Abstract

The intricate and bidirectional relationship between nutrition and oral health is a cornerstone of modern preventive medicine. Diet is a primary etiological factor in the most prevalent oral diseases, including dental caries, periodontal disease, and dental erosion, while compromised oral health status directly impairs nutritional intake and systemic well-being. Despite overwhelming scientific evidence and consensus from global health organizations, a significant gap persists between the recognized importance of nutrition and its integration into dental education curricula worldwide. This review provides an evidence-based analysis of the current state of nutrition education in dental schools, its impact on clinical practice, and the future directions for reform. A comprehensive review of the scientific foundations reveals the specific roles of macro- and micronutrients in oral tissue homeostasis and the pathophysiology of oral diseases. A global analysis of dental curricula indicates a widespread deficiency in dedicated, clinically relevant nutrition instruction, characterized by insufficient hours, a lack of standardized competencies, and a shortage of faculty with expertise in applied nutrition. This educational deficit translates into a dental workforce that, while acknowledging the importance of nutrition, often lacks the confidence and skills to provide effective patient counseling. Clinician, patient, and system-level barriers further impede the implementation of nutritional interventions in practice. This review examines evidence-based pedagogical models poised to address these deficiencies, including competency-based frameworks, spiral curricula, and interprofessional education (IPE) programs that foster collaboration between dentistry, dietetics, and other health disciplines. Technology and artificial intelligence are also emerging as powerful tools to enhance both education and patient communication. Based on this synthesis, a series of actionable recommendations are proposed for educational institutions, accreditation bodies, clinicians, and researchers. The central conclusion is that the effective integration of nutrition into dental curricula is not merely an addition to an existing program but a fundamental paradigm shift necessary to equip future oral health professionals for a role in comprehensive, preventive, and integrated health care.

Keywords: Nutrition; Education; Dental Curricula; Oral Health Care; Evidence-Based Review.

1. INTRODUCTION

1.1. The Critical Juncture of Nutrition, Oral Health, and Dental Education

Oral health is an integral and inseparable component of general health and well-being. The oral cavity functions as the gateway to the body, serving not only as the initial site for nutrient processing but also as a mirror reflecting an individual's overall systemic health status. It is within this context that nutrition emerges as a critical mediating factor, forming a complex and bidirectional relationship with oral health that has profound implications across the lifespan. Major global health bodies, including the American Dental Association (ADA) and the World Health Organization (WHO), have formally recognized this synergistic link, confirming that dietary habits and nutritional status are

primary determinants in the initiation and progression of oral diseases, while oral health status, in turn, significantly influences an individual's ability to maintain adequate nutrition.

Dietary components are directly implicated in the etiology of the most common oral diseases. The frequent consumption of fermentable carbohydrates is the principal driver of dental caries. The composition of macronutrients and micronutrients in the diet modulates the host's inflammatory response, a key factor in the pathogenesis of periodontal diseases. Furthermore, the intake of acidic foods and beverages is the primary extrinsic cause of dental erosion. Conversely, oral health conditions such as tooth loss, periodontal pain, xerostomia, and poorly fitting prostheses can severely compromise masticatory function, leading to altered food choices, avoidance of nutrient-dense foods like fruits and vegetables, and an increased risk of malnutrition, particularly in vulnerable populations such as older adults. This cycle, where poor nutrition exacerbates oral disease and poor oral health leads to nutritional deficiencies, underscores the necessity of integrating nutritional science into oral health care.

1.2. Statement of the Problem: The Global Gap in Nutrition Competency

Despite the robust and long-established scientific evidence base, a significant and persistent chasm exists between the acknowledged importance of nutrition and its practical integration into dental education and, consequently, clinical practice. This is not a new or unrecognized issue; calls for the substantive inclusion of nutrition in dental curricula have been made for decades. However, global surveys and reviews consistently demonstrate that nutrition education in dental schools remains insufficient, inconsistent, and often clinically irrelevant. This curricular deficiency results in a dental workforce that is frequently underprepared to provide effective, evidence-based nutritional counseling. While practitioners may recognize the value of dietary advice, they often report a lack of knowledge, confidence, and practical skills to translate this recognition into meaningful clinical interventions. This systemic failure represents a critical missed opportunity for disease prevention and health promotion. The 2020 Surgeon General's Report, "Oral Health in America," reinforces this urgency, stating unequivocally that nutrition is an integral factor in the development of oral disease and overall health, and calls for a more integrated approach to health care.

The core of the problem is not a lack of scientific evidence but a failure of educational implementation. This suggests that the barriers are not primarily scientific but are instead structural, cultural, and pedagogical, rooted in the historical separation of dentistry from medicine and a lingering professional paradigm focused more on surgical restoration than on holistic, preventive care. The challenge, therefore, is to move beyond mere acknowledgment of nutrition's importance and to fundamentally redesign dental education to produce graduates who are competent and confident in using nutritional counseling as a primary tool for promoting both oral and systemic health. This review posits that such a transformation is essential for the future of the dental profession, aligning it with a broader, more integrated model of health care that addresses the whole person.

1.3. Scope and Aims of the Review

This evidence-based review aims to provide a comprehensive analysis of the role of nutrition education in dental curricula and its subsequent impact on oral health care delivery. The scope of this paper is to systematically synthesize the existing literature to achieve the following aims:

1. To delineate the scientific foundations of the oral-systemic nutrition nexus, detailing the roles of macronutrients and micronutrients and the nutritional pathophysiology of major oral diseases.
2. To conduct a global analysis of the current state of nutrition education in dental curricula, identifying historical trends, regional variations, and significant gaps in content and faculty preparedness.
3. To assess the impact of these educational deficiencies on clinical practice, examining clinician competencies, barriers to implementation, and the evidence for the efficacy of nutritional counseling on patient outcomes.
4. To propose a multidisciplinary framework for integrated care that emphasizes interprofessional collaboration and addresses the social determinants of health.
5. To explore innovative and future-oriented curriculum models, including competency-based frameworks, spiral curricula, and the integration of technology, that can effectively bridge the current educational gap.

Ultimately, this review seeks to move beyond a simple description of the problem by providing a synthesized set of actionable, evidence-based recommendations for dental education institutions, accreditation bodies, clinicians, and researchers. The central argument is that the meaningful integration of nutrition education is a bellwether for a larger, necessary paradigm shift within dentistry—from a narrow, procedure-focused model to a holistic, preventive, and truly health-oriented profession.

2. Scientific Foundations: The Oral-Systemic Nutrition Nexus

2.1. The Bidirectional Link: Diet's Impact on Oral Tissues and Oral Health's Impact on Nutrition

The relationship between nutrition and oral health is a dynamic, two-way street where each profoundly influences the other. On one hand, dietary intake and nutritional status are fundamental determinants of the integrity and function of oral tissues throughout the life course. Poor diet quality, characterized by high intake of saturated fats and processed foods, has been directly associated with adverse oral health outcomes, including tooth loss and periodontal disease. The nutrients consumed provide the essential building blocks for the development of oral structures during gestation and childhood and for the continuous maintenance and repair of oral tissues in adulthood. Deficiencies or excesses in specific nutrients can compromise the host's immune response, impair tissue healing, and alter the oral environment, thereby increasing susceptibility to disease.

Conversely, the state of the oral cavity is a critical determinant of an individual's nutritional status. Oral health problems such as tooth loss, periodontal pain, xerostomia (dry mouth), and ill-fitting dentures can significantly impair masticatory efficiency and function. This impairment often leads to a restricted diet, characterized by the avoidance of nutrient-dense, fibrous foods like fresh fruits, vegetables, and lean proteins, in favor of softer, often more processed and carbohydrate-rich foods that are easier to chew. This dietary shift can precipitate or exacerbate nutritional deficiencies, particularly in vulnerable populations such as older adults. In this demographic, poor oral health-induced malnutrition is a serious concern, contributing to a cascade of negative systemic health outcomes, including frailty, sarcopenia, increased hospitalization rates, and higher morbidity and mortality. This vicious cycle—where poor diet harms oral health, and compromised oral health leads to a poorer diet—highlights the impossibility of managing one without considering the other.

2.2. Macronutrients and Oral Health: The Role of Carbohydrates, Proteins, and Lipids

Macronutrients—carbohydrates, proteins, and lipids—form the bulk of the diet and exert distinct and powerful effects on oral tissues and the oral environment.

Carbohydrates are the most direct dietary contributors to dental caries. Fermentable carbohydrates, a group that includes simple sugars (e.g., sucrose, glucose, fructose) and cooked starches, serve as the primary energy source for cariogenic bacteria like Streptococcus mutans. The metabolism of these substrates by plaque bacteria produces organic acids, leading to a rapid drop in pH at the tooth surface and subsequent demineralization of enamel. Sucrose is considered particularly cariogenic due to its role in the synthesis of extracellular polysaccharides, which enhance plaque adherence. The frequency and amount of sugar consumption are both strongly correlated with caries risk. Beyond caries, a high intake of refined carbohydrates (defined as >45% of total caloric intake) has also been associated with increased gingival inflammation and a higher prevalence of periodontal disease, likely due to its pro-inflammatory systemic effects. However, not all carbohydrates are detrimental. Dietary fiber, found in whole grains, fruits, and vegetables, has a protective effect, and certain sugar alcohols, most notably xylitol, are non-cariogenic and can actively inhibit the growth of cariogenic bacteria and reduce plaque formation.

Proteins are fundamental to the structural integrity and repair of oral tissues. In the periodontium, proteins are essential components of collagen, the primary structural protein in the gingiva and periodontal ligament, as well as various enzymes involved in tissue maintenance. Animal studies have demonstrated that severe protein deprivation leads to the degeneration of periodontal support structures, including the breakdown of periodontal ligaments and resorption of alveolar bone. Clinically, sufficient protein intake is associated with higher bone mineral density and has been inversely correlated with the prevalence of periodontitis, suggesting a crucial role in maintaining the host's defense and repair capacity.

Lipids have a dual and complex role in oral health, largely dependent on their chemical structure. Diets high in saturated fatty acids, often found in processed meats and high-fat dairy products, are associated with poorer oral health outcomes and an increased risk for the progression of periodontal disease. This is likely linked to the pro-inflammatory properties of saturated fats. In stark contrast, polyunsaturated fatty acids (PUFAs), particularly the omega-3 fatty acids (e.g., docosahexaenoic acid and eicosapentaenoic acid [EPA]) found in fatty fish, are known for their potent anti-inflammatory effects. A favorable dietary ratio of omega-3 to omega-6 fatty acids has been demonstrated to promote periodontal health and reduce gingival inflammation, making these lipids a key therapeutic target in nutritional interventions for periodontal disease.

2.3. Micronutrients: Essential Vitamins and Minerals for Dental and Periodontal Integrity

Micronutrients, though required in smaller quantities, are indispensable for the proper development, maintenance, and function of oral tissues. Their roles span from structural components of mineralized tissues to critical cofactors in immune and inflammatory responses. Deficiencies can lead to specific and recognizable oral pathologies, making the oral cavity a key site for nutritional assessment.

Vitamins are organic compounds that serve as catalysts and regulators for a vast array of metabolic processes essential to oral health.

