

Correlation between Diet and Dental Health

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ABSTRACT

Dental health is related to diet in many ways, for example, nutritional influences on oral cancer oral infectious diseases and craniofacial development. Oral diseases impact considerably on quality of life and self-esteem that are difficult to treat. The objective of this paper is to review the evidence for an association between nutrition, diet and dental diseases and to present dietary recommendations for their prevention. Diet affects the teeth during development and malnutrition may exacerbate oral infectious diseases and periodontal. The most important effect of diet on teeth is the local action of diet in the mouth on the development of dental caries and enamel erosion. Dental erosion is increasing and is associated with dietary acids, a major source of which is soft drinks. Despite improved trends in levels of dental caries in developed countries, dental caries remains prevalent and is increasing in some developing countries undergoing nutrition transition.

Keywords: diet, dental health, oral diseases, nutrition, dentistry

INTRODUCTION

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Difference between balanced and unhealthy diet

Balanced diet (what you eat) that contains the right amount of all the food groups, which includes fruits, vegetables, grains, dairy products, and protein. Not only, to get nutrients that the teeth, bones, body, and gums need, to regenerate tissues and fight back oral cancer, craniofacial developments, and periodontal diseases, but also, in preventing pathologies at an organic, cellular, and subcellular level.¹ On the other hand, an Unbalanced diet includes:-

- Carbonated/sports/energy drinks- with a high percentage of sugar and acid.
- Sticky food, like caramel and jellybeans.
- Sugary snacks, which consist of a high amount of cavity-causing sugar.
- Acidic food and beverages such as, ice tea, lemon, pickles, which leads toward dental erosion.

Hence, all the above food items cause gum disease, tooth decay, obesity hypertension, high cholesterol, type 2 diabetes, cardiovascular disease, osteoporosis.²

Occurrence of dental caries

Dental caries occurs due to demineralization of enamel and dentine. (the hard tissues of the teeth) by organic acids formed by bacteria in dental plaque through the anaerobic metabolism of sugars derived from the diet³. The rate of demineralization is affected by the concentration of hydrogen and fluoride ions (i.e. pH at the tooth surface).⁴

Bacteria involved

Streptococcus mutans and *Streptococcus sobrinus* are important bacteria in the development of dental caries. Both these bacteria readily produce organic acids from dietary sugars and like most aciduric bacteria can synthesize insoluble plaque matrix polymers (extracellular dextran) from dietary sugars-a factor that aids bacterial colonization of the tooth surface.⁵

Nutrition and oral infectious diseases

Malnutrition consistently impairs innate and adaptive of the host, including phagocytic function, cell-mediated immunity, complement system, secretory antibody, and cytokine production and function. In PEM, there are marked changes in the oral microbial ecology resulting in a preponderance of pathogenic anaerobic organisms, increased propensity of bacteria to bind to oral mucosal cells, attenuation of acute-phase protein response, and dysfunction of the cytokine system. Cellular depletion of antioxidant nutrients promotes immunosuppression, accelerated replication rate of ribonucleic acid viruses, and increased disease progression. Therefore, malnutrition can intensify the severity of oral infections and may lead to their evolution into life-threatening diseases⁶

Neonatal Diet and Oral Health

The World Health Organization and the American Pediatric Association have shown that breast feeding influences lingual deglutition, the growth of the maxillae and the correct alignment of the teeth, as well as the modelling of the hard palate. Vice versa,

bottle feeding the baby influences the formation of the ogival palate as well as the formation of “cross-bite”, a reduced opening of the back nasal cavity, and an increased incidence of sleep apnea. In addition, artificial feeding influences the possibility of the onset of arterial hypertension, obesity, cardiovascular illnesses, and inflammatory pathologies regarding oral mucous⁷

Micronutrient Deficiencies and Mucosal Disorder

Various types of nutritional deficiencies can produce oral mucosal diseases. Changes such as swelling of the tongue, papillary atrophy, and surface ulceration are possible in case of micronutrient deficiencies (iron, folate, vitamin B12) To establish iron, folate, or vitamin B12 deficiency, a hematologic screening that includes complete blood count, red-cell, serum iron, B12, and folate levels should be performed.⁸ Although they are rarely required, specific tests for suspected niacin, pyridoxine, and riboflavin deficiency are available. Although glossodynia related to nutritional deficiency is statistically uncommon, it is easily curable with replacement therapy. Identification of a vitamin deficiency through early oral symptoms can forestall development of serious and irreversible systemic and neurologic damage. Deficiencies of vitamin B12 can produce oral signs and symptoms, including glossitis, angular cheilitis, recurrent oral ulcer, oral candidiasis, and diffuse erythematous mucositis. Plummer Vinson syndrome is associated with glossitis and angular cheilitis⁹

