

# Nutrition for oral health and oral manifestations of poor nutrition and unhealthy habits

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The availability of proper nutrients is critical for the growth, development, maintenance, and repair of healthy dentition and oral tissues. Deficiencies particularly relevant to the dental practice are those in folate and other B complex vitamins; vitamins A, C, and D; calcium; fluoride; and protein. A lack of these nutrients affects nearly every structure in the oral cavity, causing or contributing to scurvy, cleft palate, enamel hypoplasia, poor mineralization, caries, and other pathoses. Damage to the dentition can also be observed in individuals with unhealthy habits; for example, a diet high in sugars will promote processes such as demineralization and caries. Diabetes also can result from a poor diet and is associated with periodontitis and oral candidiasis. Finally, the use of tobacco products and excessive alcohol intake damage the dentition and contribute to a variety of oral diseases, including stomatitis, malnutrition, and squamous cell carcinoma. Knowledge of these relationships will enable the dentist to question patients about dietary habits and provide guidance to encourage a healthy lifestyle.

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**N**utrition is critical to the oral health of the individual. From gestation through the end of life, nutrition influences the integrity and function of the dentition and supporting oral structures and has a direct effect on health in general. A well-balanced diet is key to ensuring that individuals receive the nutrients they need (Box).<sup>1</sup> If the diet does not supply enough of the vitamins, minerals, and other nutrients needed to support healthy tissues, malnutrition develops. In addition, some commonly prescribed medications are associated with nutritional deficiencies (Table 1).<sup>2-6</sup>

Poor nutrition and unhealthy habits “can affect the development and integrity of the oral cavity as well as the progression of oral diseases.”<sup>7</sup> Proper nutrition and avoidance of unhealthy habits helps avoid oral pathoses associated with nutritional deficiency, excess free sugar intake, diabetes, alcohol consumption, or tobacco use. Dentists who are knowledgeable about nutrition are equipped to ask patients relevant questions about dietary habits that may affect oral and systemic health and to provide guidance that promotes healthy lifestyles. This article will review the roles of specific nutrients in oral health as well as the harmful effects of unhealthy habits.

## Vitamins

### *Folate and B complex vitamins*

Folate (vitamin B<sub>9</sub>) is a critical component of certain biochemical reactions necessary to synthesize DNA and to power the amino acid metabolism required for cell division. It is an essential vitamin and cannot be created in the human body. Due to its role in nucleic acid synthesis and the rapid cell creation of the growing fetus, the demands for folate increase during pregnancy.<sup>8</sup> For this reason it is recommended that all women of child-bearing age, even if not currently pregnant, take a daily supplement containing 0.4-0.8 mg of folic acid.<sup>9</sup> Although folate deficiency is most often associated with neural tube defects, recent studies have found a reduced occurrence of cleft lip with or without cleft palate when pregnant women take supplemental folic acid.<sup>10,11</sup>

Because B vitamins frequently exist in the same foods, they are commonly referred to as the *B complex vitamins*. A deficiency in one is likely to be accompanied by deficiencies in others. Although they may be accompanied by disparate systemic signs, deficiencies in B<sub>2</sub>, B<sub>3</sub>, B<sub>6</sub>, and B<sub>12</sub> will typically manifest in the oral cavity as stomatitis, glossitis, and oral ulcers. Risk factors for vitamin B deficiencies include older age, medications, chronic alcohol abuse, malabsorptive syndromes, and vegetarian and vegan diets.

### *Vitamin C*

Another essential nutrient, vitamin C is required for the synthesis of collagen, which almost exclusively constitutes the

**Box.** Select key recommendations for healthy eating.<sup>a</sup>

Use a healthy eating pattern, which includes:

- A variety of vegetables from all of the subgroups—dark green, red and orange, legumes (beans and peas), starchy, and other
- Fruits, especially whole fruits
- Grains, at least half of which are whole grains
- Fat-free or low-fat dairy, including milk, yogurt, cheese, and/or fortified soy beverages
- A variety of protein foods, including seafood, lean meats and poultry, eggs, legumes (beans and peas), nuts, seeds, and soy products

Consume fewer than 10% of calories per day from added sugars.

