

**Food & Dental Health: Optimizing Oral Microbiome Health to
Reduce the Risk of Caries, Gum Disease & Disease Risk Overall**
2024 Annual Convention of the JDIQ, May 28th, 9:00 am – 11:30 am

Dental Health Profoundly Impacts Quality of Life

- Definition of oral health (World Dental Federation, Oct. 2016): Oral health is a multi-faceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expression with confidence and without pain, discomfort, and disease of the craniofacial complex.

Dental Health & Overall Risk of Disease

- “The list of connections between oral health & systemic health — conditions that affect the entire body — is remarkable.” *Scientific American, March 2024*
- “We are at a pivotal point — I call it the convergence era — where dentistry is not going to be separated from overall health for much longer. Dentistry will be brought into the primary care health-care team.” *Stephen E. Thorne, CEO, Pacic Dental Services*
- The oral cavity, though sterile at birth, becomes the habitat for more than 700 microbial species. It is the 2nd most heavily colonized part of the human body. (Biomedicines, March 2022)
- The oral microbiome - both disease and health-oriented bacteria live in the oral cavity. The health-oriented bacteria: produce alkali & buffer pH, anti-microbial properties, and convert nitrate to nitrite. (Advanced Dental Research, Feb. 2018)
- Oral microbiome dysbiosis is driven by multiple factors (genetic, diet, stress, smoking, antibiotics, tissue injury, infection).
- Oral bacteria can reach the gut through swallowing of saliva and/or enter the blood via ulcerated gingival tissues. Systemic spread of the oral microbiota can lead to inflammatory changes and contribute to the pathogenesis of many diseases. (Nutrients, Aug. 2023)
- *P. gingivalis*, the primary bacteria linked to the pathogenesis & progression of periodontal disease, is “a master at engineering its environment to survive & persist in the host”. (Frontiers In Cellular & Infection Microbiology, Sept. 2023)
- Oral bacteria can reach the gut through swallowing of saliva and/or enter the blood via ulcerated gingival tissues. Systemic spread of the oral microbiota can lead to inflammatory changes and contribute to the pathogenesis of many diseases. (Nutrients, Aug. 2023)
- Research shows a bidirectional causal relationship between gut microbes and periodontitis. (Journal of Translational Medicine, Sept. 2023)
- Review of 32 studies - the strongest links are found between periodontitis and chronic disease, especially for type 2 diabetes and heart disease. (Preventing Chronic Disease, Sept. 2019)
- The main pathogen involved in periodontal disease (*P. gingivalis*) has been linked to nearly every disease that has been described as an inflammatory, systemic disease that occurs simultaneously with periodontitis - Cardiovascular disease, Rheumatoid arthritis, Alzheimer's disease, Type II diabetes, Non-alcoholic fatty liver disease. (Frontiers in Oral Health, May 2022)

- Oral microbiome dysbiosis plays a crucial role in the initiation & development of many autoimmune diseases - inflammatory bowel disease, rheumatoid arthritis, multiple sclerosis. Targeting oral microbes might be a promising strategy for treating these diseases. (Journal of Translational Medicine, March 2023)
- “Current research strongly confirms a correlation between cardiovascular risk & periodontal disease.” (Journal of Inflammation Research, Feb. 2024)
- Periodontal disease increases the proinflammatory markers linked to endothelial dysfunction which increases the risk of atherosclerosis, high blood pressure, blood clot formation, & stroke. Periodontal treatment reduces inflammatory markers related to cardiovascular disease and may reduce the risk of cardiovascular events. (Frontiers in Cardiovascular Medicine, Aug. 2023)
- In the Kuopio Oral Health & Heart study, involving 354 participants, better oral hygiene self-care was linked to 51% lower risk of dying from cardiovascular disease. (British Dental J., Feb. 2023)
- Periodontitis may modify risk of atrial fibrillation (Afib). Patients with greater periodontal inflamed surface area (PISA) were significantly more likely to have thickening or scarring of heart tissue, which increases the risk of Afib. (JACC: Clinical Electrophysiology, Oct. 2022)
- Six-month study, 66 patients with mild Alzheimer’s Disease. Oral health intervention effectively modified subgingival microbiome and slowed cognitive decline. (Geriatric Nursing, Dec. 2022)
- In the UK Biobank Study, involving MRI images of 40,000 adults, those with poor oral health (prone to cavities, missing teeth, needing dentures) had increased damage to both white matter and microstructure of the brain. (American Stroke Assoc. International Conference, Feb. 2023)
- Prevalence of six oral health conditions were compared to severity of mental health problems. All six adverse oral health outcomes were linked to a statistically significant greater prevalence and increasing severity of mental health problems. (American Association for Dental, Oral, & Craniofacial Research, 47th Annual Conference, March 2023)
- Poor periodontal status is linked to poor treatment outcomes for depression - independently of depression severity and 14 sociodemographic and clinical predictors of treatment outcome. (Clinical & Experimental Dental Research, Feb. 2022)
- Poor oral health linked to triple the risk of liver disease. (Liver International, March 2019)
- Diabetes and oral health. Even slightly elevated blood sugar levels adversely affect oral health. Any oral infection adversely affects blood glucose levels. Treatment of inflammation (non-surgical periodontal treatment or extraction of infected teeth) can lower blood sugar levels significantly. (Diabetes Research in Clinical Practice, Nov. 2019)
- NHANES Study involving 10,096 participants. Participants who consumed an anti-inflammatory diet, and *did not have diabetes*, experienced the lowest risks of periodontitis and tooth loss. Diabetes weakened or eliminated this relationship (high blood sugar accelerates inflammation in gingival epithelium & damages gingival epithelial barrier function). (Nutrients, Oct. 2022)
- Periodontal disease triggers a specific inflammatory immune response that results in repeated flare-ups of arthritis. (Science Translational Medicine, Feb. 2023)
- In a study involving 125,324 participants (age 40 to 79), the risk of osteoporosis and fractures doubled with periodontitis. (BMC Oral Health, March 2021)
- There is a close relationship between oral microbiota and tumor occurrence. (Cancer Medicine, Sept. 2020)
- Animal study - *P. gingivalis* can travel from the mouth to the pancreas resulting in lesions that lead to cancer. It appears to accelerate pancreatic cell transformation & protects cancerous cells from death. (Gut, April 2024)