Oral Cancer

The association between diet and oral cancer is extremely serious. It is a pathology that is diagnosed, in three hundred thousand new cases in the world every year and presents the greatest incidence in people who smoke, chew tobacco, and consume alcohol.

The use of tobacco can alter the distribution of nutrients such as

antioxidants, which develop a protective action toward the cells: smokers present levels of carotenoids and vitamin E in the blood that are superior to those in the oral mucous and, in addition, have a different distribution in comparison to the norm; the levels of folates in the blood and in the cells of the oral tissues of smokers are inferior to those of non-smokers; the inside of the cheeks of smokers presents numerous micronuclei (modifications typical of pre- and neoplastic lesions). The study of the incidence, of this illness has underlined the possibility that diet can represent an important etiological factor for oral carcinogenesis.¹⁰

Vitamins A, E, C, and Beta Carotene have antioxidant properties.

- (i) They neutralize metabolic products.
- (ii) They interfere with the activation of procarcinogens
- (iii) They inhibit chromosomal aberration.
- (iv) They potentially inhibit the growth of malignant lesions (leukoplakia).

The mechanism that connects smoke to this disease has not been discovered, but some progress has been made: smoke modifies the distribution of protective substances such as folates and some antioxidants. A rebalancing of nutrients obtained through diet can modify the altered distribution caused by the consumption of tobacco. In an imbalanced diet there is a depletion of antioxidant nutrients. Fruit and vegetables have, vice versa, important antioxidant properties. Many micronutrients (vitamins in particular) are used in chemo prevention programs formulated by the US National Cancer Institute¹¹

The National Cancer Institute and the American Cancer Society have established some prudential dietary recommendations for the choice of food:

- i.** Maintain a desirable body weight.
- ii.** Eat a varied diet.
- iii.** Include a new variety of fruits and vegetables in the daily diet.
- iv.** Consume a greater quantity of foods rich in fibre.

v. Decrease the total intake of fats (30% less than the total calories).

vi. Limit the consumption of alcohol.

vii. Limit the consumption of salted food or food preserved with nitrates.

In patients with an advanced tumour disease, protein-caloric malnutrition is a recurrent problem due to factors such as a form of anorexia that is established, mal digestion, malabsorption, and to a difficulty in mastication and deglutition.¹⁰ Foods should be provided that aim to correct nutritional deficits and ponderal reduction when consumed in a large enough quantity to cover protein and caloric requirements. Malnutrition also interferes negatively with humoral and cellular immune competence and with tissue and reparative functions. Moreover, the alteration of the liver function can change the way drugs are metabolized. Therefore, malnutrition can interfere with oncological therapy and increase the severity of the collateral effects¹²

In a recent research, El-Rouby showed that lycopene can exert protective effects against 4-nitroquinoline-1-oxide induced tongue carcinogenesis through reduction in cell proliferation and enhanced cellular adhesion, suggesting a new mechanism for the anti-invasive effect of lycopene¹³.

In a recent report, Edefonti et al. showed that diets rich in animal origin and animal fats are positively, and those rich in fruit and vegetables and vegetable fats inversely related to oral and pharyngeal cancer risk.¹⁴

Current epidemiological situation/trends in dental diseases

Review of the current thinking: the scientific evidence linking diet and dental diseases

There is a wealth of evidence to show the role of dietary sugars in the aetiology of dental caries. The evidence comes from many different types of investigation including human studies (both observational and intervention), human

plaque pH studies (in which the pH of plaque is monitored in situ following ingestion of a test substance), enamel slab experiments (in which slabs of bovine enamel are fitted in a removable oral appliance and worn during periods of consumption of experimental diets and subsequently the level of demineralisation is measured), animal studies and incubation studies of oral bacteria and dietary substrates in vitro.