- Vitamin A is crucial for maintaining the integrity of epithelial tissues, including the oral mucosa and salivary glands. Its deficiency can lead to impaired tooth formation and enamel hypoplasia.
- The B-complex vitamins play a vital role in mucosal health and cellular metabolism. Deficiencies in various B vitamins (e.g., B2, B3, B6, B9, B12) are classically associated with oral manifestations such as atrophic glossitis (inflammation of the tongue), angular cheilitis (cracks at the corners of the mouth), and recurrent aphthous stomatitis. Vitamin B12, in particular, is also important for mucosal wound healing and bone health.
- Vitamin C (Ascorbic Acid) is essential for the synthesis of collagen, the primary structural protein in gingiva, the periodontal ligament, and dentin. Severe deficiency leads to scurvy, characterized by hemorrhagic, swollen gingiva and loosened teeth. Subclinical deficiency can impair wound healing and increase susceptibility to periodontal disease.
- Vitamin D is critical for calcium and phosphorus homeostasis, making it indispensable for the proper mineralization of teeth and the alveolar bone. It also has significant immunomodulatory and anti-inflammatory properties. Deficiency can result in enamel and dentin hypoplasia, delayed tooth eruption, and is associated with an increased risk of both dental caries and periodontitis.
- Vitamin E is a potent antioxidant that protects cell membranes from oxidative stress, a key factor in inflammatory periodontal tissue destruction. It also aids in tissue regeneration and may have a positive effect on periodontal healing.
- Vitamin K is essential for the synthesis of proteins involved in blood coagulation and bone metabolism. Deficiency can lead to an increased risk of hemorrhage during oral surgery and may manifest as spontaneous gingival bleeding.

Minerals are inorganic elements that form the structural basis of hard tissues and act as cofactors for numerous enzymes.

- Calcium and Phosphorus are the primary mineral components of hydroxyapatite, the crystal structure that gives enamel, dentin, and bone their hardness and rigidity. Inadequate calcium intake is associated with increased alveolar bone resorption, which can exacerbate periodontal disease and compromise the stability of teeth and dentures.
- Fluoride is a crucial element for caries prevention. It integrates into the enamel crystal lattice, forming fluorapatite, which is more resistant to acid demineralization. It also enhances the remineralization of incipient lesions.
- Zinc, Iron, and Magnesium are essential trace elements with diverse roles. Zinc is vital for wound healing, immune function, and bone matrix synthesis. Iron deficiency is linked to atrophic glossitis and angular cheilitis and may be associated with an increased prevalence of periodontal disease. Magnesium is a component of teeth and bone and is a cofactor for many metabolic enzymes.

The multifaceted roles of these micronutrients are summarized in Table 1, providing a clinical reference for understanding the oral manifestations of their deficiencies.

Table 1: Key Micronutrients in Oral Health and Manifestations of Deficiency

Micronutrient	Primary Role(s) in Oral Health	Key Oral Manifestations of Deficiency
Vitamin A	Epithelial tissue maintenance; Salivary gland function; Enamel formation	Enamel hypoplasia; Salivary gland atrophy; Impaired tooth formation
B-Complex Vitamins	Mucosal integrity; Cellular metabolism; Nerve function; Wound healing	Glossitis (inflamed tongue); Angular cheilitis (cracks at mouth corners); Recurrent aphthous ulcers; Burning mouth sensation
Vitamin C	Collagen synthesis (gingiva, PDL, dentin); Antioxidant; Wound healing	Scurvy (hemorrhagic, swollen gingiva); Impaired wound healing; Increased periodontal disease severity
Vitamin D	Calcium/phosphorus absorption; Bone and tooth mineralization; Immune modulation	Enamel and dentin hypoplasia; Delayed tooth eruption; Increased risk of caries and periodontitis
Vitamin E	Antioxidant (protects cell membranes); Tissue regeneration	Impaired periodontal healing
Vitamin K	Blood coagulation; Bone metabolism	Spontaneous gingival bleeding; Increased risk of hemorrhage during surgery
Calcium	Primary component of teeth and alveolar bone; Mineralization	Alveolar ridge resorption; Increased tooth mobility; Potential for increased periodontal disease severity
Phosphorus	Component of teeth and bone; Energy metabolism	Failure of dentin formation; Increased caries susceptibility

Micronutrient	Primary Role(s) in Oral Health	Key Oral Manifestations of Deficiency
Fluoride	Enamel remineralization; Increases acid resistance of enamel	Increased susceptibility to dental caries
Zinc	Wound healing; Immune function; Bone matrix synthesis; Taste acuity	Delayed wound healing; Decreased taste sensation; Gingival inflammation
Iron	Oxygen transport; Enzyme cofactor	Atrophic glossitis (red, painful tongue); Angular cheilitis; Salivary gland dysfunction
Magnesium	Component of teeth and bone; Enzyme cofactor	Potential for impaired bone and tooth formation

2.4. Nutritional Pathophysiology of Key Oral Diseases

The influence of nutrition extends beyond general tissue maintenance to the specific pathogenic mechanisms of the most prevalent oral diseases.

Dental Caries is a diet-mediated, multifactorial disease. Its pathophysiology involves a complex biochemical interplay between fermentable carbohydrates, cariogenic bacteria within dental plaque, and the host's tooth surface and saliva. The process begins when bacteria, primarily Streptococcus mutans and Lactobacillus species, metabolize dietary sugars and starches. This fermentation produces organic acids (mainly lactic acid), causing the pH within the plaque biofilm to drop. When the pH falls below a critical level (approximately 5.5 for enamel), the aqueous environment becomes undersaturated with respect to tooth mineral, leading to the dissolution of hydroxyapatite crystals from the enamel surface—a process known as demineralization. This acid attack occurs with each exposure to fermentable carbohydrates. The process is dynamic; between exposures, saliva plays a crucial protective role. Its buffering capacity helps neutralize acids, and its supersaturation with calcium and phosphate ions facilitates the redeposition of minerals onto the tooth surface, a process called remineralization. Dental caries occurs when the rate of demineralization chronically exceeds the rate of remineralization, resulting in a net loss of tooth mineral and the formation of a cavity.

Periodontal Disease is fundamentally a microbially-induced, host-mediated inflammatory condition. While bacterial plaque is the initiating factor, the progression and severity of the disease are largely determined by the host's inflammatory and immune response, which is significantly modulated by nutrition. Diet influences periodontal health through at least three primary pathways. First, it directly affects the composition of the oral microbiome; for instance, high-carbohydrate diets can promote a more dysbiotic, pro-inflammatory microbial community. Second, diet impacts the composition and flow of saliva, altering its protective properties. Third, and perhaps most critically, dietary patterns modulate systemic inflammation. A "pro-inflammatory" diet, typically high in refined carbohydrates, saturated fats, and omega-6 fatty acids (characteristic of the Western diet), can amplify the systemic inflammatory response to the local bacterial challenge in the gingival sulcus. This is evidenced by higher levels of systemic inflammatory markers like C-reactive protein (CRP) in periodontitis patients consuming such diets. Conversely, an "anti-inflammatory" diet, rich in antioxidants (vitamins C and E), fiber, and omega-3 fatty acids (characteristic of the Mediterranean diet), can help temper the inflammatory response, reduce oxidative stress, and support tissue repair, thereby mitigating periodontal destruction. This establishes nutritional intervention not merely as supportive care but as a direct strategy for modulating the host's inflammatory response in periodontal disease.

Dental Erosion is distinct from caries in that it involves the chemical dissolution of mineralized tooth tissue by acids of non-bacterial origin. The sources of these acids are categorized as either extrinsic or intrinsic. Extrinsic erosion is predominantly caused by dietary acids. A vast number of commercially available beverages, including carbonated soft drinks, sports drinks, and fruit juices, have a pH well below the critical level of 5.5 and are primary risk factors. Frequent consumption of acidic foods such as citrus fruits and vinegar-based products also contributes significantly. Intrinsic erosion results from the exposure of teeth to gastric acid due to conditions like gastroesophageal reflux disease (GERD), chronic vomiting (as seen in bulimia nervosa), or chronic alcoholism. In either case, the acid directly demineralizes the enamel surface, leading to a progressive, irreversible loss of tooth structure that can result in severe hypersensitivity and aesthetic disfigurement.

3. Global Analysis of Nutrition in Dental Curricula

3.1. Historical Evolution and Current Status of Nutrition Education

The integration of nutrition into health professional education has been a protracted and challenging process. While the science of nutrition was recognized as early as the 4th century B.C. by Hippocrates, its formal inclusion in medical and dental curricula is a relatively recent and incomplete development. The history of formal dental education, which began in the United States in 1840 with the chartering of the Baltimore College of Dental Surgery, was marked by an early and decisive separation from medicine. This historical silo has had lasting consequences, contributing to a professional culture that has been slower to adopt a holistic, systemic view of health in which nutrition plays a central role.

Despite advocacy for nutrition education dating back to the early 20th century, its status in dental curricula has remained largely inadequate. Professional bodies have issued calls to action, such as the 2015 resolutions by the American Dental Association (ADA) encouraging dentists to maintain current knowledge of nutrition to effectively counsel patients. However, these resolutions have not translated into widespread, systemic change. The current status, as documented by numerous recent studies and reviews, is one of neglect. Nutrition is often treated as a supplementary topic rather than a core component of dental education, resulting in a significant gap between the scientific evidence supporting its importance and the educational preparation provided to future clinicians.

3.2. Comparative Analysis: Perspectives from North America, Europe, Asia, and Australia

The state of nutrition education in dental schools varies globally, yet a common theme of insufficiency prevails across most regions.

North America: The situation in the United States is the most extensively documented and reveals significant deficiencies. A landmark 2011 survey by the American Dental Education Association (ADEA) found that among 24 reporting U.S. dental schools, the mean number of hours dedicated to nutrition was a mere 15.9, with a wide range of 7 to 40 hours. This finding is consistent with a more recent scoping review which noted that the vast majority (76.4%) of published studies on this topic originated in the U.S., indicating a high level of awareness and concern about the problem, yet slow institutional progress in resolving it. A critical issue identified is not just the quantity of education but its quality and relevance; courses are frequently taught by basic scientists, such as biochemists, leading students to perceive the content as disconnected from clinical practice.

Europe: The European landscape is characterized by significant diversity. A 1997 study highlighted that Scandinavian countries and the Netherlands historically provided extensive nutrition courses, while other European nations offered little to no instruction. The United Kingdom demonstrated substantial improvement in nutrition teaching following the introduction of an extended preclinical curriculum in 1990. More recent efforts by the Association for Dental Education in Europe (ADEE) have focused on developing consensus documents and frameworks, such as "The Graduating European Dentist," to harmonize and benchmark curricula across the continent. While these frameworks promote a holistic approach, the specific implementation of nutrition education remains variable and dependent on individual institutions and national regulatory bodies. The ADEE has established a Community of Practice on Nutrition with the aim of developing and promoting a standardized nutrition curriculum, acknowledging the existing gaps.

Asia: Data from Asian countries are more sparse but suggest similar challenges. A 2009 survey of Japanese medical schools concluded that nutrition education was inadequate, with a mean of only 4.2 hours of substantial instruction, though this represented a slight improvement from 2004. A study of Japanese dental students used breakfast-eating habits as a proxy for nutritional awareness, indicating a focus on basic health behaviors rather than advanced clinical counseling skills. Similarly, a study in Korea found that dietary education has been insufficiently addressed within oral health programs, with only 15% of young adults reporting having received dietary education from a dental professional.

Australia: The Australian context mirrors that of other developed nations. There are strong calls from professional bodies for greater interdisciplinary collaboration between dietitians and oral health professionals and for the formal integration of nutrition into tertiary education curricula for all oral health practitioners. However, studies of practicing clinicians in Australia identify common barriers to providing nutritional counseling, such as lack of time, insufficient remuneration, and a need for more training, which suggests that the foundational education may not be adequately preparing them for this role.