- Korean National Health Insurance Cohort Database. Cancer incidence in periodontitis group was double that of the control group. (Frontiers in Oncology, Aug. 2022)
- Meta-analysis - Composition of the oral microbiome appears to play significant role in predicting survival outcomes for cancer patients. Low oral microbiome diversity or the presence of *P. gingivalis* in cancer tissues is linked to a less favourable prognosis. (Systemic Reviews, Jan. 2024)

RECAP: Optimizing oral health appears to powerfully protect overall health.

Fluoride & Dental Health

- “The American Dental Association unreservedly endorses the fluoridation of community water supplies as safe, effective and necessary in preventing tooth decay.” ...in accordance with the standards established by the appropriate authority (0.7 mg/liter of water) ...supports ongoing research on safety & effectiveness.
- Caries Prevention White Paper (World Dental Federation): Fluoride has altered the dose-response relationship between sugar consumption and caries experience by delaying when cavitation occurs and thus a higher cariogenic diet can be tolerated before caries occurs in many individuals.
- The National Child Oral Health Study, involving 24,664 Australian children (age 5 to 14) - Lack of fluoridated water and high sugar intake (4 or more servings/day of food or drinks high in free sugars) increased risk of tooth decay in permanent teeth by 70%. (J. of Den. Research, April 2021)
- Study of 2,649 Grade 2 schoolchildren in two different Canadian cities. Water fluoridation stopped in Calgary in 2011, but not in Edmonton. The prevalence of caries in the primary dentition was significantly higher in Calgary – the differences were consistent and robust and widened over time since cessation. (Community Dentistry & Oral Epidemiology, Oct. 2022)
- Fluoridated water & periodontal health study - Fluoridated communities consistently displayed lower mean probing depth, clinical attachment level, & gingival inflammation. (Journal of Pharmacy & BioAllied Sciences, Feb. 2024)
- NHANES Study involving 2,098 children & adolescents - Low level of fluoride exposure (measured in blood plasma and household tap water) resulted in high prevalence of dental fluorosis (70%). (Ecotoxicology & Environmental Safety, Sept. 2021)
- Meta-analysis (30 studies) - Most studies suggest an adverse effect of fluoride exposure on children's IQ, starting at low levels of exposure. (Environmental Research, March 2023)
- Fluoride: Assessment for Developmental Neurotoxicity - “This review finds, with moderate confidence, that higher fluoride exposure (represented by populations whose total fluoride exposure approximates or exceeds the WHO Guidelines for Drinking-water Quality of 1.5 mg/L of fluoride) is consistently associated with lower IQ in children. More studies are needed to fully understand the potential for lower fluoride exposure to affect children’s IQ.” “Currently not enough evidence to evaluate potential association between fluoride exposure and cognitive impairment in adults.” (U.S National Toxicology Program, Sept. 2022)
- Fluoride & Health (comprehensive research review): Strong evidence for dental fluorosis and reduction in IQ scores in children. “The evidence supports a conclusion that fluoride exposure reduces IQ levels in children at concentrations close to those seen in North American drinking water...” Moderate evidence for thyroid dysfunction. Weak evidence for kidney dysfunction. Limited evidence for hormone disruption. (Critical Reviews in Toxicology, Feb. 2024)

RECAP: Water fluoridation protects oral health in a sugar-filled world. Understanding and minimizing potential risks is also critically important, especially during pregnancy and for small children.

