

See Cavities, Think Systemic Disease

Abstract

Caries are frequently a sign of excess sugar intake and this can be related to systemic disease. The clinician should broaden their thinking to include the possibility that excess sugar intake can cause systemic disease from atherosclerosis, peripheral vascular disease, coronary heart disease, heart attack, stroke, type 2 diabetes and kidney disease. Excess sugar damages the body in the following manner, e.g. overloads and damages the liver, causes weight gain, creates metabolic syndrome, increases uric acid levels which is a risk factor for heart and kidney disease.

Introduction

Many dental practitioners today have learned that when they detect periodontal disease that they should beware that this patient could have systemic disease from the bacteria found in periodontal tissues and pockets [1]. This can lead to simplistic thinking that if they 'see periodontal disease, think systemic disease'. Not only is this useful for referral to medical practitioners, but can be useful as a motivator to patients. The breakdown of periodontal tissues is representative of what maybe occurring in other parts of the patient's body.

This article seeks to direct the practitioner's thinking along similar paths in expanding thoughts from only seeing caries, to include other systemic diseases the patient may have. In periodontal disease the systemic disease is correlated to the presence of bacteria in periodontal tissues and distant tissues and organs, while for dental caries it is related to excess sugar intake, which also affects distant tissues and organs. The clinician should expand their thinking to include the possibility that the excess sugar intake is not only causing dental decay [2-6] but is also causing disease(s) to organs and tissues of the body [1] and treat and/or refer accordingly.

What is Excess Sugar?

Historically, until sugar and starches were available there was little decay and degenerative diseases. The beginning of the "Neolithic" or New Stone Age period occurred around 10,000 B.C. and is defined by the new way of life based on the production of food from domesticated species. It appears at different times and regions around the world during this time [7]. This was probably necessary to feed a growing population, as hunting and gathering can support one person per 10 square miles, whereas, Neolithic agriculture can support 100 times more [8,9].

Lanfranco and Eggers reviewed many studies on the frequency of caries in prehistoric man and summarized the findings as follows: hunter-gathers had a caries frequency ranging from 0-5.3; fisherman 0.4-10.3 and farmers 2.2-26.9 [14]. While there are disputes among investigators as to the method of gathering data, the trend is clear, as the diet changed, the amount of dental caries increased.

Of great importance for the hunter-gather, they rarely died of coronary artery disease, diabetes mellitus or chronic obstructive pulmonary disease, among other ailments common in societies



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like ours. They may not have been healthier in absolute terms, but they were absent infection and osteoarthritis and rarely had chronic diseases that we commonly have [10,11]. Therefore, low caries (low sugar intake) and lack of degenerative diseases are found together.

Primitive cultures today - when primitive cultures eat basic food and no sugar, there is little decay and degenerative disease. This was questioned by Price [12]. He wanted to study the health of primitive people and travelled for 10 years making observations and took over 15,000 photographs. He investigated 14 remote areas in the world, including: isolated Swiss villages, remote island of the coast of Scotland, studied traditional Eskimos, Indian tribes in Canada and the Florida Everglades, South sea islanders, Aborigines in Australia, Maoris in New Zealand, Peruvian and Amazonian Indians and tribesman in Africa [12].

His observations found less than 1% of these people had decay in their permanent teeth. He found that freedom from caries always went hand in hand with freedom from chronic diseases like cancer and heart disease and infectious diseases like tuberculosis, which at the time was a world-wide epidemic [12] others have reported the lack of degenerative diseases, particularly cancer in isolated groups [13].

More importantly, these people were healthy with well formed, broad faces and teeth in perfect alignment. Their bodies were wonderful in physical development [12]. The diets of the healthy "primitives" Price studied were all very different (in other words it was not so much what they ate that contributed to their health as what they did not eat).

Similar findings by other investigators have been found recently in several populations living in isolated areas of the world where they kept their ancestral ways of life (e.g. many African tribes, Inuits, South American Indians, Melanesian, Polynesian, under conditions of perfect adaptation to their environments and diets [14-16].