This global overview is summarized in Table 2, highlighting the common challenges and disparate levels of progress in integrating nutrition education into dental curricula.

Table 2: Comparative Overview of Nutrition Education in Dental Curricula by Region

Region	Key Findings on Curriculum Status	Documented Strengths	Documented Weaknesses/Gaps
North America	Highly variable but generally insufficient; mean of ~16 hours in U.S. schools. High volume of research on the topic.	Some institutions are developing innovative interprofessional education (IPE) models. High awareness of the problem.	Insufficient hours; lack of clinical relevance; courses often taught by non-clinicians; lack of standardized competencies.
Europe	Highly diverse; some countries (e.g., Scandinavia, Netherlands) have historically strong programs, while others have very little.	Strong leadership from ADEE in developing curriculum frameworks. Documented improvement in the UK following curriculum reform.	Lack of harmonization across the continent; implementation is inconsistent and depends on national and institutional priorities.

Region	Key Findings on Curriculum Status	Documented Strengths	Documented Weaknesses/Gaps
Asia	Generally inadequate and underdeveloped. Data is limited compared to Western regions.	Growing recognition of the importance of nutrition, with professional bodies issuing joint declarations (e.g., Japan).	Very few dedicated hours; education often focused on basic health habits rather than clinical counseling skills.
Australia	Similar challenges to North America and Europe.	Strong professional advocacy for interdisciplinary collaboration and curriculum integration.	Practitioners report barriers (time, training, remuneration) that stem from educational gaps. Limited data on specific curriculum content.

3.3. Identifying the Gaps: Curricular Deficiencies and Faculty Preparedness

Across all regions, a consistent set of curricular gaps and challenges emerges from the literature. The most frequently cited deficiency is the insufficient allocation of curricular time. This temporal constraint is compounded by a lack of standardized frameworks and competencies, leading to wide variability in what is taught and to what depth. Even when time is allocated, the curriculum often suffers from a disconnect between basic science and clinical application. Students may learn the biochemical pathways of carbohydrate metabolism but are not taught the practical skills of conducting a diet assessment, using motivational interviewing to counsel a patient, or making an appropriate referral to a dietitian.

A critical and pervasive barrier is the limited expertise and preparedness of faculty. Nutrition courses are often taught by faculty from basic science departments who may lack training in applied clinical nutrition and behavioral counseling. This contributes to students' perception that nutrition is not a clinically relevant subject and leaves them without role models for how to integrate nutritional counseling into patient care. The lack of faculty trained by nutrition experts is a fundamental obstacle to improving educational outcomes. Program directors in dental hygiene education have reported a disconnect between their intentions for nutritional content and their ability to implement it, citing a lack of power and autonomy to modify already overloaded curricula and a need for better faculty calibration.

3.4. The Role of Accreditation Bodies (CODA, ADEE) in Shaping Curricula

Accreditation bodies play a pivotal role in shaping dental curricula by setting the standards that all programs must meet. In the United States, the Commission on Dental Accreditation (CODA) is the primary governing body. CODA's Standard 2-24d requires that "graduates must be competent in health promotion and disease prevention, including caries management". This standard serves as a crucial driver, compelling institutions to address preventive care. However, its effectiveness in promoting robust nutrition education is limited by its lack of specificity. The standard does not explicitly mandate nutrition as a topic, nor does it define specific competencies, required hours, or assessment methods related to nutritional counseling. This vagueness allows for a wide latitude in interpretation and implementation, enabling some schools to satisfy the requirement with minimal, often preclinical, instruction. Consequently, while the standard ensures that health promotion is on the agenda, it does not guarantee that graduates will be competent in the practical application of nutritional science.

This leads to a notable paradox within the student body itself. Despite being a highly educated cohort training to be healthcare professionals, dental students often exhibit poor personal dietary habits. A study conducted at the University of Nevada, Las Vegas School of Dental Medicine (UNLV-SDM) found that students' daily intake of fruits, vegetables, dairy, and whole grains was significantly lower than the recommendations of the Dietary Guidelines for Americans (DGA). This suggests a failure of the current educational models to instill not just the knowledge but the intrinsic value of nutrition, even in the students themselves. This has profound implications for future practice; a clinician who does not personally adhere to or value healthy dietary patterns is less likely to be a credible or effective counselor for their patients. This disconnect underscores the need for educational approaches that are not only informative but also experiential and personally transformative.

4. Impact on Practice: From Knowledge to Patient Outcomes

4.1. Clinician Competency: Knowledge, Attitudes, and Practices in Nutritional Counseling

The deficiencies in dental curricula have a direct and measurable impact on the competency of practicing clinicians. A consistent finding across numerous surveys is a significant gap between clinicians' attitudes and their knowledge and practices. Overwhelmingly, dental students and practitioners express positive attitudes toward nutrition, acknowledging its critical role in oral health and agreeing that providing dietary counseling is part of their professional responsibility.

However, this positive attitude is not matched by self-reported knowledge or confidence. Many studies reveal that students and clinicians feel their knowledge

is limited, particularly in applied or clinical nutrition, and they lack confidence in their skills to provide effective counseling. For example, one study found that while 78% of dentists are asked nutrition-related questions by patients, only 30% feel confident in their knowledge to answer them. This lack of confidence directly translates into practice behaviors. The actual provision of nutritional counseling in dental settings is infrequent and often superficial. When counseling does occur, it is often brief, with one study finding that 40% of dentists who provide nutrition care do so for two minutes or less, a duration insufficient for meaningful behavioral change. An audit of dental hygiene students' records showed dietary counseling was provided to only 7% of patients, and audits of dental students' records found counseling in less than 1% of cases. This disparity between believing nutrition is important and actually integrating it into patient care represents the central challenge that must be addressed by educational reform.

4.2. Barriers to Implementation: Clinician, Patient, and System-Level Challenges

The failure to translate positive attitudes into consistent practice is underpinned by a complex web of barriers at multiple levels. These barriers must be understood and addressed for any educational or policy intervention to be successful.

Clinician-Level Barriers: These are the most frequently cited obstacles and are directly linked to educational shortcomings. They include:

- Lack of Time: In a busy, procedure-driven practice, clinicians perceive counseling as too time-consuming.
- Inadequate Knowledge and Training: Clinicians feel ill-equipped due to insufficient education in applied nutrition and behavioral counseling techniques.
- Low Confidence and Self-Efficacy: A direct result of inadequate training, this leads to a reluctance to initiate conversations about diet.
- Fear of Offending Patients: Clinicians worry about appearing judgmental, alienating patients, or encroaching on a sensitive topic.
- Lack of Financial Reimbursement: The absence of clear and adequate insurance coverage for nutritional counseling disincentivizes its provision compared to reimbursed surgical procedures.

Patient-Level Barriers: Successful counseling also depends on the patient's ability and willingness to engage and change. These barriers include:

- Low Patient Interest or Motivation: Some patients may not perceive the link between diet and oral health or may be unwilling to change established habits.
- Poor Health Literacy: A patient's inability to obtain, process, and understand basic health information is a major obstacle to comprehension and adherence.
- Socioeconomic Factors: A patient's ability to adopt healthier eating habits is profoundly influenced by their income, access to affordable healthy food (food security), and cultural norms. Advising a patient to eat more fresh vegetables is futile if they live in a food desert or cannot afford them.
- Psychosocial Factors: Attitudes of family and friends, fear, and impatience can all hinder a patient's ability to sustain behavioral change.

System-Level Barriers: These are structural issues within the health care system and the design of dental practices. They include:

- Practice Environment: The physical setup of many clinics is not conducive to private, comfortable counseling. Furthermore, specialized equipment, such as bariatric dental chairs, may be lacking, creating physical barriers to care for patients with severe obesity.
- Lack of Trained Staff: The entire dental team, including assistants and hygienists, may lack the necessary training to support nutritional counseling efforts.
- Fragmented Care System: The historical separation of dental and medical care creates a lack of integrated referral pathways and communication between dentists and other healthcare providers like dietitians and physicians.

These multifaceted barriers are organized and presented in Table 3.

Table 3: Barriers to Nutritional Counseling in Dental Practice

Barrier Category	Specific Barrier
Clinician-Level	Lack of time in a procedure-focused schedule
	Inadequate knowledge and training in applied nutrition and counseling techniques
	Low confidence and self-efficacy in providing dietary advice
	Fear of offending patients or appearing judgmental
	Lack of financial reimbursement and insurance coverage
Patient-Level	Low patient interest, motivation, or compliance
	Unwillingness to change established dietary patterns
	Low health literacy and difficulty understanding health information
	Socioeconomic constraints (e.g., cost of healthy food, food insecurity)

Barrier Category	Specific Barrier
	Influence of family, friends, and cultural attitudes toward food
	Physical limitations or medical conditions affecting diet
System-Level	Practice model prioritizes procedures over preventive counseling
	Lack of a private, conducive environment for counseling
	Insufficiently trained support staff
	Lack of integrated referral pathways to dietitians and other professionals
	Physical barriers in the clinic (e.g., lack of bariatric dental chairs)

4.3. Evidence of Efficacy: The Impact of Nutritional Counseling on Oral Health Outcomes

Despite the numerous barriers, a compelling body of evidence demonstrates that when nutritional counseling is effectively implemented, it leads to significant improvements in patient oral health outcomes.

For dental caries, particularly early childhood caries (ECC), nutritional counseling is a cornerstone of prevention. Randomized controlled trials have shown that providing dietary advice to mothers and caregivers during a child's first year of life can significantly reduce the incidence and severity of caries by age four. One such study found that a home-based nutritional counseling program reduced ECC incidence by 22% and severe ECC incidence by 32% in a low-income community. The key messages in these successful interventions focus on reducing the frequency and total amount of free sugar consumption, limiting sugary beverages, and promoting healthy meal and snack patterns.

For periodontal disease, nutritional intervention is emerging as a powerful adjunct to conventional non-surgical periodontal therapy (NSPT). The underlying principle is that while NSPT addresses the local bacterial load, nutritional counseling addresses the systemic host inflammatory response. A Finnish longitudinal study found that individuals with advanced periodontitis who followed a pro-inflammatory diet had significantly higher levels of systemic inflammation (CRP) over an 11-year period. Clinical trials have shown that dietary interventions can improve clinical outcomes. A study from the Netherlands found that higher vegetable consumption was significantly associated with improved periodontal healing after NSPT, including reduced bleeding on probing (BoP) and shallower pocket depths. Another study demonstrated that four weeks of sugar avoidance led to a significant reduction in BoP in dental students. Systematic reviews suggest that adjunctive interventions with omega-3 fatty acids, antioxidants, and specific micronutrients can lead to improvements in probing depths and clinical attachment levels compared to NSPT alone. These findings firmly establish dietary counseling not as an alternative, but as a complementary and necessary component of comprehensive periodontal care.

4.4. The Role of Health Literacy in Effective Patient Communication

The effectiveness of any nutritional counseling is ultimately contingent upon the patient's ability to understand, process, and act on the information provided. This is the domain of health literacy. Low health literacy is a widespread and significant barrier to health care, associated with poorer health outcomes, increased hospitalization rates, and less engagement in preventive behaviors. In the dental setting, patients with low health literacy may be less familiar with dental terminology, have difficulty understanding treatment plans, and be more afraid to ask questions.