If alcohol is consumed, consume it in moderation—up to 1 drink per day for women and up to 2 drinks per day for men—and only if you are an adult of legal drinking age.

<sup>a</sup>Adapted from the US Department of Health and Human Services and US Department of Agriculture.<sup>1</sup>

**Table 1.** Medications associated with nutritional deficiencies.

Medication	Disease <sup>a</sup>	Deficiency
Proton pump inhibitors <sup>2</sup>	Gastroesophageal reflux disorder	Vitamin B <sub>12</sub> Vitamin C
Metformin <sup>3</sup>	Diabetes	Vitamin B <sub>12</sub>
Furosemide <sup>4</sup>	Heart failure	Calcium Magnesium
Levodopa/carbidopa <sup>5</sup>	Parkinson disease	Vitamin B <sub>12</sub>
Isoniazid <sup>6</sup>	Tuberculosis	Vitamin B <sub>6</sub>

<sup>a</sup>Disease most commonly treated by the medication.

protein portion of teeth and bones and serves as the structural scaffolding over which mineralization of these structures occurs. Collagen, and thus vitamin C, are necessary for the creation of dentin, pulp, cementum, periodontal fibers, blood vessels, gingival nerves, connective tissues, and periodontal ligaments. Vitamin C continues to be necessary for the turnover of bone, tooth, and connective tissue throughout the life span.<sup>12</sup>

Inadequate intake of vitamin C will eventually manifest as scurvy. Initial symptoms of scurvy include inflammation of the gingiva. As the deficiency progresses, collagen synthesis is impaired and connective tissues are weakened, causing poor wound healing; inflamed, bleeding gingiva; and loosening of teeth as a result of tissue and capillary fragility.<sup>13,14</sup> Although uncommon in developed countries, vitamin C deficiency can occur in populations with limited food variety, which include the elderly, those who abuse alcohol or drugs, those who follow food fads, and those with a mental illness.<sup>13-16</sup> Others at risk

include smokers, those exposed to secondhand smoke, infants and children whose primary source of nutrition is cow's milk, those with end-stage renal disease on chronic hemodialysis, and those with malabsorptive conditions.<sup>13,16</sup>

All fruits and vegetables contain vitamin C, but those with the highest content include oranges, berries, broccoli, and red peppers. Table 2 lists the foods with the highest content of the vitamins and minerals pertinent to oral nutrition.<sup>17</sup>

### Vitamin A

Apart from its role in healthy vision, vitamin A functions as an important component required to maintain the mucosal membranes, salivary glands, and teeth.<sup>18,19</sup> Animal studies have shown that a deficiency in this vitamin will result in various abnormalities, including tooth brittleness, salivary gland degeneration, and increased risk of caries.<sup>20-22</sup> Vitamin A has been shown to provide a protective effect against cleft palate.<sup>23,24</sup>

Although rare in the general population of developed countries, vitamin A deficiency is common in many developing countries, often due to a paucity of food sources with adequate levels. In these countries, the populations most at risk are infants and children.<sup>25</sup> Other populations at risk include premature infants, those with cystic fibrosis, and those with other conditions causing fat malabsorption.<sup>26,27</sup>

### Vitamin D

A natural hormone of the human body, vitamin D plays an important role in the absorption of calcium, phosphorus, and magnesium from the gut, allowing the proper mineralization of bones and teeth. Like insufficient vitamin A, a deficiency in vitamin D is associated with enamel and dentin hypoplasia.<sup>28</sup> Inadequate levels of vitamin D during tooth formation may result in delayed eruption as well as lamina dura and cementum loss that leads to tooth loss.