What is in our Diets Now?

Added sugar was not a significant component of the human diet until the advent of modern food-processing methods. Since then, the

intake of sugar has risen steadily. The average US sugar utilization per capita on the basis of food disappearance data (2002) was 55 kg (120 lb) per year in 1970 and it reached 68 kg (150 lb) per year in 1995, which is almost 0.5 lb per day [17,18]

In the United States, the average person consumes more than 126 grams of sugar per day, which are slightly more than three 12-ounce cans of Coca-cola. That is more than twice the average sugar intake of all 54 countries observed by Euromonitor. It is also more than twice what the World Health Organization recommends for daily intake, which is roughly 50 grams of sugar for someone of normal weight. At the other end of this list is China, where the average consumption of sugar is just less than 16 grams [19].

High intakes of dietary sugars in the setting of a worldwide pandemic of obesity and cardiovascular disease have heightened concerns about the adverse effects of excessive consumption of sugars. In 2001 to 2004, the usual intake of added sugars for Americans was 22.2 teaspoons per day (355 calories per day). On the basis of the 2005 US Dietary Guidelines, intake of added sugars greatly exceeds discretionary calorie allowances, regardless of energy needs. In view of these considerations, the American Heart Association recommends reductions in the intake of added sugars. A prudent upper limit of intake is half of the discretionary calorie allowance, which for most American women is no more than 100 calories per day and for most American men is no more than 150 calories per day from added sugars [20].

Excess Sugar and Liver Damage

The impact of sugar consumption on health continues to be a controversial topic. There are plausible mechanisms and research evidence that supports the suggestion that consumption of excess sugar promotes the development of cardiovascular disease (CVD) and type 2 diabetes (T2DM) both directly and indirectly. The direct pathway involves the unregulated hepatic uptake and metabolism of fructose, leading to liver lipid accumulation, dyslipidemia, decreased insulin sensitivity and increased uric acid levels. The epidemiological data suggest that these direct effects of fructose are pertinent to the consumption of the fructose containing sugars, sucrose and high fructose corn syrup (HFCS), which are the predominant added sugars. Consumption of added sugar is associated with development and/or prevalence of fatty liver, dyslipidemia, insulin resistance, hyperuricemia, CVD and T2DM, often independent of body weight gain or total energy intake. There are diet intervention studies in which human subjects exhibited increased circulating lipids and decreased insulin sensitivity when consuming high sugar compared with control diets [21].

Excess Sugar and Metabolic Syndrome

Metabolic syndrome is a cluster of metabolic risk factors. When a patient presents with these risk factors together, the chances for future cardiovascular problems are greater than any one factor presenting alone.

For example, high blood pressure alone is a serious condition, but when a patient has high blood pressure along with high fasting glucose levels and abdominal obesity, this patient may be diagnosed with metabolic syndrome. There is a greater chance this patient will have cardiovascular problems because of the combination of risk factors.

Metabolic syndrome is a serious health condition that affects about 34 percent of adults and places them at higher risk of cardiovascular disease, diabetes, stroke and diseases related to fatty buildups in artery walls. The underlying causes of metabolic syndrome include overweight and obesity, physical inactivity and genetic factors.

How is Metabolic Syndrome Diagnosed?

Metabolic syndrome occurs when a person has three or more of the following measurements [22]:

- Abdominal obesity (Waist circumference of 40 inches or above in men, and 35 inches or above in women)
- Triglyceride level of 150 milligrams per deciliter of blood (mg/dL) or greater
- HDL cholesterol of less than 40 mg/dL in men or less than 50 mg/dL in women
- Systolic blood pressure (top number) of 130 millimeters of mercury (mm Hg) or greater, or diastolic blood pressure (bottom number) of 85 mm Hg or greater
- Fasting glucose of 100 mg/dL or greater

Although metabolic syndrome is a serious condition, you can reduce your risks significantly by reducing your weight; increasing your physical activity; eating a heart-healthy diet that's rich in whole grains, fruits, vegetables and fish; and working with your healthcare provider to monitor and manage blood glucose, blood cholesterol, and blood pressure [22].