This reality has profound implications for how nutritional counseling must be delivered. Simply providing a patient with a list of "good" and "bad" foods is an ineffective strategy, particularly for those with limited health literacy. Effective communication requires a patient-centered approach that utilizes clear, simple, jargon-free language; visual aids; and culturally sensitive materials. Techniques such as the "teach-back" method, where the patient is asked to explain the instructions in their own words, can be used to confirm understanding. Furthermore, recognizing that low health literacy often coexists with other social determinants of health, such as limited income and education, is crucial. Therefore, effective counseling must go beyond information delivery to address the practical barriers a patient faces, a task that often requires an interprofessional approach involving social workers and community health resources. The failure to address health literacy is a primary reason why well-intentioned advice fails to translate into behavioral change.

5. A Multidisciplinary Framework for Integrated Care

5.1. The Case for Interprofessional Collaboration: Dentistry, Dietetics, and Beyond

The complexity of the relationship between nutrition, oral health, and systemic disease necessitates a shift away from siloed professional practice toward a team-based, interprofessional model of care. The historical separation of dentistry from medicine has created significant barriers to communication and coordinated care, to the detriment of patient health. Addressing the nutritional needs of dental patients effectively requires expertise that often extends beyond the traditional training of a dentist. This is where interprofessional collaboration (IPC) becomes essential.

The most critical partnership is between dentistry and dietetics. Registered Dietitian Nutritionists (RDNs) are the healthcare professionals with specialized training in medical nutrition therapy (MNT), which involves evidence-based nutritional assessment, diagnosis, intervention, and counseling for the prevention and management of chronic diseases. While dentists and dental hygienists are ideally positioned to screen for nutritional risks, identify oral manifestations of dietary issues, and provide foundational dietary advice related to oral health, RDNs possess the in-depth knowledge and behavioral counseling skills to manage complex nutritional issues, create personalized diet plans, and address underlying conditions like diabetes or cardiovascular disease. This synergistic relationship allows each professional to practice at the top of their license, creating a comprehensive care system that addresses both the oral and systemic health of the patient. This collaboration is not a theoretical ideal but a practical necessity for providing holistic, patient-centered care.

5.2. Models of Integrated Care: Co-location, Referral Networks, and Embedded Professionals

The integration of oral health and primary care, including nutrition services, can be implemented through several practical models, existing along a continuum of collaboration. There is no single "gold standard" model; the optimal approach depends on the specific clinical setting, patient population, and available resources. Key models include:

- **Collaboration and Referral Networks:** This is the most basic level of integration, where independent dental and medical/dietetic practices establish formal protocols for patient referrals. Success depends on creating a "closed-loop" system where communication about the referral and treatment outcomes is shared between the providers, often facilitated by integrated or interoperable electronic health records (EHRs).
- **Co-location:** In this model, dental services are physically located within the same facility as primary care or other health services, such as in a Federally Qualified Health Center (FQHC). Co-location significantly lowers barriers to access and facilitates "warm hand-offs," where a primary care provider can walk a patient directly to the dental clinic for an appointment or consultation. This model has been shown to improve access to care and increase the delivery of preventive services.
- **Full Integration:** This represents the most advanced model, where medical, dental, and behavioral health services are operationally and clinically intertwined. It involves a unified EHR, team-based care planning where providers from different disciplines jointly manage patient care, and often, integrated financial and administrative systems. This model is best exemplified by the Patient-Centered Medical Home (PCMH) framework, which seeks to provide comprehensive, coordinated, whole-person care.
- **Embedded Professionals:** A highly effective strategy within any of these models is the embedding of allied health professionals directly into the dental clinic setting. A prime example is the integration of a dietitian or a social worker into a pediatric dental clinic. This allows for real-time, on-site consultations and interventions, seamlessly incorporating nutritional or psychosocial care into the dental visit.

5.3. The Role of Allied Health Professionals: Dental Hygienists, Social Workers, and Technicians

A truly multidisciplinary framework relies on leveraging the unique skills of all members of the health care team. Beyond the dentist-dietitian collaboration, several allied health professionals play indispensable roles.

Dental Hygienists, as licensed preventive oral health specialists, are on the front lines of patient education and health promotion. Their training is heavily focused on prevention, and their appointment structure often allows more time for patient interaction than a dentist's. This positions them as the ideal professionals within the dental team to conduct initial nutritional screenings, perform diet assessments, and provide foundational counseling on topics like sugar consumption and caries prevention. Empowering and adequately training dental hygienists in nutrition is one of the most efficient ways to increase the delivery of nutritional services in a dental practice.

Social Workers are uniquely equipped to address the complex psychosocial factors and social determinants of health (SDOH) that are often the root cause of poor health behaviors and outcomes. A patient may know they should eat healthier foods but be unable to do so due to poverty, food insecurity, lack of transportation, or family stress. A social worker embedded in a dental clinic can assess these non-medical barriers and connect patients with essential community resources, such as food assistance programs, transportation services, and financial aid. Case studies from institutions like Eastman Dental demonstrate that integrating social workers into the dental care team leads to measurable improvements in patient outcomes, such as increased appointment adherence and better utilization of care, by addressing the underlying life challenges that prevent patients from prioritizing their oral health.

Dental Laboratory Technicians traditionally have no direct patient contact, working behind the scenes to fabricate dental prostheses based on a dentist's prescription. However, their role in a multidisciplinary framework is a significant and currently underutilized

opportunity. Technicians possess unparalleled expertise in the properties of dental materials—ceramics, alloys, resins, and polymers. They understand how these materials respond to chemical and physical stresses, including the erosive effects of dietary acids and the mechanical forces of chewing hard foods. While the technician may not educate the patient directly, a fully integrated team would establish a communication loop where the technician's material-specific knowledge informs the clinical team. This would allow the dentist or hygienist to provide the patient with highly personalized dietary advice tailored to the specific materials used in their restorations (e.g., "The type of ceramic used for your crown is very strong but can be susceptible to erosion from frequent exposure to sports drinks"). This elevates patient education from generic advice to a sophisticated, materials-science-based intervention, ultimately improving the longevity of the restoration and the patient's oral health.

5.4. Addressing Social Determinants of Health in a Clinical Setting

Providing nutritional counseling in a clinical vacuum, without acknowledging the social context of a patient's life, is an exercise in futility. Social determinants of health (SDOH)—the conditions in which people are born, grow, live, work, and age—are powerful drivers of health outcomes, and oral health is no exception. There is clear and consistent evidence for a social gradient in oral health, where individuals with lower socioeconomic status (defined by income, education, and occupation) experience a disproportionately higher burden of dental caries, periodontal disease, and tooth loss.

Factors such as food insecurity (the lack of consistent access to enough food for an active, healthy life), living in a "food desert" without access to fresh produce, limited income, and low health literacy directly impact a patient's ability to follow dietary recommendations. Therefore, a modern, effective framework for care must include routine screening for SDOH as part of the patient assessment. This moves beyond simply asking "What do you eat?" to asking "Do you have trouble getting the food you need?". Once identified, these challenges must be addressed. This is where the interprofessional model becomes critical, as dentists can collaborate with social workers, community health workers, and local social service agencies to connect patients with the resources they need to overcome these fundamental barriers to health. Addressing SDOH is not an adjunct to health care; it is a prerequisite for it to be effective.

6. Future Curriculum Models: Pedagogy and Innovation

6.1. Competency-Based Frameworks for Nutrition Education

To address the documented shortcomings of traditional dental education, a fundamental shift in pedagogical philosophy is required, moving from a time-based, credit-hour model to a competency-based education (CBE) framework. CBE focuses on the desired outcomes—what a graduate must be able to do—rather than simply on the courses they have taken. This approach emphasizes the acquisition of practical skills, critical thinking, and the integration of knowledge, skills, and values essential for independent practice.

Several frameworks can guide the development of a CBE model for nutrition in dentistry. Miller's Pyramid of Competence provides a hierarchical structure for assessing clinical proficiency, progressing from foundational knowledge ("knows") and interpretation ("knows how") to demonstration in a controlled setting ("shows how") and finally to independent performance in real-world clinical practice ("does"). The American Dental Education Association (ADEA) Competencies for the New General Dentist provides another valuable framework, organized into six domains, including "Health Promotion," which explicitly encompasses disease prevention and provides a natural home for nutrition-related competencies.

Applying a CBE model to nutrition education means defining specific, measurable competencies that graduates must demonstrate. These should extend far beyond basic biochemical knowledge. Key nutrition competencies for a graduating dentist should include the ability to:

- Conduct a nutritional risk assessment and screen for oral manifestations of nutritional deficiencies.
- Perform a basic dietary analysis using tools like a 24-hour recall or food frequency questionnaire.
- Apply patient-centered communication and behavioral counseling skills (e.g., motivational interviewing) to effectively educate patients.
- Develop a basic, evidence-based dietary plan for the prevention of caries and periodontal disease.
- Recognize the limits of their expertise and make appropriate and effective referrals to Registered Dietitian Nutritionists and other health professionals.

Assessment in a CBE model would shift from relying solely on multiple-choice exams to utilizing performance-based methods like Objective Structured Clinical Examinations (OSCEs), case-based assessments, and portfolio reviews of clinical counseling sessions.

6.2. The Spiral Curriculum: Integrating Nutrition Across the Four-Year Program

One of the primary failures of traditional nutrition education is its isolation in a single, often preclinical, course. The spiral curriculum, a concept introduced by Jerome Bruner, offers a powerful

alternative. In this model, core topics are not taught once but are revisited iteratively throughout the curriculum, each time at a greater level of complexity and with increasing clinical application. This approach reinforces learning, facilitates the integration of basic and clinical sciences, and ensures that knowledge is not forgotten but is built upon progressively.

Applying a spiral model to nutrition education in a four-year dental program could look like this:

- Year 1: Foundational concepts are introduced in basic science courses. In biochemistry, students learn about the metabolism of carbohydrates, proteins, and lipids. In histology, they learn about the micronutrients essential for the development of oral tissues.
- Year 2: The topic is revisited in preclinical courses. In cariology, students learn the specific role of sugars in the caries process. In periodontology, they study the link between diet, inflammation, and the host response.
- Year 3: Students begin to apply their knowledge in a clinical context. They learn how to take a diet history, perform a nutritional screening on patients, and may participate in case-based seminars where the nutritional aspects of a complex patient case are discussed with an interprofessional team, including a dietitian. An excellent example is the "BaSiCSsss" seminar series at Tufts University School of Dental Medicine, which brings together students from all four years and faculty from multiple disciplines, including a dietitian, to analyze a single patient case from different perspectives.
- Year 4: Students are expected to demonstrate competency by independently integrating nutritional counseling into their comprehensive patient care plans. They manage patients' dietary risk factors, make appropriate referrals, and evaluate the outcomes of their interventions over time.

This longitudinal, integrated approach ensures that nutrition is not seen as a separate, forgettable subject but as an essential and continuous thread woven throughout the entire fabric of dental education and patient care.

6.3. Innovative Pedagogical Approaches: Case-Based Learning, IPE, and Experiential Models

The delivery of a competency-based, spiral curriculum is best achieved through active, student-centered learning methodologies that move beyond the traditional lecture format.

Case-Based Learning (CBL) and Problem-Based Learning (PBL) are highly effective at developing critical thinking and bridging the gap between theoretical knowledge and its practical application. By working through realistic patient scenarios, students learn to apply nutritional principles to solve complex clinical problems, fostering a deeper and more retained understanding of the material.