Infants who are exclusively breastfed and infants consuming less than 1 L of formula per day are at particular risk of vitamin D deficiency, as breastmilk alone contains insufficient levels of the vitamin, and most formula is not sufficiently fortified. Therefore, the American Academy of Pediatrics (AAP) recommends that all breastfed infants, and non-breastfed infants who do not ingest at least 1 L of vitamin D–fortified formula daily, receive a supplemental 400 IU of vitamin D per day, which is readily available in liquid formulations.<sup>29</sup>

Other risk factors for vitamin D deficiency include older age (due to decreased efficiency of synthesis at the skin), living at higher latitudes, medications, kidney disease, and vegan diets.<sup>30</sup> Because most foods do not contain it naturally, many foods, including milk and grain products, are fortified with vitamin D.

### Minerals

#### Calcium and phosphorus

The mineralization of the protein matrix is completed with the deposition of hydroxyapatite, giving bones and teeth their compressive strength. Composed of calcium and phosphorus minerals, hydroxyapatite is also a critical component of both enamel and dentin. Inadequate intake of calcium during pregnancy may result in bone deformities, incomplete tooth calcification, tooth

**Table 2.** Food sources with the highest vitamin and calcium content.<sup>a</sup>

Nutrient	Fruits	Vegetables	Proteins	Dairy
Vitamin B	No significant source	Leafy greens (spinach, kale, cabbage, broccoli) Beans Peas	Chicken Fish Eggs	No significant source
Vitamin C	Oranges Grapefruit Mangos Pineapples Strawberries Raspberries Blueberries Watermelon	Green and red peppers Leafy greens Potatoes (sweet, white) Tomatoes Cauliflower	No significant source	No significant source
Vitamin A	Yellow and orange fruits (bananas, oranges, apples, peaches, pineapple, nectarines)	Leafy greens Yellow and orange vegetables (carrots, peppers, squash, sweet potatoes)	Eggs Cod liver oil	Whole milk
Vitamin D	No significant source	No significant source	Fatty fish (tuna, salmon, mackerel) Egg yolks	No significant source <sup>b</sup>
Calcium	No significant source	Leafy greens	Salmon Almonds Brazil nuts Dried beans	Milk (whole, 2%, skim) Yogurt Cheese

<sup>a</sup>Information gathered from *A.D.A.M. Medical Encyclopedia*.<sup>37</sup>

<sup>b</sup>Most milk sold in the United States is fortified with vitamin D.

malformation, and increased susceptibility to caries after tooth eruption, especially since enamel will not regenerate once the maturation process has ended.

Bone growth continues through childhood and into adolescence. Inadequate intake of calcium will lead to osteopenia, or decreased bone density and mass. If this deficiency remains unaddressed, it will lead to osteoporosis, a disorder wherein the bones become porous, brittle, and subject to fracture. Tooth mobility and premature tooth loss may result. Although not the most common site of fractures, the jaw and oral alveoli will exhibit reduced strength due to the paucity of these minerals. In addition to effects on the dentition, calcium deficiency is associated with more severe periodontal disease.<sup>31</sup>

Certain populations are at greater risk for calcium deficiency, including the elderly, postmenopausal women, amenorrheic women, those with eating disorders, those with lactose intolerance or allergies to cow’s milk, and vegans.<sup>32,33</sup>

**Fluoride**

Fluoride is a ubiquitous mineral found in all soil, bodies of water, plants, and animals and is therefore a constituent of all diets to some extent. It catalyzes the incorporation of calcium and phosphate into enamel and is itself incorporated into enamel during mineralization, resulting in fluorapatite, a

substance that is harder and less acid-soluble than hydroxyapatite. As early childhood caries is one of the greatest risk factors for caries in the permanent dentition, primary prevention is key. Fluoride forms a cornerstone of that prevention and, apart from fluoridated community water, is available in fluoridated toothpaste and varnish.