People with metabolic syndrome are at increased risk for the following [22]:

- Atherosclerosis, peripheral vascular disease and other diseases related to fatty buildups in artery walls. These blockages narrow the arteries and restrict blood circulation throughout the body, but are especially dangerous when they affect the arteries leading to your brain, heart, kidneys and legs.
- Coronary heart disease and heart attack. When the arteries that supply blood to the heart become narrowed or blocked by fatty deposits called plaque, they decrease the amount of blood and oxygen reaching the heart, which can cause chest pain (angina) or a heart attack.
- Stroke. A stroke occurs when the blood supply to a part of your brain is interrupted by a blocked or burst blood vessel, which deprives the brain of oxygen and nutrients. Within a few minutes, brain cells begin to die, resulting in brain damage, other complications, or death.
- Type 2 diabetes. Diabetes occurs when the body can no longer make enough insulin or is unable to use insulin properly. This causes sugars to build up in the blood and increases risks for kidney failure and cardiovascular disease.

More than one in three (34%) of U.S. adults have metabolic syndrome. Although these risks are significant, there is good news. Metabolic syndrome can be treated and you can reduce your risks for cardiovascular events by maintaining a healthy weight, eating a heart-healthy diet, getting adequate physical activity and following your healthcare providers' instructions [23].

One of the sources of added sugar to the diet is sugar sweetened beverages. Several reviews have presented evidence syntheses on associations between SSB consumption and metabolic syndrome/type 2 diabetes [24-26] weight [24,26-29] and cardiovascular disease [24].

Excess Sugar and Heart Disease

Yang et al. used data from the National Health and Nutrition Examination Survey (NHANES 1988-1994, 1999-2004, and 2005-2010 for trend analysis and NHANES III Linked Mortality cohort (1988-2006), a prospective cohort of a nationally representative sample of US adults for the association only.

Yang et al. found that most US adults consume more added sugar than is recommended for a healthy diet [30]. A higher percentage of calories from added sugar is associated with significantly increased risk of cardiovascular disease (CVD) mortality. In addition, regular consumption of sugar-sweetened beverages is associated with elevated CVD mortality. Our results support current recommendations to limit the intake of calories from added sugars in US diets.

Yang et al. concluded that most US adults consume more added sugar than is recommended for a healthy diet [30]. They observed a significant relationship between added sugar consumption and increased risk for CVD mortality.

Randomized clinical trials and epidemiological studies have shown that individuals, who consume higher amounts of added sugar especially sugar sweetened beverages, tend to gain more weight [31], and have a higher risk of obesity [26,29,32-35], type 2 diabetes mellitus [26,34-38], dyslipidemias [39,40] hypertension [41,42] and cardiovascular disease [36-43].

Excess Sugar and Kidney Disease

In a review article, Johnson et al. discussed the epidemic of cardio-renal disease characterized by increasing rates of obesity, hypertension, the metabolic syndrome, type 2 diabetes, and kidney disease [44]. Whereas, excessive caloric intake and physical inactivity are likely important factors driving the obesity epidemic, it is important to consider additional mechanisms. Fructose has the unique ability to induce an increase in uric acid and maybe a major mechanism by which fructose can cause cardio-renal disease.

Fructose as a sweetener is used in soda drinks and maybe a causative factor in chronic kidney disease (CKD). The risk of chronic kidney disease in patients who regularly drink soda is controversial. A meta-analysis was done to evaluate the associations between consumption of sugar and artificially sweetened soda and CKD [45].

They concluded that children who consumed SSBs during infancy had higher odds of obesity at 6 years than non-SSB consumers. SSB consumption during infancy may be a risk factor for obesity in early childhood [44].

The problem of excess sugar begins in childhood affecting the health of the body and teeth and continues throughout life. Whenever excess sugar intake is suspected, it will be very beneficial to the patient to receive proper diet counseling and other necessary referrals.

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