

Dairy and Dental Health: What is the Connection?

Written by Debbie Pietsch, RD

Key Messages

- Nutrition and oral care have a dynamic two-way relationship. Healthy eating helps to keep teeth healthy. Healthy teeth and good oral care are important in maintaining overall health, keeping the body free from systemic diseases.
- Choosing the right foods can help to promote mineralization of teeth. Dairy foods in particular have been shown to decrease plaque pH or acidity of dental plaque, increase saliva production, and reduce overall bacteria production in the mouth. All of these effects help reduce the incidence of dental caries.
- By collaborating, nutrition and dental health experts can help to decrease the incidence of oral diseases while improving the overall health of their patients. This can be accomplished through screening, education, and referring patients appropriately.



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Introduction

Have you ever wondered about the role nutrition plays in keeping your teeth and gums healthy? Or the role that good oral health could play in reducing your incidence of certain diseases? Dental caries (tooth decay) and periodontal (gum) disease are considered the two most prevalent but preventable infectious oral health diseases in industrialized nations.¹ Among children, dental caries are the most common chronic childhood disease and a major cause of tooth loss in the United States. Nearly 20 per cent of young children, almost 80 per cent of young adults, and approximately 95 per cent of older adults have experienced dental decay.² Although the cause of dental caries and periodontal disease is multifactorial, diet and nutrition have long been recognized as important factors in maintaining good oral health.

Providing your clients with some simple, easy-to-follow steps can help protect them from oral diseases. Nutrition plays a role in the pre-eruptive development of teeth and the maintenance of healthy teeth and gums by providing nutrients essential for healthy development. Current research supports the role of certain foods—such as dairy products—in preventing decay and promoting healthy oral tissue.

Periodontal disease is a chronic bacterial infection that affects the periodontium, or the hard and soft tissues that surround and support the teeth. Periodontal disease is a major

cause of tooth loss in adults and has been connected to several diseases such as heart disease and increased risk of stroke. This issue of *Nutrition File™ for Health Educators* will review the role of nutrition in the promotion and maintenance of good oral health. This will include how food choices and dietary patterns can influence the development of oral disease, as well as a review of current literature on nutrition and the prevention of these diseases.

Healthy Eating and Oral Health *Bone Up on Your Facts*

The dynamic two-way relationship between nutrition and oral health is a complex one involving all oral structures, including our teeth, gums, bones, muscles, tongue and salivary glands. Proper nutrition is essential to protect the oral cavity and surrounding structures.³ These structures are critical to enable an individual to consume a balanced diet. Good dentition is essential for chewing foods.

Like the bones in our body, our teeth rely on continuous remineralization. Remineralization occurs naturally in the mouth because saliva contains calcium and phosphate ions at concentrations that constitute super saturation with respect to enamel. If the mouth is kept at a fairly neutral environment, around a pH of 7.0, teeth favour remineralization. Making good food choices and avoiding foods that contribute to demineralization can go a long way in preventing dental

caries and improving periodontal health. Research has shown that having good dental care along with eating the right foods can help reduce cavities and improve dental health.⁴ This knowledge can be used by health professionals to help their clients minimize their risk for dental caries.⁴

Dental Caries: Can the foods you eat cause them?

No one parameter is responsible for formation of a carious lesion. A combination of factors is involved, including a susceptible tooth surface, bacteria in the dental plaque, cariogenic (cavity-causing) carbohydrates, and some properties of saliva. Fermentable carbohydrates are carbohydrates that the plaque bacteria can use to produce acid, decreasing the pH to a level where demineralization occurs. These include sugars and starches found naturally and in processed foods. The frequency of consumption of fermentable carbohydrates and their retentive properties, or their tendency to adhere to teeth, are of primary concern for the development of dental caries. Some examples of retentive foods are raisins, fruit leather or dried fruit rolls, sweetened grain products and toffee. Prolonged oral retention of cariogenic foods may lead to extended periods of acid production and demineralization and to shortened periods of remineralization.³ Since sugars are the preferred substrate for oral bacteria, some research has suggested that the timing of sugar-containing foods can also play a role. Sugar-containing foods and fermentable carbohydrates are best consumed with meals rather than in-between meals to reduce the opportunity for acid production.⁵ The lower the plaque pH and the longer the duration of exposure, the higher the potential for dental caries becomes. On the other hand, foods that help to increase the oral pH or stimulate saliva production may help reduce the risk of dental caries.