Although all children will benefit from receiving the proper amount of fluoride, minorities and those living in poverty have a greater risk of caries and would benefit to a greater degree.<sup>34</sup> The AAP recommends slightly different supplementation modalities based on high- versus low-risk patients.<sup>35</sup> For all populations, living in an area with community water fluoridation is encouraged. Further, starting at tooth emergence, both high- and low-risk populations benefit from brushing teeth with fluoridated toothpaste and applying fluoride varnish every 3-6 months. In high-risk patients, a further recommendation to use over-the-counter mouthrinse starting at age 6 years applies if the child can reliably swish and spit. Dietary supplements in addition to toothpaste, varnish, and mouthwash are recommended only if the water supply is not fluoridated.<sup>35</sup>

**Other nutrients**

Just as numerous oral pathoses are related to a lack of nutrients in the diet, the presence of certain substances and qualities of

**Table 3.** Policy statements on sugar-sweetened beverages and dental caries.

Organization	Policy statement
Academy of General Dentistry (AGD) <sup>38</sup>	<p>“Prevalence of and Connection between Sugar Consumption and Caries: ...Sugar consumption is the most important contributing factor of caries, which is the most prevalent of worldwide diseases.”</p> <p>“Levels of Sugar Consumption: AGD supports recommendations of sugar consumption for children not to exceed 6 teaspoons per day. However, consumption of less than 3 teaspoons of sugar per day is more optimal. Consumption of sugary foods should not be substituted for adherence to sugar-free beverage ingestion.”</p>
American Academy of Pediatric Dentistry (AAPD) <sup>37</sup>	<p>“The AAPD encourages:          ...Educating the public about the association between frequent consumption of carbohydrates and caries.”          “Furthermore, the AAPD encourages:          ...School health education programs and food services to promote nutrition programs that provide well-balanced and nutrient-dense foods of low caries-risk, in conjunction with encouraging increased levels of physical activity.”</p>
American Academy of Pediatrics (AAP) <sup>39</sup>	<p>“In the evaluation of the risk of dental caries, pediatricians should routinely discuss the relationship between fruit juice and dental decay and determine the amount and means of juice consumption.”</p> <p>“Juice should not be introduced into the diet of infants before 12 months of age unless clinically indicated. The intake of juice should be limited to, at most, 4 ounces/day in toddlers 1 through 3 years of age, and 4 to 6 ounces/day for children 4 through 6 years of age. For children 7 to 18 years of age, juice intake should be limited to 8 ounces or 1 cup of the recommended 2 to 2.5 cups of fruit servings per day.”</p>
American Dental Association (ADA) <sup>40</sup>	<p>“Unrestricted, at-will consumption of liquids, beverages and foods containing fermentable carbohydrates (e.g. juice drinks, soft drinks, milk, and starches) can contribute to decay after eruption of the first tooth.”</p>
World Health Organization (WHO) <sup>41</sup>	<p>“In both adults and children, WHO recommends reducing the intake of free sugars to less than 10% of total energy intake. WHO suggests a further reduction of the intake of free sugars to below 5% of total energy intake.”</p> <p>“The recommendation to further limit free sugars intake to less than 5% of total energy intake...is based on the recognition that the negative health effects of dental caries are cumulative, tracking from childhood to adulthood. Because dental caries is the result of lifelong exposure to a dietary risk factor (i.e. free sugars), even a small reduction in the risk of dental caries in childhood is of significance in later life; therefore, to minimize lifelong risk of dental caries, the free sugars intake should be as low as possible.”</p>

food, either in excess or outright, will also manifest in disparate ways in the oral cavity. Habits of dietary intake and properties of foods will also contribute to oral pathosis.

### Carbohydrates

Among many other functions, carbohydrates serve as both an immediate source of energy as well as a means of storing it. They are necessary to the human diet yet also promote the growth of pathogens that reside in the mouth. While carbohydrates in the right proportion will benefit a patient by providing necessary energy, and the oral cavity has means by which to keep the oral flora in check, an excess of most types of carbohydrates will tilt the balance toward the bacteria that use carbohydrates for energy production, surpassing the checks on growth of these microorganisms.