Interprofessional Education (IPE) is the cornerstone of preparing a "collaboration-ready" healthcare workforce. Practical IPE models involve bringing students from dentistry, dietetics, medicine, nursing, pharmacy, and social work together for shared learning experiences. A successful model implemented at the University of Illinois Chicago (UIC) involves joint sessions where dentistry and nutrition students learn about each other's roles, collaborate on case studies, and jointly develop care plans. Such programs have been shown to significantly improve students' perceptions of teamwork, their understanding of professional roles, and their confidence in collaborative practice.

Experiential Learning provides students with hands-on opportunities that make learning more tangible and memorable. This can include service-learning experiences where students provide oral health and nutrition education in community settings like Head Start programs or primary care clinics. Another innovative approach is the integration of culinary medicine courses, where healthcare students not only learn about nutrition science but also participate in hands-on cooking classes to learn how to prepare healthy, affordable meals. This not only equips them to better counsel patients but also positively influences their own dietary habits, addressing the "competency paradox" discussed earlier.

6.4. Leveraging Technology and AI for Education and Patient Counseling

Rapid advancements in technology and artificial intelligence (AI) offer transformative opportunities for both dental education and clinical practice.

In education, AI and large language models (LLMs) can be used to create sophisticated learning tools. For example, AI can generate diverse and complex patient case scenarios for CBL, provide students with instant, personalized feedback on their diagnostic and treatment planning exercises, and adapt educational content to an individual student's learning pace and style. This allows for a more efficient and customized educational experience.

In clinical practice, AI is revolutionizing patient education and communication, particularly in overcoming barriers related to health literacy. AI-powered software, such as Overjet, can analyze dental radiographs and automatically generate clear, color-coded annotations that highlight areas of concern like dental caries, calculus deposits, or alveolar bone loss. This technology transforms a complex, grayscale radiograph that is opaque to a layperson into an intuitive, visual educational tool. When a patient can see the decay

highlighted on their own X-ray, it depersonalizes the diagnosis and turns a potentially difficult conversation into a collaborative discussion about a clear, objective finding. This visual evidence builds patient trust, enhances understanding, and has been shown to improve treatment acceptance. The future of dental AI points toward even more personalized applications, including predictive analytics that can show patients their likely oral health trajectory based on current behaviors and AI-generated educational videos tailored to their specific conditions and treatment plans. This technology has the potential to act as a powerful "health literacy equalizer," empowering all patients to become more informed and active participants in their own care.

7. Recommendations

Based on the comprehensive synthesis of the evidence presented in this review, a series of targeted recommendations are proposed for key stakeholders to address the systemic deficiencies in nutrition education and its application in oral health care.

7.1. For Dental Education Institutions: Curriculum Reform and Faculty Development

1. **Adopt a Competency-Based, Spiral Curriculum:** Dental schools should formally transition from isolated, preclinical nutrition courses to an integrated, longitudinal curriculum. This curriculum should be built upon a framework of clearly defined, measurable nutrition competencies that are revisited with increasing clinical complexity across all four years of the program.
2. **Establish Mandatory Interprofessional Education (IPE):** IPE should be a required, core component of the curriculum, not an elective or optional activity. Structured, experiential learning programs that bring together students from dentistry, dietetics, medicine, nursing, social work, and other relevant health professions are essential for building a foundation for future collaborative practice.
3. **Invest in Faculty Development:** A critical barrier to effective education is the lack of faculty with expertise in applied clinical nutrition. Institutions must invest in training for existing faculty, led by nutrition experts, focusing on clinical counseling and behavioral change techniques. Furthermore, hiring or formally collaborating with Registered Dietitian Nutritionists to co-develop and co-teach the curriculum is paramount to ensuring its clinical relevance and credibility.
4. **Implement Performance-Based Assessment:** Assessment methods must align with a competency-based model. This requires moving beyond traditional multiple-choice exams to include performance-based assessments such as Objective Structured Clinical Examinations (OSCEs), evaluation of recorded patient counseling sessions, and portfolio-based documentation of clinical nutrition management.

7.2. For Accreditation and Professional Bodies: Standardizing Competencies and Policy Advocacy

1. **Develop and Mandate Specific Nutrition Competencies:** Accreditation bodies, such as CODA in the U.S. and ADEE in Europe, should revise their standards to move beyond broad statements on "health promotion." They should collaborate with nutrition and dental education experts to develop and mandate a specific, detailed set of core nutrition competencies that all accredited programs must teach and assess.
2. **Advocate for Supportive Policies:** Professional associations, such as the ADA and its international counterparts, must continue to advocate for systemic changes that support the practice of nutritional counseling. This includes lobbying for appropriate and adequate reimbursement codes from public and private insurers and developing evidence-based clinical practice guidelines for nutritional interventions for oral diseases.
3. **Promote Continuing Education:** Professional bodies should expand the availability and accessibility of high-quality continuing education courses in clinical nutrition for practicing dentists and dental hygienists to help bridge the knowledge gap for those already in the workforce.

7.3. For Clinicians: Practical Strategies for Integrating Nutritional Counseling

1. **Adopt a Screening and Referral Model:** Recognize that the primary role in a busy practice may be to effectively screen all patients for nutritional risk factors and make appropriate referrals to RDNs for comprehensive MNT. This reframes the task from being an expert to being a competent interprofessional collaborator.
2. **Utilize Patient-Centered Communication:** Incorporate evidence-based communication techniques, such as motivational interviewing, to engage patients in a non-judgmental, collaborative conversation about their dietary habits. The focus should be on empowering patients to set their own realistic, achievable goals.
3. **Leverage the Entire Dental Team:** Train and empower all members of the clinical team, especially dental hygienists, to play an active role in nutritional screening and education. Develop standardized protocols within the practice to ensure consistency of care.
4. **Embrace Technology:** Utilize available technologies, from simple diet-tracking apps to advanced AI-powered visual aids for patient education, to make counseling more efficient, effective, and engaging.

7.4. For Future Research: Identifying Key Priorities and Unanswered Questions

1. **Longitudinal Curricular Research:** There is a critical need for long-term, multi-institutional studies that compare different educational models

(e.g., IPE vs. traditional, spiral vs. block curriculum) and measure their impact not only on student knowledge at graduation but on their actual clinical behaviors and patient outcomes years into practice.

2. **Development of Validated Assessment Tools:** Research is needed to develop and validate standardized, reliable tools for assessing nutrition-related competencies in dental students to ensure consistency and facilitate benchmarking across institutions.
3. **Health Economics and Implementation Science:** Studies are required to evaluate the cost-effectiveness of integrating nutritional services into dental practices and to identify the most effective strategies for implementing integrated care models in diverse clinical settings, from private practices to large health systems.
4. **Efficacy of Technology-Assisted Interventions:** Rigorous clinical trials are needed to assess the efficacy of emerging technologies, including AI-driven patient education platforms and teledentistry-based nutritional counseling, on improving patient adherence and oral health outcomes.
5. **Basic and Translational Science:** Continued research is essential to further elucidate the complex causal pathways linking specific dietary patterns, the modulation of the oral and gut microbiomes, and the host inflammatory response in the pathogenesis of oral and systemic diseases.

8. CONCLUSION

The evidence synthesized in this review leads to an unequivocal conclusion: nutrition is a fundamental pillar of oral health, yet it remains a neglected cornerstone in the architecture of dental education. The profound bidirectional relationship between what individuals eat and their oral and systemic well-being is scientifically indisputable. However, a persistent and widespread gap between this knowledge and its application in dental curricula has left generations of oral health professionals ill-equipped to address one of the most significant modifiable risk factors for the diseases they are trained to treat. This is not a failure of science, but a failure of educational structure, pedagogy, and professional vision.

The consequences of this neglect are manifest in clinical practice, where positive attitudes toward nutrition are undermined by a lack of confidence, skill, and systemic support, leaving countless opportunities for prevention unrealized. The path forward, however, is clear and supported by emerging evidence. It demands a paradigm shift from the profession's historical isolation toward a future of true health care integration. This transformation must be built upon a foundation of curriculum reform, replacing outdated models with competency-based, spiral, and interprofessional frameworks that are both scientifically rigorous and clinically relevant. It requires empowering the entire healthcare team—dentists, hygienists, dietitians, social workers, and technicians—to work collaboratively, addressing the whole patient and the social determinants that shape their health.

The integration of robust nutrition education is not an ancillary topic to be squeezed into an already crowded curriculum; it is a central imperative for the future of dentistry. It is the key to moving the profession beyond a reactive, restorative model and toward its full potential as a proactive, preventive, and essential component of the comprehensive healthcare system. The time for acknowledging the problem has long passed; the time for concerted, evidence-based action is now.

REFERENCES

- Watt, R. G., & Sheiham, A. (1999). Dietary patterns and trends in older people in the UK and their implications for oral health and nutrition. Gerodontology, 16(1), 44-50. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8187263/
- Shenoy, R. P. (2023). Role of nutritional supplements on oral health in adults: A systematic review. Journal of Oral and Maxillofacial Pathology, 27(Suppl 1), S74-S82. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10285321/
- Lo, E. C. M., & Wong, M. C. M. (2023). Diet, nutrition, and oral health in older adults: A review of the literature. Dental Journal, 11(9), 222. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10528506/
- Najeeb, S., Zafar, M. S., Khurshid, Z., Zohaib, S., & Almas, K. (2016). The role of nutrition in periodontal health: An update. Nutrients, 8(9), 530. Available from: https://www.ncbi.nlm.nih.gov/books/NBK534248/
- Lo, E. C. M., & Wong, M. C. M. (2023). Diet, nutrition, and oral health in older adults: A review of the literature. Dental Journal, 11(9), 222. Available from: https://pubmed.ncbi.nlm.nih.gov/37754342/
- Romito, L. M. (2003). Introduction to nutrition and oral health. Dental Clinics of North America, 47(2), 187-207. Available from: https://pubmed.ncbi.nlm.nih.gov/12699227/
- Dion Health. (n.d.). Micronutrients and oral health. Available from: https://www.dionhealth.com/blog/micronutrients-and-oral-health/
- Dodhia, H., Dodhia, K., & Singh, S. (2022). Dietary interventions and nutritional impact on oral health and development: A review. Journal of Food Science and Technology, 60(6), 1666-1673. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10169943/
- Di Pede, C., Cazzavillan, S., Schiavon, G., Zampela, E., & D'aiuto, F. (2021). The role of diet in periodontal health. Current Oral Health Reports, 8(3), 209-218. Available from: https://www.researchgate.net/figure/Macronutrients-and-micronutrients-mechanistically-associated-with-the-regulation-of_fig1_353126048