Tooth erosion caused by increased mouth acidity has been linked to the consumption of certain foods. Tooth erosion occurs when acidic food and drinks create an acidic environment that ‘dissolves’ away the surface of the tooth. In a study done by Lussi et al.,⁶ considerable tooth erosion occurred when citrus fruits were eaten more than twice a day

if that individual also consumed soft drinks daily. The relationship between dental caries and the foods we eat is not a simple one. Not only does what and when we eat affect our cariogenic potential, but oral hygiene, lifestyle, biological and chemical factors play a role.

The Beverage Story

Milk and Dairy

We know that certain nutrients found in milk and milk products—such as calcium, phosphate, and protein—promote the remineralization of teeth. Is there something else about milk products that protects our teeth? Experiments have shown that cheese³ and other milk products⁴ can be anticariogenic and help to promote remineralization of tooth enamel. Mechanisms proposed to explain the anticariogenic effects of cheese and other milk products are:

- increased salivary flow which results in a buffering effect to neutralize plaque acids;
- inhibition of plaque bacteria growth thus less overall acid-producing bacteria;
- increased alkaline substances like calcium, inorganic phosphate and casein which decrease demineralization and enhance remineralization.^{3,7}

An inverse relationship has also been shown between the intake of milk products and prevalence of periodontitis.^{8,9}



A study done by Kashket and DePaola⁷ has shown that chewing cheddar cheese after consumption of a sugary food returned plaque pH toward neutrality within two minutes of consumption. Examples of other cheeses that may help to maintain optimal pH or have been shown not to substantially increase plaque acidity include Gouda, Blue, Monterey Jack, Mozzarella, and Swiss. When cheese is consumed on its own, other protective effects are increased salivary flow, salivary pH increasing to 7.5, and calcium being incorporated into plaque to increase plaque calcium levels.⁷ These effects on plaque pH and calcium have been suggested to decrease tooth demineralization and caries potential.

The positive effects of cheese on dental caries have been recognized by the American Academy of Pediatric Dentistry and the American Dental Association.^{10, 11} Aged cheese is recognized as a nutritious, cavity-fighting snack with characteristics that can disrupt the development of cavities when eaten alone or at the end of a meal or snack.

In addition to protecting teeth, nutrients found in milk are important for the soft tissues of the oral cavity as well. Nutrient deficiencies are frequently first evident in oral mucosa due to rapid cell turnover. Nutrients such as protein, vitamin A, zinc and vitamin B complex are critical in maintaining the health of the oral cavity including the tongue, gingiva, and lips.

What about chocolate milk?

Chocolate milk, the most popular of the flavoured milks, is milk that has added sugar and chocolate flavouring. All milk-based beverages contain the naturally-occurring sugar lactose and flavoured milk contains the same fifteen essential nutrients as plain milk. Chocolate milk contains about two teaspoons of added sugar per eight-ounce serving, which is about the same amount of carbohydrate as half a banana. Chocolate milk contains about two teaspoons less sugar than an eight-ounce serving of a soft drink and often less than many juices.

Does the added sugar contained in the chocolate flavouring cause more dental caries? Children who consume flavoured milk have higher total milk intake and lower soft drink and fruit drink intake. These children have higher calcium intakes without additional overall added sugars throughout the day.¹² There is evidence that foods containing milk casein, calcium, phosphorous, and cocoa, which are all found in chocolate milk, may be less likely to contribute to dental caries than sucrose alone or other snack foods.^{13, 14}

In addition, liquid sugars such as those found in milk—both flavoured and unflavoured—pass through the oral cavity fairly quickly with limited contact time or adherence to tooth surfaces³ and are thus unlikely to significantly increase the risk for dental caries. Also the calcium, phosphorous and cocoa in flavoured milk may protect teeth from decay. In a study conducted by Murphy et al.¹⁵, it was shown that children and

adolescents who drank flavoured milk or plain milk had higher intakes of vitamin A, calcium, phosphorous, magnesium, and potassium. In summary, chocolate milk is a popular, well-liked beverage. If children like it, they will be more likely to drink this nutrient-dense beverage, rather than soft drinks, obtaining more nutrients. Consumed in moderation chocolate milk is a preferable alternative to similarly sweetened soft drinks.¹⁴



Beverage Trends

During the past half-century, beverage consumption patterns have changed dramatically. Daily milk consumption decreased from 3.46 to 2.75 servings in 2- to 18-year-olds¹⁶ from 1977 to 2001. Between the late 1970s and 1994, soft drink consumption increased by 48 per cent.^{16, 17} Soft drink consumption has been negatively associated with milk consumption and found to have a dilutional effect on the intakes of many essential nutrients.¹⁶ Children who consume high amounts of carbonated soft drinks may also have undesirable eating patterns and consume high amounts of sugars from other dietary sources.