Food & Dental Caries

- Dental disease is associated with a dysbiotic shift in the composition of a natural microbiome. Causes include fermentable carbohydrate intake, poor oral hygiene, endless snacking, lack of saliva, smoking, stress, eating late at night. (Odontology, Feb. 2019)
- Sequence and Combination of Foods Eaten: Sugary foods and drinks consumed at mealtimes cause less decay than when consumed as snacks as the exposure or frequency of acid attacks are reduced. The last food item consumed exerts the greatest influence on subsequent plaque pH.
- Frequency of Intake: The amount of sugar is not as important as the frequency of consumption. It takes 30 minutes to an hour to restore the neutral pH of the mouth and restore minerals to tooth enamel lost in an acid attack (remineralisation). Space frequency of food and beverage intake at least 2 hours apart.
- Around the clock eating is harming health. Most people eat for 15 hours or longer each day. Food intake is erratic and continuous (25% of meals/snacks are within 1 hr 25 min. of next meal). The only time people really stopped eating, for any length of time, is when they are sleeping. (Cell Metabolism, Sept. 2015)
- NHANES (10,514 adults, age 20+) - The amount of added sugars intake was more consistently and strongly associated with dental caries than the frequency of intake. (Int. J of Environmental Research & Public Health, April 2022)
- Might one simple question indicate a child's caries risk and guide preventive advice? Are sugar-sweetened drinks or snacks consumed in the hour before bedtime?" (Brit Dental J, Nov. 2019)
- Those who consumed free sugars within the hour before bed more than doubled their caries risk. (Community Dental Health, March 2017)
- Circadian Rhythm & Dental Health - Night shift workers experience lower saliva flow rate, lower saliva pH, and higher incidence of dental caries. (European Journal of Dentistry, July 2019)
- Research Review (167 studies) - Western-type diet promotes periodontal disease - High-sugar, High-saturated fat, Low-fibre, Low omega-3 fat. (Journal of Clinical Medicine, Jan. 2021)
- Severity of periodontitis is associated with the processing level of consumed food. (Nutrients, Sept. 2022)
- Starchy foods are often ignored when dentists counsel patients about oral health and dental caries. "Starchy foods (particularly those more rapidly digested in the oral cavity) have a similar or greater potential than sugary foods to drop plaque pH and may therefore pose an increased risk of dental caries." (Nutrients, Aug. 2021)
- WHO Guidance on Starch based on a review of 156 studies: Rapidly digested starch intake (more processed), but not total starch intake promotes increased risk of caries. Health professionals should promote consumption of slowly digested starches, such as that found in whole grains, fruits, and vegetables and advocate limiting rapidly digested starches only, especially when combined with free sugars. (Journal of Dental Research, Jan. 2019)
- Higher glycemic index starchy foods produce greater decrease in plaque pH & increase in post-meal blood sugar. FOODS TESTED: white bread, instant mashed potatoes, canned chickpeas, pasta, breakfast cereals, white rice. Higher GI breads, rice, breakfast cereals, and potatoes reduced plaque pH similar to 10% sugar solution. Lower GI foods, including whole canned chickpeas and pasta produced significantly smaller decreases in pH. (Nutrients, Aug. 2021)
- Children & Caries (1200 preschool children): total sugar-containing snack intake; potato chip intake; potato chips plus sugary drink intake most significant. (Caries Research, Nov. 2010)

Sugar... How Much We Eat & Why

- Children, teens, and young adults are the highest consumers of sugar. All are exceeding recommended limits.
- Based on research from NHANES, 61% of infants and 98% toddlers consume added sugars daily. Top sources include yogurt, baby food snacks, fruit drinks, sugars/sweets, and sweet bakery products. (Journal of the Academy of Nutrition & Dietetics, Nov. 2019)
- Evidence is unequivocal that food marketing to which children are exposed alters their food preferences, choice, purchases, and intake. The bombardment of junk food advertising is a disaster for young people's health.
- Over 90% of food products advertised to children and teens on Facebook, YouTube, and Instagram are unhealthy. (Pediatric Obesity, March 2023)
- Even brief marketing exposures to unfamiliar, unhealthy food brands in TV and online advertising increases children's brand recognition and positive attitude towards brands. Advergaming provides an immersive, brand-rich experience where children's interest is stimulated through challenge and reward. (J of the Academy of Nutrition & Dietetics, Jan. 2020)
- "This type of marketing can normalize high-fat, high-sugar and high sodium foods at a time in young viewers' lives when they're developing eating habits that are going to follow them into adulthood." Caitlyn Edwards, PhD, Penn State University
- Chile's Law of Food Labeling & Advertising (2016). Mandatory front-of-package warning labels.
- No child-directed marketing allowed.
- "In both animals and humans, the evidence in the literature shows substantial parallels and overlap between drugs of abuse and sugar, from the standpoint of brain neurochemistry as well as behaviour." Dr. James J. DiNicolantonio
- Eating sugary snacks alters our brain activity and creates lasting preferences for less healthy foods. (Cell Metabolism, March 2023)

Sugar & Dental Health

- Based on a review of 73 meta-analyses, a diet high in added sugar is linked to 45 poor health outcomes, including dental caries. (BMJ, Feb. 2023)
- A high sugar intake significantly decreases microbial diversity (resulting in dysbiosis or an imbalance of the oral ecosystem) and promotes the dominance of certain bacterial species (Streptococcus, Scardovia, Veillonella, Rothia, Actinomyces, and Lactobacillus). (Clinical & Experimental Dental Research, Aug. 2022)
- Each additional 5 grams of sugars (about 1 tsp) intake has been associated with an increase in the probability of developing caries.
- The higher the ultra-processed food consumption, the higher the probability of having caries in adolescence. (Community Dentistry & Oral Epidemiology, April 2023)
- Pelotas Birth Cohort Study (3,654 children, 4-years old) - Caries incidence was almost 50% greater when sugar was introduced before 12 months of age (versus 24 months). (Caries Research, Jan. 2023)

Sugary Drinks & Dental Health

- The consumption of sugary drinks significantly increases risk of tooth decay, tooth loss, gum disease and dental erosion.