When microorganisms such as *Streptococcus mutans*, *Lactobacillus* spp, and *Streptococcus sanguis* metabolize carbohydrates, they create acidic metabolites at the dentition; as the metabolites accumulate, they collectively lower the salivary pH to less than 5.5.<sup>36</sup> In the presence of an acidic pH at the tooth surfaces, demineralization occurs, first of the enamel and then of the dentin, ultimately resulting in rapid destruction of the tooth if left unchecked.<sup>36</sup> Bacterial biofilms may also form at the

gingiva, predisposing sites to destruction of the gingival tissue, known as *plaque-induced gingivitis*.

In light of the pathophysiology of caries development, other food qualities modulate cariogenicity. One such quality is the composition of foods. Snacking on foods with cariogenic features can result in sustained periods of decreased pH in the oral cavity.<sup>36</sup> Although all fruits may be cariogenic due to the presence of fructose, cariogenicity is offset in fruits with an increased water content, such as melons. Dairy products contain cariogenic sugars such as lactose but have lower cariogenicity than other food groups because dairy products tend to have an alkaline nature, which may offset the acidic environment necessary for caries development. Conversely, acidic foods and sugar-sweetened beverages will contribute to the demineralization process. Sugar-sweetened beverages create an especially acidic environment in the mouth, and frequent ingestion of fruit juices, sodas, and energy drinks that results in prolonged contact with teeth is a particular risk factor in the development of caries.<sup>37</sup> While there are no clinical practice guidelines restricting the consumption of sugar-sweetened beverages to prevent dental caries, a number of dental and medical organizations have policy statements advocating for the reduced intake of free sugars, acknowledging the association between excessive free sugar intake and dental caries (Table 3).<sup>37-41</sup>



## Protein

Needed for the construction of all body tissues, proteins are a basic nutritional necessity for any living organism. At the biochemical level, the protein collagen is intimately involved in the formation of dentin, cementum, periodontal ligaments, gingiva, oral mucosa, and bones such as the maxilla and mandible. As the building blocks of protein, amino acids are required for maintenance and repair of the oral tissues as well as for the formation of antibodies necessary to resist infection.

Protein deficiency results in poor structural integrity of the dentition, degeneration of the structures supporting the dentition, delayed wound healing, and poor resistance to oral pathogens. Protein deficiency, although possible in isolation, is closely linked to protein-energy malnutrition, defined as insufficient intake of calories and consequently insufficient intake of protein. Early childhood malnutrition is associated with enamel hypoplasia and caries of the primary dentition as well as delayed exfoliation of the primary teeth.<sup>42,43</sup> Meanwhile, early or chronic protein-energy malnutrition can reduce salivary gland function into adolescence, an outcome that has important implications for antibacterial defense.<sup>44</sup> Groups at risk for protein deficiency include those living in poverty or developing countries; those with intellectual disability, cystic fibrosis, or malignancy; those undergoing prolonged hospitalization; vegetarians and vegans; and the elderly.

## Diabetes

Diabetes is a disease in which the blood glucose levels are elevated due to a lack of response by the body's cells to insulin and/or poor pancreatic secretion of insulin. Obesity is a risk factor for diabetes, and obesity often stems from a poor diet that is high in saturated fat and cholesterol as well as a lack of exercise. Once diabetes develops, it is important for diabetic patients to manage their carbohydrate intake to maintain proper blood glucose levels and avoid complications of diabetes. Oral complications of diabetes include periodontitis and candidal infections.