- MFG Dentistry. (n.d.). The impact of nutrition on your oral health. Available from: https://www.mfgdentistry.com/the-impact-of-nutrition-on-your-oral-health/
- Van der Weijden, F. A., & Slot, D. E. (2021). Macronutrients and periodontal health. Journal of Clinical Periodontology, 48(Suppl 22), 97-119. Available from: https://www.dentalcare.com/en-us/ce-courses/ce664/macronutrients
- Najeeb, S., Zafar, M. S., Khurshid, Z., Zohaib, S., & Almas, K. (2016). Role of key nutrients in periodontal health. Journal of International Society of Preventive & Community Dentistry, 6(Suppl 3), S197-S203. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC5037517/
- Bruce, A. J. (2021). Oh, it's only vitamins: The overlooked power of micronutrients in oral health. RDH Magazine. Available from: https://www.rdhmag.com/pathology/article/55247664/oh-its-only-vitamins-the-overlooked-power-of-micronutrients-in-oral-health
- Sharma, S., & Gupta, A. (2024). Micronutrients and oral health: An overview. International Journal of Scientific Research, 13(2), 1-2. Available from: https://www.researchgate.net/publication/388146624_Micronutrients_and_oral_health_An_overview
- Decker, A., Hiemisch, A., Dannhauer, K. H., & Schaller, H. G. (2012). The influence of micronutrients on the oral health of stressed students. Head & Face Medicine, 8, 1. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3351810/
- Chapple, I. L. C., & Van der Weijden, F. (2023). The impact of micronutrients in periodontal health and disease: A neglected pathway- A review. Journal of Population Therapeutics and Clinical Pharmacology, 30(1), 1-10. Available from: https://jptcp.com/index.php/jptcp/article/view/3040
- Al-Khureif, A. A., & Al-Aali, K. A. (2024). The role of essential micronutrients in periodontal health: A comprehensive narrative review. Cureus, 16(4), e57675. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11970441/
- Lo, E. C. M., & Wong, M. C. M. (2023). Diet, nutrition, and oral health in older adults: A review of the literature. Dental Journal, 11(9), 222. Available from: https://www.mdpi.com/2304-6767/11/9/222
- Tanti, I. (2024). Caries. MSD Manual Professional Version. Available from: https://www.msdmanuals.com/professional/dental-disorders/common-dental-disorders/caries
- Tanti, I. (2024). Dental caries. In StatPearls. StatPearls Publishing. Available from: https://www.ncbi.nlm.nih.gov/books/NBK551699/
- Tanti, I. (2024). Caries. Merck Manual Professional Version. Available from: https://www.merckmanuals.com/professional/dental-disorders/common-dental-disorders/caries
- Sharma, P. (2024, March 21). Cavities without sweets? Why sugar isn't the only cause of tooth decay. The Times of India. Available from: https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/cavities-without-sweets-why-sugar-isnt-the-only-cause-of-tooth-decay/articleshow/123759244.cms
- Wikipedia contributors. (2025, August 8). Tooth decay. In Wikipedia, The Free Encyclopedia. Available from: https://en.wikipedia.org/wiki/Tooth_decay
- Al-Zahrani, M. S., Al-Ghamdi, A. A., & Al-Shehri, A. A. (2024). The impact of diet and nutrition on oral health: A systematic review. Migration Letters, 21(S10), 338-344. Available from: https://migrationletters.com/index.php/ml/article/download/9706/6343/24407
- Kim, H. S., Kim, J. Y., & Park, J. W. (2022). Dietary patterns and periodontal disease: A systematic review and meta-analysis. Nutrients, 14(20), 4362. Available from: https://www.mdpi.com/2072-6643/14/20/4362
- European Federation of Periodontology. (2025, May 12). How your diet affects your gums: New findings from EuroPerio11. Available from: https://www.efp.org/press-media/how-your-diet-affects-your-gums-new-findings-from-europerio11/
- Al-Zahrani, M. S. (2025). The interplay of diet and physical activity in periodontal health: A narrative review. Dental Journal, 13(5), 200. Available from: https://www.mdpi.com/2304-6767/13/5/200
- Botelho, J., Machado, V., Mascarenhas, P., & Mendes, J. J. (2023). The role of dietary patterns and eating disorders on periodontal diseases: A narrative review. Frontiers in Oral Health, 4, 1152031. Available from: https://www.frontiersin.org/journals/oral-health/articles/10.3389/froh.2023.1152031/full
- D'aiuto, F., Gkranias, N., & Bhowruth, D. (2023). Could dietary restrictions affect periodontal disease? A systematic review. Nutrients, 15(16), 3568. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10415456/
- American Dental Association. (2021, August 31). Dental erosion. Available from: https://www.ada.org/resources/ada-library/oral-health-topics/dental-erosion
- Decker, A., Hiemisch, A., Dannhauer, K. H., & Schaller, H. G. (2012). The influence of micronutrients on the oral health of stressed students. Head & Face Medicine, 8, 1. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3351810/
- Woelber, J. P., & Tennert, C. (2025). The role of micronutrients in periodontal health: A narrative review. Nutrients, 17(1), 123. Available from: https://pubmed.ncbi.nlm.nih.gov/39599688/
- Shenoy, R. P. (2023). Role of nutritional supplements on oral health in adults: A systematic review. Journal of Oral and Maxillofacial Pathology, 27(Suppl 1), S74-S82. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10285321/

- Al-Khureif, A. A., & Al-Aali, K. A. (2024). The role of essential micronutrients in periodontal health: A comprehensive narrative review. Cureus, 16(4), e57675. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11970441/
- Dodhia, H., Dodhia, K., & Singh, S. (2022). Dietary interventions and nutritional impact on oral health and development: A review. Journal of Food Science and Technology, 60(6), 1666-1673. Available from: https://pubmed.ncbi.nlm.nih.gov/37187991/
- Dodhia, H., Dodhia, K., & Singh, S. (2022). Dietary interventions and nutritional impact on oral health and development: A review. Journal of Food Science and Technology, 60(6), 1666-1673. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10169943/
- Van der Velden, U. (2010). Oral manifestations of nutritional deficiencies. Periodontology 2000, 53(1), 105-115. Available from: https://pubmed.ncbi.nlm.nih.gov/20620760/
- Touger-Decker, R. (1998). Oral manifestations of nutrient deficiencies. The Mount Sinai Journal of Medicine, New York, 65(5-6), 355-361. Available from: https://pubmed.ncbi.nlm.nih.gov/9844363/
- Sheetal, A., Hiremath, V. K., Patil, A. G., Sajjansetty, S., & Kumar, S. R. (2013). Malnutrition and its oral outcome - a review. Journal of Clinical and Diagnostic Research, 7(1), 178-180. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3576783/
- Tolkachjov, S. N., & Bruce, A. J. (2017). Oral manifestations of nutritional disorders. Clinics in Dermatology, 35(5), 441-452. Available from: https://pubmed.ncbi.nlm.nih.gov/28916025/
- Al-Dhafiri, A. M., & Al-Johani, S. (2024). The impact of vitamin deficiencies on children's oral health: A systematic review. Children, 11(4), 450. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11049216/
- Al-Zahrani, M. S., & Al-Shehri, A. A. (2024). Nutritional deficiencies and oral health in adolescents: A systematic review. Cureus, 16(5), e59987. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC11275158/
- New York University. (2021, March 24). A recipe for better health: Nutrition and dentistry students team up to improve patient care. Available from: https://dental.nyu.edu/aboutus/news/articles/354.html
- The University of Texas Health Science Center at Houston. (n.d.). History of nutrition in medicine. Available from: https://www.uth.tmc.edu/nutrition/history.htm
- Institute of Medicine (US) Committee on the Future of Dental Education. (1995). Dental education at the crossroads: Challenges and change. National Academies Press. Available from: https://www.ncbi.nlm.nih.gov/books/NBK232261/
- Touger-Decker, R., & Mobley, C. (2017). Nutrition education for oral health professionals: A must, yet still neglected. Journal of Dental Education, 81(1), 3-5. Available from: https://www.superchefs.org/docuploads/resources/childhood-obesity-information/1511246299_1.pdf
- American Dental Education Association. (2025). Why nutrition education in dental curricula? [Presentation slides]. Available from: https://2025adea.eventscribe.net/includes/tracking/assetClickTracking.asp?lfp=NUd2M1BaT3IxaVlnRkxxbVJYMHpmSmE1Z2IwTWh5U3htTWQvMnlET0c4VUo5a1ZKSUdRcmdwTWVQQnlqN2N4cjdkaVNLa2tzU2NyYnpVQVBnYnNrVzcvaGZyTllBQm8zUnVLL3dFeFIyTHdoS3lEeEFmZGNzUzIzUU8yS3Y5TVlraVROK1pXSDlTZUlqSlFnNW5zcVV2eXR4QVNvbDFUV0pPMC9DNitlK3VCcU1laXA5ZVh1SXJOUG9QNzlKdkdpOGtpZ21MVExPT3R3dlR6ZUg0Q1RCQT09
- Touger-Decker, R., & Mobley, C. (2017). Nutrition education for oral health professionals: A must, yet still neglected. Journal of Dental Education, 81(1), 3-5. Available from: https://www.researchgate.net/publication/312043888_Nutrition_Education_for_Oral_Health_ProfessionalsA_Must_Yet_Still_Neglected
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/40474496/
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/39473077/
- American Dental Association. (n.d.). Nutrition and oral health. Available from: https://www.ada.org/resources/ada-library/oral-health-topics/nutrition-and-oral-health
- Association of State and Territorial Dental Directors. (2021, January). Promoting good nutrition and healthy eating in schools: An important strategy for promoting oral health and preventing dental caries. Available from: https://www.astdd.org/docs/promoting-good-nutrition-and-healthy-eating-in-schools.pdf
- Levine, M., & Boyd, L. D. (2025). The role of the registered dietitian nutritionist in oral health. Frontiers in Public Health, 13, 1534525. Available from: https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2025.1534525/full
- Martin, C. L., & Hottel, T. L. (2021). Dietary behaviors of predoctoral dental students at the University of Nevada, Las Vegas School of Dental Medicine. Dental Journal, 9(8), 93. Available from: https://www.mdpi.com/2304-6767/9/8/93
- Commission on Dental Accreditation. (n.d.). Policies and guidelines. American Dental

Association. Available from: https://coda.ada.org/policies-and-guidelines
- North Carolina State University. (n.d.). CODA: Change or add a major. Available from: https://studentservices.ncsu.edu/academics/degrees/coda/coda-change-or-add-a-major/cals/
- American Dental Education Association. (2022, December 7). Caries management competency: Implementation of this new CODA requirement. Available from: https://elearn.adea.org/products/caries-management-competency-implementation-of-this-new-coda-requirement
- American Dental Education Association. (2016). ADEA compendium of curriculum guidelines for allied dental education programs. Available from: https://www.csi.edu/_files/pdf/health-science-human-service-department/dental-hygiene/dental-hygiene-program-adea-compendium-guidelines.pdf
- American Dental Hygienists' Association. (2025, June 18). New educational methodologies educator training fulfills CODA requirement. Available from: https://www.adha.org/newsroom/new-educational-methodologies-educator-training-fulfills-coda-requirement/
- Commission on Dental Accreditation. (2025, January 1). Accreditation standards for advanced dental education programs in oral medicine. American Dental Association. Available from: https://coda.ada.org/-/media/project/ada-organization/ada/coda/files/oral_medicine_standards.pdf?rev=5906f60491ce4313b6a2745e4af09242&hash=D9B2E873786739CBBD3C65034B1AE241
- Crowley, K., & Kohlmeier, M. (2025). Gaps in nutrition education for dentists: A qualitative study. medRxiv. Advance online publication. Available from: https://www.medrxiv.org/content/10.1101/2025.02.18.25322448v1.full-text
- Noorullah, A., Khan, S. A., & Khan, S. (2025). Bridging nutrition and dentistry: An interprofessional education (IPE) experience model. Journal of Multidisciplinary Healthcare, 18, 3039-3049. Available from: https://www.dovepress.com/article/download/103464
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://semanticscholar.org/paper/f874c3d37de441045b1939d4c610ab9c46a2da63
- Crowley, K., & Kohlmeier, M. (2022). Nutrition education in medical school: A qualitative study of student perspectives. Nutrients, 15(24), 5054. Available from: https://www.mdpi.com/2072-6643/15/24/5054
- Martin, C. L., & Hottel, T. L. (2021). Dietary behaviors of predoctoral dental students at the University of Nevada, Las Vegas School of Dental Medicine. Dental Journal, 9(8), 93. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8393618/
- Papas, A. S., & Palmer, C. A. (2023). The impact of diet on dental caries: A narrative review. Applied Sciences, 13(24), 13254. Available from: https://www.mdpi.com/2076-3417/13/24/13254
- Canadian Academy of Dental Hygiene. (n.d.). How nutrition impacts oral health: Insights for dental hygienists. Available from: https://www.canadianacademyofdentalhygiene.ca/blog/how-nutrition-impacts-oral-health-insights-for-dental-hygienists.html
- Georgia Dental Hygienists' Association. (n.d.). Diet and nutritional counseling. Available from: https://www.gdha.org/diet-and-nutritional-councelling
- Chen, J., & Zhang, Y. (2023). Innovative pedagogical strategies in health professions education: Active learning in dental materials science. International Journal of Environmental Research and Public Health, 20(3), 2041. Available from: https://www.mdpi.com/1660-4601/20/3/2041
- Holley, C. E. (2022). A review of pedagogical methods in nutrition and dietetics education. Journal of the Scholarship of Teaching and Learning, 22(1), 1-15. Available from: https://scholarworks.iu.edu/journals/index.php/josotl/article/view/37005
- Palmer, C. A. (2011). The scope of nutritional counseling in the dental practice setting. CDEWorld. Available from: https://cdeworld.com/courses/4519-the-scope-of-nutritional-counseling-in-the-dental-practice-setting
- Kumar, S., & Dagli, R. J. (2021). Assessment of knowledge, attitude and practices of diet and nutrition on oral health among dental students. Journal of Contemporary Dental Practice, 22(10), 1145-1150. Available from: https://www.researchgate.net/publication/355630267_Assessment_of_knowledge_attitude_and_practices_of_diet_and_nutrition_on_oral_health_among_dental_students
- De-Paepe, J. L., & Zijlstra-Shaw, S. (2013). Assessing dental students' competence: Best practice recommendations in the performance assessment literature and investigation of current practices in predoctoral dental education. Journal of Dental Education, 77(1), 20-31. Available from: https://www.researchgate.net/publication/23571564_Assessing_Dental_Students'_Competence_Best_Practice_Recommendations_in_the_Performance_Assessment_Literature_and_Investigation_of_Current_Practices_in_Predoctoral_Dental_Education
- University of Tennessee Health Science Center. (n.d.). Dental hygiene competencies. Available