Collectively, information from all the different types of studies provides an overall picture of the cariogenic potential of different dietary carbohydrates. The strength of the evidence linking sugars in the aetiology of dental caries comes from the multiplicity of the studies rather than the power of any one study alone¹⁵. It is worth noting that some of Diet, nutrition and prevention of dental diseases the earlier epidemiological studies were done in communities that did not have the benefit of exposure to fluoride

Dietary sugars and dental caries The evidence shows that sugars are undoubtedly the most important dietary factor-and the factor studied most often-in the development of dental caries. In this paper, the term 'sugars' refers to all mono and disaccharides while the term 'sugar' only refers to sucrose, the term 'free sugars' refers to all mono and disaccharides added to foods by manufacturer, cook or consumer, plus sugars naturally present in honey, fruit juices and syrups and the term 'fermentable carbohydrate' refers to free sugars, glucose polymers, fermentable oligosaccharides and highly refined starches.

Worldwide epidemiological observational studies Sugar intake and levels of dental caries can be compared at country level. Sreebny¹⁶ correlated the dental caries experience of primary dentition (dmft) of 5 and 6-year-olds with sugar supplies data of 23 countries, and the dental caries experience (DMFT) of 12-year-olds to sugar supplies data of 47 countries.

For both age groups, significant correlations were observed: $p < 0.31$ for deciduous dentition and $p < 0.7$ for permanent dentition- meaning that 52% of the variation in caries levels could be explained by the per capita availability of sugar. From the above data it was calculated that for every 25 g of sugar per day one tooth per child would become decayed, missing or filled¹⁷. In countries with an intake of sugar below 18 kg/person/ yr (equivalent to, 50 g/person/d) (n = 21) experience of caries was consistently below DMFT 3 (the WHO goal for 2000).

The countries with sugar supplies in excess of 44 kg/person/ yr (120 g/person/d) had considerably higher levels of caries. The previous data refer to populations of children who were not exposed to the benefits of fluoride. This point is well explained by a later analysis by Woodward and Walker who did not find such a strong association between per capita sugar availability and mean DMFT of 12-year-olds in developed (n = 29) and developing (n = 61) countries.¹⁸

The influence of fluoride on the sugars-carries relationship

Fluoride alters the resistance of the teeth to demineralisation as well as the speed with which the enamel surface remineralises following a plaque acid challenge. Fluoride affects the tooth post-eruptively in three ways.

First, it reduces and inhibits demineralisation: Fluoride is incorporated into the enamel lattice and/or binds to enamel crystal surfaces and replaces the hydroxyl groups in hydroxyapatite. By converting hydroxyapatite into fluoroapatite which is more stable, fluoride reduces the susceptibility of the enamel to demineralisation. Second, remineralisation of enamel in the presence of fluoride results in the porous lesion being remineralised with fluoroapatite rather than hydroxyl apatite (the former being more stable and more resistant to further attack by acids).

Lastly, fluoride also affects plaque by inhibiting bacterial metabolism of sugar thus reducing acid production.

The main action of fluoride is topical at the enamel surface after eruption. The inverse relationship between fluoride in drinking-water and dental caries is well established¹⁹

Without any dietary modifications topical fluoride in either toothpaste, mouth rinses or varnishes reduces caries in children by between 20 and 40%, but does not eliminate dental caries. Over 800 controlled trials of the effect of fluoride on dental caries have been conducted and show that fluoride is the most effective preventive agent against caries¹²⁰.

Over the past three decades, it has been observed in developed nations that excessive use of fluorides can reduce dental caries

Much of the data that illustrate, an association between intake of dietary sugars and dental caries were collected in the pre fluoride era. More recent studies that attempt to focus only on the relationship between sugars and caries are confounded by the presence of fluoride but show that a relationship between sugar intake and caries still present in the presence of fluoride. The relation between sugar intake and dental caries in children has been observed in the longitudinal studies and remained the same even after controlling for use of fluoride and oral hygiene practices²⁰. In a cross-sectional study of 12-year-old children in the UK who were using fluoride toothpaste, DMFS scores were significantly related to the number of times sugary foods were consumed²¹.