Recent data from the Canadian Community Health Survey¹⁸ published in July 2006 has indicated that a third (37 per cent) of children aged 4 to 9 years do not meet the recommended two daily servings of milk products. By age 30, more than two thirds of Canadians do not reach daily minimums. Soft drinks, on the other hand, contribute the largest percentage of calories from “Other Foods”—foods that are not part of the four food groups. These foods are of low nutrient value. The Food Guide recommends moderate consumption of these foods, but the “Other Foods” category is now accounting for about 22 per cent of daily calories consumed.

Which ones make a difference?

The implications of this trend of increased carbonated soft drink consumption could have far-reaching effects on dental caries and dental erosion. Currently, carbonated soft drinks account for the largest share of added sugar (24 per cent) in children’s and adolescents’ diets.¹⁹ It has been well documented that frequent consumption of simple sugars such as monosaccharides

and disaccharides are involved in the etiology of caries in permanent teeth.¹⁹ Children with a high carbonated soft drink consumption pattern have a significantly higher incidence of dental caries, even when compared with those children with a high juice consumption pattern.^{19,5} 100% fruit juices provide sugar substrates such as fructose and glucose, while other liquid beverages such as soft drinks contain primarily high-fructose corn syrup.⁵ Added sugars such as corn syrup, high-fructose corn syrup, fructose, dextrose or sucrose (table sugar) have a higher cariogenic risk than other sugars such as galactose found in milk.³ *Note: Galactose is formed when lactose, the sugar in milk, is broken down to glucose and galactose by the enzyme lactase.*

New Research on Nutrition and Dental Health

Systemic Illnesses

Dental caries and periodontal disease have long been known to be associated with endocarditis. Other dental diseases have only been recently linked to other systemic diseases, some of which include atherosclerotic/ cardiovascular disease, cerebrovascular disease and potentially to other medical conditions such as Sjögren’s Syndrome, a disease that causes a loss of salivary gland parenchyma.²¹ These systemic diseases are thought to arise from highly-specific microbe adhesions in the mouth. In immunologically-susceptible individuals, these microbes gain access to the systemic circulation. Chronic dental infections or periodontal infections are also thought to increase risk of systemic microbe exposure.²¹ It is an intriguing thought: if we could improve our oral health through nutrition, could we reduce the incidence of disease?

Table 1: Foods and Dietary Factors that Prevent Dental Caries

Foods That Contain Protective Factors			
Food	Cariostatic Factors	Mechanisms	Supportive Evidence
Cow’s milk	Calcium, phosphate, casein	Promote remineralization and prevent demineralization	Experimental studies
	Minor milk proteins	Enamel absorbs milk proteins, which confer protection against acid dissolution	Epidemiological studies
Cheese	Calcium, phosphate, casein, casein phosphopeptides	Cheese consumption increases salivary flow rate and pH	Experimental studies in humans
		Cariostatic factors promote remineralization	Animal studies
			Epidemiological studies
Apples	Flavonoids (phenolic compounds)	Inhibition of bacterial adherence	Experimental studies in animals Equivocal results from intervention studies
Cranberries	Flavonoids	Inhibition of bacterial adherence; antibacterial action	Experimental studies in vitro
Tea (green and black)	Flavonoids, fluoride	Inhibition of bacterial adherence; antibacterial action	Evidence for flavonols comes from experimental studies in animals and human volunteers
Peanuts		Gustatory flow and mechanical stimulus for salivary flow	Experimental studies
High-fiber foods		Mechanical stimulus for salivary flow	Epidemiological observational studies

Adapted from Nutrition and Oral Health - Quintessence International ²⁰

Other Foods

What about other foods less studied and their effects on oral bacteria? In a study done by Shimazaki et al.²², a high intake of foods containing lactic acid—such as yogurt and kefir—may reduce the risk of periodontal disease. The mechanism is still unclear, but the authors speculate that the role of probiotics such as lactobacilli found naturally in products like yogurt may inhibit the growth of anaerobic bacteria. More research in this area may help us to understand the mechanism of lactic acid-containing foods on periodontal diseases.

Comelli et al.⁹ further studied the effect of milk components on the oral microbiota and on the incidence of dental caries, both in vitro and in vivo. Certain bacterial strains found in milk products may modify the bacterial profile in dental plaque. This alteration of bacteria, specifically the cariogenic species of *Streptococcus sobrinus*, can help to reduce its pathogenic potential. Dairy bacteria, of which 23 were examined in this study, elicited positive effects by adhering to the tooth surface. Of the many bacteria examined the *Lactococcus lactis* and *Streptococcus thermophilus* strains had the highest propensities for tooth adhesion.