- Higher sugar-sweetened beverage consumption (≥ 1 serving/day) linked to lower oral microbiota richness and diversity, along with a selective increase in aciduric bacteria (*Neisseria* and *Streptococcus*). (International Journal of Food Sciences & Nutrition, Feb. 2022)
- Based on a meta-analysis of 38 studies, there is a robust dose-response relationship (for both caries & erosion) between the consumption of sugar-sweetened beverages and dental caries. (European Journal of Public Health, Feb. 2021)
- NHANES, 4,906 children (age 2 to 19) - Beverages were the most important source of added sugars associated with increased caries (risk was diminished among children with home water fluoride of 0.7 ppm or greater). (JDR Clinical & Translational Research, April 2022)
- A significant positive relationship exists between sugar in coffee and tea and the number of root caries in community-dwelling elderly. (Community Dental Health, Aug. 2020)
- When it comes to dental health, high-tech treatment has taken priority over prevention in wealthy countries. Worldwide, the heavy marketing of sugary drinks is causing increasing damage to dental health. (The Lancet, July 2019)
- Advertising sugary drinks to children is extensive and via multiple channels, and has profound effects on childhood preferences, purchase requests, consumption patterns, and health. (The Lancet, July 2019)
- Singapore - first country in the world to ban ads (tv, radio, print, online) for soft drinks & other sugary drinks. (Oct. 2019)
- Health label warnings on sugary drinks (Peru, Uruguay, Mexico, Israel, Chile, some U.S. states) decrease sales and intake.
- Teach kids how food companies, through marketing, manipulate and hook them on addictive junk food for financial gain. Teach them how product labels deceive, and ads target vulnerable populations. This is more effective than teaching them why they should eat healthy. (Nature Human Behaviour, April 2019)

Guidelines for Sugar Intake & Sugar Content of Foods

- American Heart Association (Sept. 2009) recommends a daily added sugar limit of 6 teaspoons daily for women and 9 for men.
- American Heart Association recommendation (Aug. 2016): Kids age 2 – 18 should have no more than 6 teaspoons of added sugar daily. Children younger than 2 years should not consume foods or drinks with added sugars at all. Children & teens aged 2 to 18 should consume no more than 8 oz (250 ml) of sugar-sweetened drinks per week.
- In March 2015, the World Health Organization released guideline recommendations on the intake of free sugars to reduce the risk of disease in adults and children, with a focus on the prevention of dental caries. Adults and children should reduce their daily intake of free sugars to less than 10% of their total energy intake. A further reduction to below 5% or roughly 25 grams (6 teaspoons) per day would provide additional health benefits.
- Free sugars include sugar that is added to foods, plus the sugars naturally present in honey, syrups, and fruit juices. Because there is no reported evidence of adverse effects of consumption of intrinsic sugars and sugars naturally present in milk, the recommendations of this guideline focus on the effect of free sugars intake.
- In Canada “added sugars” is not included on food labels. Instead, Canada decided to have “total” sugars listed on food labels (Jan. 2022 came into law), which includes both added and naturally occurring sugar. This is unfortunate for the consumer. Most other countries, including the U.S. and the UK, list “added sugars” which is much more useful for the consumer.

- There are over 50 names for sugar. The revised Canadian food label groups all “added sugars” together in brackets on the ingredient list.
- Almost 70% of packaged foods and drinks in Canada contain added sugar. (analysis of over 40,000 products - CMAJ Open, Jan. 2017)
- Sugar, babies, and toddlers – one-third or more of the calories in half of all baby foods are coming from sugar. “Concentrated fruit juice” is a widely used ingredient by the food industry. Many products carry cartoon images to appeal to children. (World Health Organization, 2019)
- Most products high in sugar have so-called “halo” labelling, focusing on their “organic” status or that they were “high in fibre” or contained “1 of your 5 a day”. (British Dental Assoc., July 2022)
- The majority children’s sweetened drinks (on-pack label claims) are described as real, natural, and/or organic. Two-thirds of 34 sweetened drinks analyzed contained no juice, yet images of fruit appeared on 85% of the packages. Most drinks which contain juice, have no more than 5%. (UConn Rudd Center for Food Policy & Obesity, Oct. 2019)
- Vitamins, fruit juice, & cereal bars considered ‘healthy’ by some parents. Frequent consumption of these items in children (age 1 to 3) is linked to a significantly higher incidence of caries. (Pediatric Dentistry, May/June 2021)
- Divide grams of “sugars” on food labels by 4 to determine how many teaspoons of sugar a product contains.
- Children should be encouraged to eat whole fruit to meet their recommended daily fruit intake. Fruit juice increases risk of dental caries and weight gain. Juice should not be introduced into the diet of infants before 12 months of age unless clinically indicated. 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 daily. (Policy Statement, Pediatrics, June 2017)
- In randomized controlled trials, 100% fruit juice has been shown to result in decreased microhardness, increased surface enamel loss, increased erosion depth, greater enamel softening, and increased demineralization. (Frontiers in Public Health, July 2019)
- Low/no-calorie sweeteners can adversely affect gut microbiota at doses relevant to human use and do pose safety concerns at currently approved levels. More research is required. (Food & Chemical Toxicology, July 2019)
- Center for Science in the Public Interest (March 2023) - Acesulfame potassium: May increase cancer risk. Aspartame: May increase cancer risk. Erythritol: Safety uncertain. Limit intake until more research. Sucralose: may cause cancer and boost blood sugar. More research needed. Allulose: Safe (may cause GI woes in sensitive people). Monk fruit extract: Appears to be safe, but more research is needed. Stevia: Is a safe choice.
- Stevia – possible benefits: May increase microbiome diversity, Lowers blood sugar, Antioxidant, Anti-inflammatory, Lowers blood pressure, Reduces liver & kidney damage (Microorganisms, April 2022)
- Research Review (283 studies) on health effects of non-sugar sweeteners. In the short-term they may reduce body weight. Long-Term they are linked to a higher risk of type 2 diabetes, cardiovascular diseases & mortality. ((World Health Organization, July 2022)