Other risk causing factors²³

(i) Age= the older people are at high risk for poor nutrition. Those on limited diets or undergoing medical treatment may suffer from anorexia, as a result, become isolated, and weak in resources, or money to eat nutritionally balanced meals. This would result in loss of teeth, gum-related diseases, pain, and temporomandibular joint (TMJ)

disorder, which can impair an individual's ability to taste, bite, chew and swallow food.²²

(ii) Medications can cause dry mouth, making it difficult to chew and swallow food. This can deteriorate nutritional state that could have a harmful impact on an individual's oral health. Many herbal supplements contain active ingredients that may not safely mix with a prescription or over-the-counter drugs. Some food items with prescription drugs.

(iii) Allergies and Restrictive diets= those are on food allergies or on restrictive diets, e.g., gluten-free, as well as vegetarians, particularly vegans (consuming no food or drink of animal origin), may experience vitamin and protein deficiencies which may cause problems related to gums and tooth decay at the extreme point. Thus selecting an appropriate amount of nutrients is essential for the body. Taking a multi vitamin daily is also recommended.

(iv) Chronic periodontal (gum) disease

(v) Lack of vitamins (supplements) like= vitamin c, it helps produce collagen, the connective tissue that holds bone together; a deficiency may lead to bleeding gums and loose teeth. Vitamins B12 and B2 (riboflavin), mouth sores can develop with insufficient B12 and B2.

Periodontal disease

Periodontal disease is a chronic disease that may only become evident with increasing age. Apart from severe vitamin C deficiency, which results in scurvy-related periodontitis, there is little evidence for an association between diet and periodontal disease, although current interest is focusing on the potential preventive role of antioxidant nutrients. The pivotal factor in the etiology of periodontal disease is the presence of plaque, and prevention measures focus on oral hygiene. There is a plethora of evidence that suggests

periodontal problems begin more rapidly in populations that are suffering from malnutrition and the important role of nutrition in maintaining an adequate host immune response may explain this observation²³.

Consequence

The Social consequences, is low self-esteem, eating ability, nutrition, and health both in childhood and older age. According to the survey, the second International Collaborative Study of Oral Health Systems (ICSII) 25 revealed that in all countries covered by the survey considerable numbers of children and adults reported impaired social functioning such as avoiding laughing or smiling due to poor appearance of teeth. According to the report, children all over the world show sign of trepidation about meeting others because of their tooth appearance or maybe others will be making jokes about their teeth.

The 5A's approach to nutritional counseling:

Prior information regarding the patient's dietary exposures, including meals, snacks, frequency, the structure of meals, and intake of sugared beverages, is key to providing successful behavior modification.

The 5A's approach to nutritional counseling incorporates these key counseling components and can provide an effective and structured system easily implementable in the dental practice to increase compliance to nutritional recommendations. These steps outlined by Eaton et al.²⁵ include

1. Address:

the agenda, "What you eat is very important for your health and to decrease your further risk of dental caries. I recommend we review your dietary intake."

2. Assess:

the patient's present and past dietary history and sources of motivation;

3. Advise:

patients based on their present dietary intake and oral and systemic health risks

to move forward with focused areas of recommended modification;

4. Assist

In preparing reasonable goals using anticipatory guidance, identifying potential barriers, sources of support, refer to a dietitian if needed; and

5. Arrange

frequent follow-up which can be arranged through phone, or dental office visit.

How to maintain a balanced diet at home

i. Limit consumption of food and beverages that contribute to poor oral health.

ii. Eat sweets at mealtime, not as a snack, because the increased flow of saliva during a meal helps protect the teeth by washing away and diluting sugar.

iii. If sugar is the first ingredient listed on a product label, then the food has high sugar content. Look for other sugars on the label such as corn syrup and sweeteners, dextrose, fructose, glucose, honey, maple syrup.

iv. Check to see if liquid medicines (such as cough syrup) contain sugar. Ask a physician or pharmacist for sugar-free medicines.

v. Drink water between meals.

vi. Prepare food in healthy ways, such as steamed, sautéed, poached, or baked. Avoid fried food and limit salt intake.

vii. Maintain proper oral hygiene. Brush twice a day for two minutes with fluoridated toothpaste and a soft toothbrush clean or floss between teeth and gums once a day; clean or scrape the tongue daily.

viii. Delay brushing for at least an hour after consuming acidic food or beverages, as acid softens the tooth's surface, brushing will cause more enamel loss. Instead, rinse mouth with water, chew hard cheese or sugarless gum to stimulate saliva flow, which helps to wash away and neutralize acids.

ix. Professional cleanings, customized home care and to discuss nutrition and healthy food choices.

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