Diabetes is associated with a higher prevalence of periodontitis compared to that found among the general population.<sup>45,46</sup> Individuals with diabetes have a threefold increased risk of developing periodontitis, and poorly controlled diabetes (defined as hemoglobin A<sub>1c</sub> > 9) is considered a significant risk factor.<sup>47,48</sup> While some low-quality evidence suggests that treatment of periodontal disease improves A<sub>1c</sub> levels by 0.29% up to 4 months after receiving care, there is no evidence that this reduction is sustained or has an impact on diabetic-associated morbidity and mortality.<sup>49</sup> However, the consensus report of the joint European Federation of Periodontology and American Academy of Periodontology Workshop on Periodontitis and Systemic Diseases recommends that patients with diabetes be told they are at increased risk for periodontitis, monitored regularly for periodontal changes, provided with proper management of diagnosed periodontitis, and placed on a preventive care regimen.<sup>50</sup>

Diabetes is also associated with higher *Candida* counts in the oral cavity. Furthermore, concomitant denture use and smoking significantly increase the risk for candidal pathologies in diabetics.<sup>51,52</sup> The most common manifestations of candidal infection in diabetic patients include angular cheilitis, median rhomboid

glossitis, and denture stomatitis.<sup>52</sup> Angular cheilitis is treated with topical antifungal medications, while median rhomboid glossitis and denture stomatitis are treated with either nystatin oral suspension (400,000-600,000 U orally, 4 times a day) or clotrimazole lozenges (10-mg lozenge, 5 times a day).

## Unhealthy habits

### Tobacco

Derived from the tobacco plant, tobacco in various forms has been used for centuries and has been found to be severely detrimental to human health.<sup>53</sup> Tobacco use is strongly associated with multiple pathoses, including myocardial infarction, stroke, chronic obstructive pulmonary disease, addiction, and malignancies of various systems. The wide array of forms of tobacco and frequency of use determine which pathoses manifest and to what extent. However, nearly all tobacco products interface with the oral cavity during use, increasing the risk of oral disease no matter the form of tobacco.

Oral manifestations of tobacco use occur in both the dentition and the oral mucosa and range from the cosmetic to the cancerous.<sup>54</sup> Extrinsic tooth stains are a simple darkening of the enamel, while so-called smoker's melanosis is a staining of the oral mucosa secondary to increased melanin production and deposition by melanocytes. Acute necrotizing ulcerative gingivitis, or trench mouth, is a sudden, rapidly progressive polymicrobial infection for which both smoking and malnutrition are predisposing factors. It manifests as pain, bleeding, and ulceration of the gingiva. The prevalence of periodontitis in general is greater in smokers than nonsmokers, likely secondary to a deficient local immune system.<sup>54</sup> Nicotinic stomatitis, or smoker's palate, is a gradual deformation of the hard palate mucosa secondary to the heat stream of smoke, manifesting as fissured or cobblestone-like lesions.

Leukoplakia is a white, premalignant plaque of the oral mucosa; 3%-15% of such lesions convert into squamous cell carcinoma (SCC).<sup>55</sup> Similarly, red plaques or mixed red and white plaques, respectively termed *erythroplakia* or *erythro-leukoplakia*, are also premalignant, albeit with a higher conversion rate to cancer.<sup>56</sup> Oral cancer accounts for 3%-4% of all malignancies, and SCC is the predominant type, comprising about 90% of all oral cancers.

Tobacco is one of the principal risk factors of oral cancer development due to the presence of dozens of known carcinogens.<sup>53,57</sup> Tobacco use can predispose any site of the oral cavity to cancerous growth, including the lips, gingiva, alveolar ridges, buccal mucosa, floor of the mouth, tongue, and hard palate. Visual and tactile examinations to screen for oral cancer among people who use tobacco, alcohol, or both may decrease oral cancer-specific mortality.<sup>58</sup> Any persistent, nonhealing lesion should therefore be biopsied to rule out SCC. Environmental or secondhand smoke is similarly associated with an increased risk of certain types of oral cancer.<sup>59</sup> Those who quit tobacco use, in particular smoking, may reduce their risk of primary cancer recurrence as well as the development of a second primary cancer.

Due to the widespread and profoundly negative effects of tobacco, the US Preventive Services Task Force recommends that clinicians ask all adults about tobacco use and advise them

## 1

How often do you have a drink containing alcohol?