RECAP: Endless snacking, especially at bedtime, is harmful to oral health. Understand the power of the food industry & food marketing. Sugar-rich foods (especially sugary drinks!) and processed starchy foods are detrimental to oral health, and we’re consuming WAY too much!!! Stevia appears to be the safest sugar alternative based on current available research.

Food & Dental Erosion

- “Over the last few decades, there was a drastic decline in the prevalence of dental caries worldwide which has been accompanied by a remarkable increase in the incidence of non-carious lesions such as dental erosion.”
- Meta-analysis of 22 studies - Dental erosion is prevalent among over one-third of preschool children, especially in those with more frequent intake of fruit juices soft drinks. (Healthcare, March 2022)
- GOAL: Prevention & early detection (severe states can lead to aggressive and costly treatments). Early clinical signs of dental erosion: loss of enamel texture, a silky glossy appearance, sometimes a dulling of the surface gloss (referred to as the "whipped clay effect), cupping, restorations 'standing proud'. A diet analysis is a useful diagnostic aid (the following may increase risk of erosion): soft drinks, sports drinks, energy drinks, fruit juices, chewable vitamin C tablets, sweet/sour candies, vinegar-based dressings, white wine. (Journal of Esthetic & Restorative Dentistry, Jan. 2021)
- Our research has shown that permanent damage to the tooth enamel will occur within the first 30 seconds of high acidity coming into contact with the teeth. This is an important finding and suggests that such drinks are best avoided. (University of Adelaide, Aug. 2014)
- Acids (phosphoric, citric, malic) are added to beverages for taste and increased shelf-life. (J Am Dent Assoc., April 2016)
- Erosive potential of 379 Beverages (juices, sodas, flavored waters, teas, and energy drinks) were evaluated in the United States. Results: 54% were erosive; 39% were extremely erosive; Only 7% were minimally erosive. (J Am Dent Assoc., April 2016)
- Soft drinks sweetened with sugar, aspartame, erythritol or stevia all resulted in significant dental erosion. (Journal of Clinical Pediatric Dentistry, May/June 2019)
- Non-sugared drinks (diet and zero-calorie) are often more erosive than sugared beverages. (General Dentistry, July-Aug. 2015)
- Calcium fortification can significantly reduce the erosive potential of fruit juice. (Scientific World Journal, June 2022)
- Adding calcium to soft drinks and other acidic products, such as medications, may reduce enamel erosion (provided pH is not too low). (Swiss Dental Journal, March 2023).
- Millennial drinks & dental erosion. The following drinks were tested - energy & sports drinks, flavoured sparkling water, kombucha, unsweetened iced tea, vegetable/fruit juice blend, & soft drink. An energy drink & kombucha resulted in significantly more enamel softening than other beverages tested. All drinks were acidic with pH below 4.5. (General Dentistry, July/Aug. 2023)
- Adding a “water enhancer” to water significantly increases the potential for dental erosion, due to the citric acid content. (General Dentistry, Sept/Oct. 2018)
- Sparkling water is made by pumping carbon dioxide into water, which ultimately turns into carbonic acid, and causes the pH to decrease. Many flavoured, sparkling waters have added citric acid, which may cause a further decrease in pH. Many flavoured waters are made with “natural flavours” - citric acid could be a component of one of those “flavours,” but labels don’t have to list it separately, so consumers would never know.
- Study: pH Analysis of 105 bottled water (28 mineral water, 45 spring water, 32 carbonated). Bottled spring and mineral water less likely to be erosive. Carbonated bottled water more likely to be erosive. (Clinical & Experimental Dental Research, Feb. 2022)
- Sparkling water makers have become increasingly popular. Higher carbonation levels generally result in higher enamel erosion. Test strips (pH) can be purchased on Amazon.