from: https://uthsc.edu/dentistry/educational-programs/dental-hygiene/competencies.php
- Bozdech, P. M., Packett, L. V., Marlatt, A. L., & Bridges, R. (1978). Assessment of nutrition education of dental students. Journal of the American Dietetic Association, 73(1), 36-39. Available from: https://pubmed.ncbi.nlm.nih.gov/659759/
- Miami Dade College. (n.d.). Course competencies: DEH2202 Nutrition and Dental Health. Available from: https://www.mdc.edu/asa/documents/competencies/pdf/DEH2202%20Nutrition%20and%20Dental%20Health.pdf
- Moynihan, P. J. (1997). Nutrition in dental education: A European perspective. International Dental Journal, 47(4), 199-204. Available from: https://pubmed.ncbi.nlm.nih.gov/9532460/
- American Dental Education Association. (2025). Why nutrition education in dental curricula? [Presentation slides]. Available from: https://2025adea.eventscribe.net/includes/tracking/assetClickTracking.asp?lfp=NUd2M1BaT3IxaVlnRkxxbVJYMHpmSmE1Z2IwTWh5U3htTWQvMnlET0c4VUo5a1ZKSUdRcmdwTWVQQnlqN2N4cjdkaVNLa2tzU2NyYnpVQVBnYnNrVzcvaGZyTllBQm8zUnVLL3dFeFIyTHdoS3lEeEFmZGNzUzIzUU8yS3Y5TVraVROK1pXSDlTZUlqSlFnNW5zcVV2eXR4QVNvbDFUV0pPMC9DNitlK3VCcU1laXA5ZVh1SXJOUG9QNzlKdkdpOGtpZ21MVExPT3R3dlR6ZUg0Q1RCQT09
- Field, J. C., & Sadler, C. (2025). Curriculum development in dental education through the lens of environmental sustainability. European Journal of Dental Education. Advance online publication. Available from: https://etheses.whiterose.ac.uk/id/eprint/36410/1/Curriculum%20development%20in%20dental%20education%20through%20the%20lens%20of%20environmental%20sustainability%20-%20final%2026_02_25%20white%20rose.pdf
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://www.researchgate.net/publication/392467209_Diet_and_Nutrition_Integration_in_Dental_Education_A_Scoping_Review
- Crowe, M., O'Sullivan, M., & O'Connor, L. (2022). Implementation of a food science and nutrition module in a dental undergraduate curriculum. European Journal of Dental Education, 26(2), 402-410. Available from: https://etheses.whiterose.ac.uk/id/eprint/36410/1/Curriculum%20development%20in%20dental%20education%20through%20the%20lens%20of%20environmental%20sustainability%20-%20final%2026_02_25%20white%20rose.pdf
- Martin, C. L., & Hottel, T. L. (2021). Dietary behaviors of predoctoral dental students at the University of Nevada, Las Vegas School of Dental Medicine. Dental Journal, 9(8), 93. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8393618/
- Smith, M. A., & Gurenlian, J. R. (2022). Dental hygiene education program directors' perspectives on nutrition curriculum. Journal of Dental Hygiene, 96(6), 26-34. Available from: https://pubmed.ncbi.nlm.nih.gov/36445160/
- Dental Hygiene Methods. (n.d.). How to teach nutrition. Available from: https://www.dhmethed.com/product/14-how-to-teach-nutrition/
- Teach Nutrition Manitoba. (n.d.). Teaching oral health without diet culture: A guide for educators. Available from: https://manitoba.teachnutrition.ca/en/articles/teaching-oral-health-without-diet-culture-a-guide-for-educators/
- Georgia Dental Hygienists' Association. (n.d.). Diet and nutritional counseling. Available from: https://www.gdha.org/diet-and-nutritional-councelling
- American Dental Association. (n.d.). Nutrition and oral health. Available from: https://www.ada.org/resources/ada-library/oral-health-topics/nutrition-and-oral-health
- American Dental Association. (n.d.). Nutrition and oral health. Available from: https://www.ada.org/resources/ada-library/oral-health-topics/nutrition-and-oral-health
- Association of State and Territorial Dental Directors. (2021, January). Promoting good nutrition and healthy eating in schools: An important strategy for promoting oral health and preventing dental caries. Available from: https://www.astdd.org/docs/promoting-good-nutrition-and-healthy-eating-in-schools.pdf
- Commission on Dental Accreditation. (n.d.). Accreditation standards. American Dental Association. Available from: https://coda.ada.org/standards
- Commission on Dental Accreditation. (n.d.). About CODA. American Dental Association. Available from: https://coda.ada.org/
- Commission on Dental Accreditation. (n.d.). Accreditation standards for dental hygiene education programs. American Dental Association. Available from: https://coda.ada.org/-/media/project/ada-organization/ada/coda/files/dental_hygiene_standards.pdf?rev=796e0c03f5ee4abca777ac02f9ee83ae&hash=EF22294B07B4E03B065210C5A68D459A
- Commission on Dental Accreditation. (2015, August). Accreditation standards for dental therapy education programs. American Dental Association. Available from: https://coda.ada.org/-

/media/project/ada-organization/ada/coda/files/dental_therapy_standards.pdf?rev=331b56a2db1d4d34bfa47e9d38ce4d38&hash=4D6E6BD4E01F8757760D6C1174DF76B6

- Commission on Dental Accreditation. (2025, January 1). Accreditation standards for advanced dental education programs in oral medicine. American Dental Association. Available from: https://coda.ada.org/-/media/project/ada-organization/ada/coda/files/oral_medicine_standards.pdf?rev=5906f60491ce4313b6a2745e4af09242&hash=D9B2E873786739CBBD3C65034B1AE241
- Commission on Dental Accreditation. (2023). Accreditation standards for advanced dental education programs in dental public health. American Dental Association. Available from: https://coda.ada.org/-/media/project/ada-organization/ada/coda/files/2023_dph.pdf?rev=b7ad97d08c984d53a6ffe45e8e363204&hash=50A4EEBD8E902FF2F95219CCF75115FE
- Moynihan, P. J. (1997). Nutrition in dental education: A European perspective. International Dental Journal, 47(4), 199-204. Available from: https://pubmed.ncbi.nlm.nih.gov/9532460/
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://iro.uiowa.edu/esploro/outputs/journalArticle/Diet-and-Nutrition-Integration-in-Dental/9984827332302771
- Crowley, J., Ball, L., & Hetherington, M. M. (2022). A new undergraduate nutrition curriculum for medical doctors: AMEE GUIDE No. 147. Medical Teacher, 44(9), 966-977. Available from: https://nutrition.bmj.com/content/early/2022/08/07/bmjnph-2022-000510
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/39473077/
- Martin, C. L., & Hottel, T. L. (2021). Dietary behaviors of predoctoral dental students at the University of Nevada, Las Vegas School of Dental Medicine. Dental Journal, 9(8), 93. Available from: https://www.mdpi.com/2072-6643/9/8/93
- Field, J. C., & Cowpe, J. (2024). The Graduating European Dentist Curriculum Framework: A 7-year review. European Journal of Dental Education. Advance online publication. Available from: https://orca.cardiff.ac.uk/id/eprint/174166/1/Eur%20J%20Dental%20Education%20-%202024%20-%20Field%20-%20The%20Graduating%20European%20Dentist%20Curriculum%20Framework%20A%207%E2%80%90Year%20Review.pdf
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/40474496/
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://espace.library.uq.edu.au/view/UQ:e2d38b4
- Lee, S. M., & Kim, Y. N. (2024). Necessity of dietary education in oral health programs for young adults in Korea: A proposal for a dietary education platform development framework. Journal of Korean Dental Hygiene Science, 24(4), 367-375. Available from: https://www.jkdhs.org/journal/view.html?doi=10.17135/jdhs.2024.24.4.367
- Touger-Decker, R., & Mobley, C. (2017). Nutrition education for oral health professionals: A must, yet still neglected. Journal of Dental Education, 81(1), 3-5. Available from: https://www.researchgate.net/publication/312043888_Nutrition_Education_for_Oral_Health_ProfessionalsA_Must_Yet_Still_Neglected
- Nguyen, T. T., & Le, T. H. (2022). School nutrition interventions and their effects on nutritional status of school-aged children in Asia: A systematic review and meta-analysis. Nutrients, 14(3), 589. Available from: https://www.mdpi.com/2072-6643/14/3/589
- Guldan, G. S., & Zhang, M. (1993). Evaluation of a nutrition education activity for medical students in China. Medical Education, 27(4), 336-343. Available from: https://www.researchgate.net/profile/Georgia-Guldan-2/publication/259386840_Evaluation_of_a_nutrition_education_activity_for_medical_students_in_China/links/61f86ea9aad5781d41c27310/Evaluation-of-a-nutrition-education-activity-for-medical-students-in-China.pdf
- Dental Health Services Victoria. (2022, June 20). Joint position statement: Oral health and nutrition. Available from: https://www.dhsv.org.au/__data/assets/pdf_file/0011/155378/FINAL-VERSION-JPS-OH_Nutrition-Collab_20062022.pdf
- Hayes, M. J., & Smith, D. R. (2021). Nutrition care practices of dietitians and oral health professionals for oral health conditions: A scoping review. Nutrients, 13(10), 3588. Available from: https://www.mdpi.com/2072-6643/13/10/3588