Conclusion

As our knowledge of the links between oral health and nutrition continues to grow, collaborative efforts in screening, education and referring can help prevent oral infectious disease and/or oral manifestations of systemic disease.²⁴ Table 2 shows how nutrition can play a role in reducing oral infections.

Table 2: Diet Recommendations for Oral Health³

1. Eat a well-balanced diet according to Canada's Food Guide, with an emphasis on whole grains, fruit and vegetables, and milk products.
2. Practice good oral hygiene by using fluoride toothpaste with regular brushing and flossing (two times a day and at bedtime). Visit your dentist and dental hygienist for regular checkups.
3. Consume milk products (e.g. yogurt, chocolate milk) and foods with fermentable carbohydrates with meals instead of between meals.
4. Add raw fruit or vegetables to meals to increase salivary flow.
5. Drink sweetened and acidic beverages with meals and include foods that can buffer the acidogenic effects. Drink, rather than sip, sweetened and acidic beverages to decrease tooth exposure time.
6. Chew sugarless gum between meals and snacks to clear the mouth and increase salivary flow. Choose chewing gums that contain sugar alcohols such as xylitol which can stimulate remineralization.
7. Moderate eating frequency (for example, three meals per day and no more than three snacks) to reduce repeated exposure to sugars, other fermentable carbohydrates, and acids. Good dental snack choices that are not fermentable include vegetables, nuts and seeds, cheese and unsweetened popcorn.
8. Avoid putting an infant or child to bed with a bottle of milk, juice or other sugar-containing beverage. If your child requires a night-time bottle, water is recommended.

Adapted from Comelli et al.³

Nutrition file

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Now, **Smile and Say Cheese...**

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For a complete list of references, please visit www.moreaboutmilk.com/educators.php.

Good Nutrition for Happy Teeth

Have you ever wondered if what you eat can affect the health of your teeth? You may be surprised to learn that eating healthy foods along with brushing, flossing and drinking fluoridated water can keep your teeth smiling.

Your teeth are alive and they are constantly changing. Nutrients like protein, calcium and phosphorous from the foods you eat replace those lost from your teeth. You can think of this balance like a “tooth bank”: you need to put back in what you take out in order to maintain a positive balance.

Why do we get cavities?

Dental plaque is the sticky film that forms on our teeth. This plaque contains bacteria or “germs” that use the sugars we eat to make an acid. This acid can eat away at our tooth enamel (the outside of your teeth), forming a hole. These holes are what we call a cavity or dental carie. The longer the sugars stay in our mouths, the higher the risk for forming cavities. However, there are some studies that show that certain foods—like cheese or other milk products—can protect your teeth from these acids.

Not just a bite of cheese....

Studies have shown that cheese and other milk products may help to reduce dental caries. Having a glass of milk along with sweets can reduce your chances of developing cavities. Chocolate milk is a good choice that provides the same amount of protein and essential nutrients as white milk. The natural and added sugars in chocolate milk, if consumed in moderation, do not cause cavities as they don't cling to your teeth or stay in your mouth for a long period of time.

How do milk and milk products protect your teeth?

- They provide the ideal levels of the nutrients needed to keep rebuilding your teeth and keep your gums and mouth healthy.
- They neutralize or buffer some of the acid formed from sugars in the mouth.
- Cheese can stimulate saliva production. Saliva is the liquid in your mouth that helps to clear food. Examples of cheeses found to be “tooth-friendly” include aged cheddar, Gouda, Blue, Monterey Jack, Mozzarella and Swiss.

Five Tips to a Healthy Smile

1. Reduce the number of times a day you eat or drink foods or beverages containing sugars. Sugars can come from starchy foods such as bread, pasta, rice and potatoes or from beverages. Remember that beverages contain both natural sugars like in milk and 100% fruit juice and added sugars found in sweetened fruit juices, sports drinks and soft drinks.
2. Drink water between meals.
3. Avoid sugar-rich foods that stay in the mouth for a long time. Examples include gum with sugar, hard candies or lollipops. Don't put your child to bed with a bottle of sugar-containing liquids such as milk, juice or soft drinks.
4. Keep healthy snacks available at all times. Serve vegetables, cheese, nuts or seeds for snacks. Stay away from soft, sticky sweets that can get stuck in the teeth such as toffee, raisins and fruit snacks like dried fruit rolls or fruit leathers.
5. Brush your teeth at least twice a day and before going to bed. Floss at least once a day, and see your dental hygienist and dentist regularly.

(Adapted from the Canadian Dental Association – Your Oral Health – Caring for your Teeth)



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