- Mouth rinsing for 10 seconds with alkaline water after drinking acidic beverage may reduce dental erosion. (Journal of Oral Science, Jan. 2022)
- Diluting apple juice with water reduces erosive potential significantly, but with orange juice not nearly as much. (Swiss Dental Journal, Dec. 2019)
- Case Study: 30-year old female drank lemon juice and water at each main meal, and often with snacks, for one year. The result was severe erosion of enamel, dentinal hypersensitivity, excessive pigmentation. (The Pan African Medical Journal, July 2018)
- Apple cider vinegar is popular among celebrities, especially women, as one of the most popular oral supplements for weight reduction. Daily consumption can easily cause significant dental erosion. (European Journal of Dentistry, April 2022)
- Erosive potential of dry mouth lozenges & tablets. Most erosive: DenTek, Med Active, Cotton Mouth. Least erosive: Xylimelts. (Journal of Dentistry, Feb. 2021)
- Meta-analysis (22 studies) - Omnivore diet associated with a higher risk for periodontal disease. Vegetarians/vegan diet associated with a higher risk for dental erosion. (Evidence Based Dentistry, March 2023)
- Strong inverse relationship between milk consumption frequency and dental erosion severity. (Journal of International Society of Preventive & Community Dentistry, Nov/Dec. 2022)

RECAP: The vast majority of beverages on the market promote dental erosion. Prevention & early detection matters.

Tea, Coffee, Alcohol & Dental Health

- Increased consumption of green tea shows a strong positive association with oral health-related quality of life in both men and women, especially at an intake of ≥ 3 cups/day of green tea. (European Journal of Clinical Nutrition, April 2019)
- Green tea promotes oral health by: Reducing inflammation of the tongue, cheek, & throat; promoting growth of health-promoting bacteria (*Lactobacillus* & *Bacillus*) and inhibiting growth of pathogens (*Achromobacter*); reversing microbial disorders in oral cavity. (Journal of Food Science, October 2023)
- Tea polyphenols protect against the disruption of the epithelial cell barrier, which prevents invasion by periodontal pathogens, like *P. gingivalis*. (Cytokine, March 2019)
- Long-term green or black tea consumers are significantly more likely to maintain functional dentition (≥ 20 teeth). (BMC Public Health, Feb. 2024)
- Green and black tea compared to soft drinks and orange juice over 20 weeks: The erosive effect of tea was similar to water, which has no erosion potential. Given the systemic and dental benefits of tea and the low potential for erosion, green and black tea should be highly encouraged for daily beverage consumption. (General Dentistry, July/Aug. 2008)
- Rinsing with green tea more effectiveness in decreasing *Streptococcus mutans* compared to black tea. (Macedonian Journal of Medical Sciences, Nov. 2019)
- Based on a review of 5 studies, green tea-based mouthwashes can be considered as an alternative to chlorhexidine mouthwashes in sustaining oral hygiene (plaque index and/or gingival index), especially because of the added advantages provided by herbal preparations. (Indian Journal of Dental Research, March/April 2018)
- Mouthwash study (green tea vs green tea plus ginger vs chlorhexidine) - Green tea plus ginger resulted in the most significant reduction in plaque & gingival index score and can be used as an alternative to Chlorhexidine. (Journal of Indian Society of Periodontology, July/Aug. 2021)

- Fluoride Content of Various Teas - Tea plants hyperaccumulate fluoride from the soil. Black tea has most. White tea has least. (Scientific Reports, July 2021)
- STUDY: Fluoride Content of Different Types of Tea (black, green, matcha). Most teas contain a higher fluoride concentration than optimally fluoridated water (0.7 mg/L). All tested tea samples contained fluoride in amounts ranging from 0.521 to 6.082 mg/L. Matcha green tea powder had the highest concentration of fluoride. (General Dentistry, Jan. 2021)
- NHANES, 3928 Children & Teens (age 6 to 10) - Children and teens who drank black or green tea had 42% higher plasma fluoride concentrations. Children and teens who consumed fluoridated (≥ 0.7 mg/L) tap water had 36% higher plasma fluoride concentrations. (International J. of Environmental Research & Public Health, Dec. 2020)
- Coffee has antibacterial activity against *S. mutans* (this is reduced when mixed with milk and sugar). (The Journal of Oral and Maxillofacial Pathology, Jan/April 2020)
- Teeth exposed to hot coffee showed visible signs of demineralization. Teeth exposed to hot black tea showed visible signs of remineralization - scratches initially present appeared to fade away (high fluoride content may play a role). Decrease in surface hardness of teeth exposed to hot coffee was double that of teeth exposed to hot black tea. (JPMA, July 2016)
- Alcohol consumption, especially heavy drinking, may negatively impact oral microbiome - depletes beneficial bacteria & increases pathogenic bacteria. (Microbiome, April 2018)
- Based on a review of 18 studies, higher alcohol use (about 3 or more drinks daily) is linked to a 60% higher risk of periodontal disease. (J Clin Periodontol., July 2016)

RECAP: Unsweetened tea, especially green tea, and coffee can be good for oral health. Tea, especially matcha and black tea can contribute high levels of fluoride to the diet. Alcohol consumption, beyond moderation, is harmful to oral health.