- A. Never
- B. Monthly or less
- C. 2 to 4 times a month
- D. 2 to 3 times a week
- E. 4 or more times a week

## 2

How many standard drinks containing alcohol do you have on a typical day?

- A. 1 or 2
- B. 3 or 4
- C. 5 or 6
- D. 7 to 9
- E. 10 or more

## 3

How often do you have 6 or more drinks on 1 occasion?

- A. Never
- B. Less than monthly
- C. Monthly
- D. Weekly
- E. Daily or almost daily

**Figure.** Alcohol Use Disorders Identification Test-Consumption (AUDIT-C) questionnaire.<sup>70</sup> Scored on a scale of 0-12 points: A = 0 points; B = 1 point; C = 2 points; D = 3 points; E = 4 points. In men, a total score of 4 or more points is a positive indicator of patients at risk for hazardous drinking or alcohol use disorders. In women, a total score of 3 or more points is a positive indicator of the same risks.

to stop using tobacco.<sup>60</sup> The American Dental Association (ADA) recommends that dentists provide educational materials on tobacco prevention or cessation to patients.<sup>61</sup>

### Alcohol

Like tobacco, alcohol can be carcinogenic to humans, and heavy use is a major risk factor for the development of both precancerous and cancerous oral lesions.<sup>62</sup> Alcohol independently increases the risk of cancer in the oral cavity by generating reactive oxygen molecules that can damage DNA and proteins through oxidation and metabolization into the toxin acetaldehyde.<sup>62,63</sup> In addition to the individual carcinogenic properties of alcohol, the frequent concomitant use of alcohol with tobacco yields a greater risk of oral malignancy; the two appear to have a synergistic effect on each other.<sup>57,64-66</sup> As with tobacco use, the risk of developing head and neck cancer due to alcohol ingestion appears to be dose dependent.<sup>57,67</sup>

Alcohol is also a well-known cause of malnutrition, by multiple mechanisms. By providing 7 kcal/g, it decreases the appetite, discouraging caloric intake from food sources, and consequently

decreases nutrient intake, especially of proteins and B vitamins. Associated symptoms and conditions such as nausea, emesis, anorexia, pancreatitis, and gastritis can further contribute to reduced food intake. Absorption of nutrients is diminished as alcohol causes mucosal erosions and loss of epithelial villi at the stomach and parts of the small intestine. Chronic alcohol use results in hepatotoxicity, which impairs nutrient metabolism, especially of protein and vitamin A.<sup>68</sup> Altogether, nutrient deficiencies secondary to alcohol will result in the oral pathoses described earlier, in addition to the primary insults from alcohol.

Dentists who wish to assess the alcohol use of their patients can employ 1 of the following 3 screening tools:

1. The full-length Alcohol Use Disorders Identification Test (AUDIT)<sup>69</sup>
2. The abbreviated AUDIT-Consumption (AUDIT-C) subscale (Figure)<sup>70</sup>
3. A single-question screen: "How many times in the past year have you had *X* or more drinks in a day?" (*X* = 5 for men and 4 for women)<sup>71</sup>

These 3 methods have the best performance in determining alcohol use among a wide spectrum of populations compared to other screening tools such as the CAGE questionnaire (acronym referring to key words in the questions: *cut down; annoyed; guilty; eye-opener*).<sup>71</sup> The ADA recommends that dentists inquire about both tobacco and alcohol use in children, adolescents, and pregnant and postpartum women.<sup>72,73</sup>

### Conclusion

Vitamins, minerals, and other nutrients are vital to the growth, development, maintenance, and repair of healthy dentition and oral tissues as well as the body systems in general. Nutritional deficiencies and unhealthy habits can cause or contribute to oral pathoses such as scurvy, cleft palate, enamel hypoplasia, poor mineralization, caries, squamous cell carcinoma, and others. Dentists can play an important role in educating patients on the importance of good nutrition to oral and systemic health.

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