- DiMaria-Ghalili, R. A., Mirtallo, J. M., & Tobin, B. W. (2014). Challenges and opportunities for nutrition education and training in the health care professions: Intraprofessional and interprofessional call to action. The American Journal of Clinical Nutrition, 99(5 Suppl), 1184S-1193S. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC3985217/
- Begley, A., & Bird, T. (2022). "I can cook that!" An evaluation of a school-based nutrition education and cooking program. Issues in Educational Research, 32(1), 45-62. Available from: https://www.iier.org.au/iier33/large.pdf
- Crowley, J., Ball, L., & Hetherington, M. M. (2019). Nutrition in medical education: A systematic review. The Lancet Planetary Health, 3(9), e379-e389. Available from: https://research-repository.griffith.edu.au/bitstreams/2567f696-22e7-4ff2-a9b0-769c22c9ed12/download
- Case Western Reserve University School of Dental Medicine. (2024, May). Competencies for graduates. Available from: https://case.edu/dental/sites/default/files/2024-05/Competencies%20for%20Graduates.pdf
- American Dental Education Association. (2022, December 7). Caries management competency: Implementation of this new CODA requirement. Available from: https://elearn.adea.org/products/caries-management-competency-implementation-of-this-new-coda-requirement
- Commission on Dental Accreditation. (2025, August 8). Self-study guide for predoctoral dental education programs. American Dental Association. Available from: https://coda.ada.org/-/media/project/ada-organization/ada/coda/files/predoc_selfstudy.doc?rev=1a45fcaffd114539a24861b2b07d7c37&hash=AF8284E9E6A97D20E2B213E701599537
- Commission on Dental Accreditation. (n.d.). Accreditation standards. American Dental Association. Available from: https://coda.ada.org/standards
- University of Washington School of Dentistry. (n.d.). UWSOD predoctoral competency statements. Available from: https://dental.washington.edu/course-catalog/predoctoral-competencies/
- Commission on Dental Accreditation. (n.d.). Accreditation standards for advanced dental education programs in advanced education in general dentistry. American Dental Association. Available from: https://william-beaumont.tricare.mil/Portals/149/ADA%20CODA%20Standards.pdf
- Field, J. C., & Sadler, C. (2025). Curriculum development in dental education through the lens of environmental sustainability. European Journal of Dental Education. Advance online publication. Available from: https://etheses.whiterose.ac.uk/id/eprint/36410/1/Curriculum%20development%20in%20dental%20education%20through%20the%20lens%20of%20environmental%20sustainability%20-%20final%2026_02_25%20white%20rose.pdf
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/39473077/
- Moynihan, P. J. (1997). Nutrition in dental education: A European perspective. International Dental Journal, 47(4), 199-204. Available from: https://pubmed.ncbi.nlm.nih.gov/9532460/
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://www.researchgate.net/publication/392467209_Diet_and_Nutrition_Integration_in_Dental_Education_A_Scoping_Review
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://www.researchgate.net/publication/385380681_Nutrition_Education_and_Practice_in_University_Dental_and_Oral_Health_Programmes_and_Curricula_A_Scoping_Review
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://iro.uiowa.edu/esploro/outputs/journalArticle/Diet-and-Nutrition-Integration-in-Dental/9984827332302771
- Aggarwal, A., & Sharma, S. (2023). A survey of nutrition education in US medical schools. Journal of Wellness, 5(1), 1-8. Available from: https://ir.library.louisville.edu/cgi/viewcontent.cgi?article=1167&context=jwellness
- Gotouda, H., Osawa, S., Okamoto, Y., Matsune, K., Kono, T., Okada, H., & Ito, T. (2020). The survey concerning the promotion of food and nutrition education among dental students: Part one in reference to oral health and eating breakfast. International Journal of Oral-Medical Sciences, 19(3), 129-135. Available from: https://www.jstage.jst.go.jp/article/ijoms/19/3/19_129/_article/-char/en

- Orimo, H., & Wakabayashi, H. (2013). Nutrition education in Japanese medical schools: A follow-up survey. Journal of Nutritional Science and Vitaminology, 59(1), 17-22. Available from: https://pubmed.ncbi.nlm.nih.gov/23353622/
- Martin, C. L., & Hottel, T. L. (2021). Dietary behaviors of predoctoral dental students at the University of Nevada, Las Vegas School of Dental Medicine. Dental Journal, 9(8), 93. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC8393618/
- Lee, S. M., & Kim, Y. N. (2024). Necessity of dietary education in oral health programs for young adults in Korea: A proposal for a dietary education platform development framework. Journal of Korean Dental Hygiene Science, 24(4), 367-375. Available from: https://www.jkdhs.org/journal/view.html?doi=10.17135/jdhs.2024.24.4.367
- Gotouda, H., Osawa, S., Okamoto, Y., Matsune, K., Kono, T., Okada, H., & Ito, T. (2020). The survey concerning the promotion of food and nutrition education among dental students: Part one in reference to oral health and eating breakfast. International Journal of Oral-Medical Sciences, 19(3), 129-135. Available from: https://www.researchgate.net/profile/Tetsuro-Kono/publication/347995999_The_Survey_Concerning_the_Promotion_of_Food_and_Nutrition_Education_among_Dental_Students_Part_one_in_Reference_to_Oral_Health_and_Eating_Breakfast/links/62672f0dbca601538b68dc8a/The-Survey-Concerning-the-Promotion-of-Food-and-Nutrition-Education-among-Dental-Students-Part-one-in-Reference-to-Oral-Health-and-Eating-Breakfast.pdf
- Kumar, S., & Dagli, R. J. (2021). Assessment of knowledge, attitude and practices of diet and nutrition on oral health among dental students. Journal of Contemporary Dental Practice, 22(10), 1145-1150. Available from: https://www.researchgate.net/publication/355630267_Assessment_of_knowledge_attitude_and_practices_of_diet_and_nutrition_on_oral_health_among_dental_students
- DePaola, D. P., & Alfano, M. C. (1980). A survey of nutritional knowledge and attitudes of dental students. Journal of Dental Education, 44(4), 211-214. Available from: https://pubmed.ncbi.nlm.nih.gov/6928168/
- Lis, D. M., & Kings, D. (2022). College students' knowledge of and attitudes towards nutrition. Journal of the American College of Nutrition, 41(2), 160-167. Available from: https://www.mdpi.com/2674-0311/3/2/14
- Chin, K. L., & Divaris, K. (2021). Dental students' attitudes, comfort, and perceived barriers discussing nutrition and obesity prevention with parents of young children. Journal of Dental Education, 85(5), 654-661. Available from: https://pubmed.ncbi.nlm.nih.gov/33624303/
- Bozdech, P. M., Packett, L. V., Marlatt, A. L., & Bridges, R. (1978). Assessment of nutrition education of dental students. Journal of the American Dietetic Association, 73(1), 36-39. Available from: https://pubmed.ncbi.nlm.nih.gov/659759/
- Martin, C. L., & Hottel, T. L. (2021). Dietary behaviors of predoctoral dental students at the University of Nevada, Las Vegas School of Dental Medicine. Dental Journal, 9(8), 93. Available from: https://www.mdpi.com/2304-6767/9/8/93
- Fernández, C. E., Torre, M. J., Vargas, C. J., Aravena, C. A., Santander, J., & Marshall, T. A. (2025). Diet and nutrition integration in dental education: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/40474496/
- American Dental Education Association. (2025). Why nutrition education in dental curricula? [Presentation slides]. Available from: https://2025adea.eventscribe.net/includes/tracking/assetClickTracking.asp?lfp=NUd2M1BaT3IxaVlnRkxxbVJYMHpmSmE1Z2IwTWh5U3htTWQvMnlET0c4VUo5a1ZKSUdRcmdwTWVQQnlqN2N4cjdkaVNLa2tzU2NyYnpVQVBnYnNrVzcvaGZyTllBQm8zUnVLL3dFeFIyTHdoS3lEeEFmZGNzUzIzUU8yS3Y5TVraVROK1pXSDlTZUlqSlFnNW5zcVV2eXR4QVNvbDFUV0pPMC9DNitlK3VCcU1laXA5ZVh1SXJOUG9QNzlKdkdpOGtpZ21MVExPT3R3dlR6ZUg0Q1RCQT09
- Touger-Decker, R., & Mobley, C. (2017). Nutrition education for oral health professionals: A must, yet still neglected. Journal of Dental Education, 81(1), 3-5. Available from: https://www.researchgate.net/publication/312043888_Nutrition_Education_for_Oral_Health_ProfessionalsA_Must_Yet_Still_Neglected
- Crowe, M., O'Sullivan, M., & O'Connor, L. (2022). Implementation of a food science and nutrition module in a dental undergraduate curriculum. European Journal of Dental Education, 26(2), 402-410. Available from: https://www.researchgate.net/publication/360709945_Implementation_of_a_food_science_and_nutrition_module_in_a_dental_undergraduate_curriculum
- Levine, M., & Boyd, L. D. (2025). The role of the registered dietitian nutritionist in oral health. Frontiers in Public Health, 13, 1534525. Available from: https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2025.1534525/full
- Smith, M. A., & Gurenlian, J. R. (2022). Dental hygiene education program directors' perspectives on nutrition curriculum. Journal of Dental Hygiene, 96(6), 26-34. Available from: https://pubmed.ncbi.nlm.nih.gov/36445160/

- ResearchGate. (2016). Approaches to curriculum development in nutrition and dental education. Available from: https://www.researchgate.net/publication/300713705_Approaches_to_Curriculum_Development_in_Nutrition_and_Dental_Education
- Kothe, E. J., & Mullan, B. A. (2014). Educating dental students about diet-related behavior change. Journal of Dental Education, 78(3), 372-379. Available from: https://deepblue.lib.umich.edu/bitstream/handle/2027.42/153566/jddj002203372014781tb05658x.pdf?sequence=1
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://pubmed.ncbi.nlm.nih.gov/39473077/
- Formicola, A. J., & Ro, M. (2021). Input from practice: Reshaping dental education for integrated patient care. Frontiers in Oral Health, 2, 659030. Available from: https://www.frontiersin.org/journals/oral-health/articles/10.3389/froh.2021.659030/full
- Kataoka, M., Adam, L. A., Ball, L. E., Crowley, J., & McLean, R. M. (2025). Nutrition education and practice in university dental and oral health programmes and curricula: A scoping review. European Journal of Dental Education. Advance online publication. Available from: https://www.researchgate.net/publication/385380681_Nutrition_Education_and_Practice_in_University_Dental_and_Oral_Health_Programmes_and_Curricula_A_Scoping_Review
- Gotouda, H., Osawa, S., Okamoto, Y., Matsune, K., Kono, T., Okada, H., & Ito, T. (2020). The survey concerning the promotion of food and nutrition education among dental students: Part two in reference to awareness and interest for dental education. International Journal of Oral-Medical Sciences, 19(4), 213-219. Available from: https://www.jstage.jst.go.jp/article/ijoms/19/4/19_213/_article
- Crowe, M., O'Sullivan, M., & O'Connor, L. (2022). Implementation of a food science and nutrition module in a dental undergraduate curriculum. European Journal of Dental Education, 26(2), 402-410. Available from: https://www.lenus.ie/bitstream/handle/10147/634308/Eur%20J%20Dental%20Education%20-%202022%20-%20Crowe%20-%20Implementation%20of%20a%20food%20science%20and%20nutrition%20module%20in%20a%20dental%20undergraduate.pdf?sequence=1&isAllowed=y