Foods That Promote Good Dental Health

- NHANES (3,001 participants) - Risk of periodontal disease reduced significantly with a healthy diet (over 30%). Healthier diets contained more healthy fats, seafood, plant proteins, whole grains, and fruits & vegetables. (Frontiers in Nutrition, Aug. 2022)
- Pathogenic bacteria initiate periodontal disease. Inflammation and oxidative stress play a huge role in the severity of tissue destruction. Host modulation therapy: fortify the host immune response - no smoking, healthy body weight, antioxidant-rich/anti-inflammatory diet. (Archives of Oral Biology, Sept. 2019)
- Anti-Inflammatory Foods: colourful fruits and vegetables; beans/legumes; high fibre, whole grains; herbs and spices; healthy fats (olive oil and vegetable oils, salmon, nuts and seeds, avocado); healthful, unsweetened beverages (green/black tea and coffee).
- Pro-Inflammatory Foods (limit or avoid): sugar-sweetened drinks; refined grains; sweets and desserts (cookies, ice cream, cake); red and processed meats; foods high in saturated fats, such as fatty red meats and butter; ultra-processed foods (nutrient-poor, calorie-rich); any calories in excess of energy needs.
- A pro-inflammatory diet contributes significantly to periodontal inflammation. (Journal of Periodontology, Dec. 2023)
- Hamburg City Health Study - Researchers report significant inverse link between anti-inflammatory diet score & periodontitis. Most dentists recommend limiting sugar intake, but rarely discuss which foods are proinflammatory and anti-inflammatory. (Nutrients, July 2023)

- Review of RCTs (20 studies) - Effects of anti-inflammatory diets on 14 different inflammation markers in adults. A Mediterranean diet is linked to statistically significant and clinically meaningful differences in inflammatory markers. (Nutrition Reviews, Jan. 2023)
- Switching from a Western to Mediterranean diet reduced gingivitis significantly in people with gingivitis. (Journal of Clinical Periodontology, Dec. 2021)
- In patients with gingivitis, following an anti-inflammatory diet for 4 weeks resulted in a significant reduction in gingival inflammation and bleeding. (Journal of Clinical Periodontology, April 2019)
- When patients with type 2 diabetes were switched to the Nordic diet for two weeks, the reduction in gingival bleeding was as substantial as might be expected from one session of professional tooth cleaning. (International Journal of Molecular Sciences, July 2018)
- Based on NHANES data (over 6,800 participants), adherence to an anti-inflammatory diet is associated with significantly fewer missing teeth. (Clinical Nutrition, Aug. 2018)
- Diet versus lifestyle - your overall diet and lifestyle contribute substantially to inflammation, especially in interaction with one another. Excess body weight is the most pro-inflammatory factor. (Journal of Nutrition, Dec. 2019)
- Fructose contained in fresh whole fruit does not break down in the mouth so is generally less cariogenic.
- Periodontal disease risk decreases with increasing consumption of fruits & vegetables (non-starchy). (Nutrients, Nov. 2022).
- A high intake of fruits & vegetables may reduce periodontitis risk by 50%. A high intake of refined grains & desserts may more than triple periodontitis risk. (Public Health Nutrition, Jan. 2024)
- There is a large body of evidence that clearly shows the actions of omega-3 fats (EPA and DHA) in periodontitis. Omega-3 fats: reduce inflammation, reduce bone loss, increase clinical attachment gain. (Nutrients, Feb. 2023)
- Higher oily-rich fish consumption linked to less severe periodontitis, including less gingival inflammation & periodontal pockets. (J of Clin. Periodontology, Feb. 2022)
- In the NHANES study, low intakes of dietary fibre (12 g or less daily) are linked to a significantly higher risk of moderate-to-severe periodontitis. (Journal of Nutrition, Dec. 2016)
- The risk of periodontitis was about 25% less in those who consumed only multigrain rice versus white rice. (Epidemiology & Health, July 2023)
- Popcorn is a healthy, non-cariogenic snack and a much better choice than potato chips, pretzels or cheezies.
- Nuts are a healthy, non-cariogenic snack and a much better choice than granola bars or trail mix (made with dried fruit).
- Long-term Dietary Change (3 month) & Oral Biofilm - High sugar diet promotes caries-promoting Streptococcus bacteria. Higher dairy and fibre-rich diets result in significantly lower abundance of Streptococcus. (Applied & Environmental Microbiology, Aug. 2020)
- Adolescents with low milk intake (<0.4 servings/day) versus those with high intake (≥3.7 servings/day) - Milk intake was inversely associated with the caries causing Streptococcus mutans in saliva and tooth biofilm samples. (PLOS One, March 2018)
- Based on a study with almost 10,000 adults, frequent intake of dairy foods (≥7 servings/week) is associated with a 24% lower prevalence of periodontal disease. (Nutrients, May 2019)
- Most plant-based milk alternatives contain more cariogenic carbohydrates, lack phosphopeptides, have fewer minerals, and less buffering capacity. (Nutrients, March 2023)

- Chocolate milk is more cariogenic than plain milk, but less so than sugar-sweetened soft drinks. Cocoa may be protective.
- NHANES (8,959 participants, periodontal examination) - The intake of various micronutrients within a certain range may be beneficial in reducing the risk of periodontitis, whereas excessive micronutrient intake may increase the risk of periodontitis.) *Nutrients*, June 2022
- Vitamin D has a profound impact on immunity (turns antimicrobial genes on) and inflammation (turns pro-inflammatory genes off). Deficiency leads to inflammation and ultimately, alveolar bone loss. (*Journal of Periodontal Research*, Aug. 2019)

RECAP: Consuming primarily a whole foods, plant-rich, unprocessed diet, reduces inflammation and promotes good oral health. Oily fish (omega-3 fats) and unsweetened dairy products may be beneficial. In terms of supplements for oral health, a multivitamin, along with vitamin D, are recommended.

Nitrates & Dental Health

- Dietary nitrate found in dark leafy greens in the diet is converted in the mouth by “nitrate-reducing bacteria” to nitrite and ultimately, to nitric oxide, which helps: control blood pressure, defend against invading bacteria, and maintain a healthy oral and gut microbiome. (*Dentistry Journal*, May 2022)
- Nitrate-reducing bacteria (*Rothia* & *Neisseria*) are consistently found at higher levels in those free of disease (compared to those with caries, periodontitis, and/or halitosis) and increase when nitrate is consumed. Bacteria normally associated with oral disease (*Veillonella* – caries, *Prevotella* - periodontal diseases & halitosis) decrease in the presence of nitrate. (*Journal of Dental Research*, Feb. 2022)
- Periodontitis impairs nitrate-reducing capacity after vegetable intake. (*International Journal of Oral Science*, Jan. 2024)
- Chronic mouthwash use may endanger beneficial bacteria. Those who gargled at least twice a day were about 50% more likely to develop prediabetes or diabetes than those who used it less frequently or not at all. “Chronic mouthwash use can be likened to the effect of antibiotics on gut bacteria. Few would contemplate going on antibiotics permanently, while more than 20% of Americans use mouthwash daily.” (*Nitric Oxide*, Dec. 2017)
- Nitric oxide-generating potential of the oral microbiome is strongly and consistently associated with cardiometabolic risk. (*Journal of the American Heart Association*, May 2022)
- Twice-daily chlorhexidine usage was associated with a significant increase in systolic blood pressure after 1 week of use. Recovery from use resulted in an enrichment in nitrate-reducing bacteria on the tongue. (*Biomedical Journal*, March 2019)
- Study - 87 participants gargled with mouthwash twice a day for 5-7 days. Listerine reduced some nitrate-reducing bacteria, however, chlorhexidine, targeted more and to a greater degree. (*Frontiers in Cellular & Infection Microbiology*, Feb. 2023)
- In 37 patients suffering from gingival inflammation, consuming a nitrate-rich diet (green smoothie consumed for two weeks) alters the composition of the oral microbiome and decreases gingival inflammation in periodontal recall patients. (*Journal of Periodontology*, Nov. 2021)
- “It is clear now that antiseptic mouthwash disrupts nitrate metabolism to nitric oxide leading to clinical symptoms of nitric oxide deficiency. Based on the science, nitrate should be considered an indispensable nutrient that should be accounted for in dietary guidelines.” (*Nitric Oxide*, March 2023)

- Our professional opinion & advice - high frequency & prolonged use of mouthwash should not be routine component of maintenance of good oral health. (International Dental Journal, Nov. 2023)
- “The ideal mouthwash, whilst combatting oral disease, should “balance” antimicrobial communities, especially those associated with health. Which antimicrobial mouthwash best fits this ideal remains uncertain.” (International Dental Journal, Nov. 2023)
- Review (22 studies) - Herbal products, used in addition to scaling and root planing, often showed comparable outcomes to chlorhexidine (and sometimes better outcomes). (Int. J of Environmental Research & Public Health, Aug. 2022)

RECAP: Nitrate-rich foods, like dark leafy greens, are important for oral health and overall health.

Probiotics

- NHANES (8,574 participants) - Daily intake of medium to high levels of live dietary microbes linked to significantly lower risk of periodontitis. (Oral Diseases, Jan. 2024)
- Research review on probiotics and dental health (24 clinical trials) - Able to reduce harmful bacteria (65% reduction in *Streptococcus mutans*). Equally effective or better than chlorhexidine in reducing oral pathogens, gingival index, and plaque index scores. (Current Pharmaceutical Biotechnology, April 2023)
- Meta-analysis on probiotics and periodontal disease (19 studies) - Used as an adjunct to scaling and root planing, probiotics can result in statistically significant improvements in: plaque index, periodontal probing depth, clinical attachment level, gingival index, bleeding on probing, deep probing depth levels of subgingival microbes. (Beneficial Microbes, March 2023)
- Probiotics versus Antibiotics for Periodontal Disease (research review – 10 studies) - Probiotics showed a significant reduction in probing pocket depth and clinical attachment loss. Antibiotics were more effective in reducing plaque and gingival index. Probiotics can be used as alternative to antibiotics, however, a combination is more effective. (Oral Diseases, Nov 2023)
- There is currently no standard on what an effective dose is for probiotics for oral health. Adhesion of probiotics is limited due to salivary washout - it is vital that a panel of experts determine a “minimal adherent probiotic dose”. (Frontiers in Microbiology, July 2023)
- Clinical guide to probiotic products available in Canada (www.probioticchart.ca). Designed to translate scientific evidence available for probiotic products to practical, clinically relevant information. Can help you select the appropriate product, dose, and formulation for a specific indication (genus, species and strain).

RECAP: Probiotics may benefit oral health, however, choosing the appropriate, science-backed product is critical. Fermented foods that contain live microbes may also benefit oral health.

© Liz Pearson, RD

Website: www.lizpearson.com