

Ironman Sports Medicine Conference
 Role of Sugar in Obesity and Chronic Disease
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Outline

1. Introduction to the Problem
 - A. Obesity – sweeping the nation

Twenty years ago, the common perception was that sugar intake was associated with several chronic diseases: Diabetes, coronary heart disease, obesity, and hyperactivity in children. Sugar was also thought to be the sole cause of dental caries. Recent advances in scientific knowledge, however, have shed some light on the role of sugar in chronic diseases and dental caries. The evidence indicates that sugar is not in itself associated with the aforementioned chronic diseases and is not the sole offender in the development of dental caries.

- B. Who is at risk?

Prevalence

The prevalence of overweight (Body Mass Index (BMI) of 25 or more) and obesity (BMI of 30 or more) increased over the last decade across racial / ethnic groups, as shown in Table 1.

Mexican American and black (non-Hispanic) adults in the U.S. are considerably more overweight and obese than white (non-Hispanic) adults.

Increase in Overweight and Obesity Prevalence Among U.S. Adults* by Racial / Ethnic Group		
	Overweight (BMI ≥ 25) Prevalence (%)	Obesity (BMI ≥ 30) Prevalence (%)

Racial / Ethnic Group	1988 to 1994	1999 to 2000	1988 to 1994	1999 to 2000
Black (non-Hispanic)	62.5	69.2	30.2	39.9
Mexican American	67.4	73.4	28.4	34.4
White (non-Hispanic)	52.6	62.3	21.2	28.7

Source: CDC, National Center for Health Statistics, National Health and Nutrition

Examination Survey. Flegal et. al. JAMA. 2002; 288:1723-7 and IJO. 1998;22:39-47.
 *Ages 20 and older for 1999 to 2000 and ages 20 to 74 for 1988 to 1994.

The American Indian population also has high prevalence rates of overweight. Among the highest rates reported (overweight defined as BMI of ≥ 27.8 for men and ≥ 27.3 for women) are for American Indians in Arizona at 80 percent for women and 67 percent for men, according to researchers of the Strong Heart Study in 1995.

Gender: For women, the black (non-Hispanic) population has the highest prevalence of overweight (78 percent) and obesity (50.8 percent).

For men, the Mexican American population has the highest prevalence of overweight (74.4 percent) and obesity (29.4 percent).

Overweight, obesity and severe obesity (BMI of 40 or more) prevalence increased for men and women in various racial / ethnic groups in the U.S. over the last decade.

Increase in Overweight (BMI ≥ 25) Prevalence Among U.S. Adults (Ages 20 to 74) by Racial / Ethnic Group and Gender		
	Men Prevalence (%)	Women Prevalence (%)

0. Racial / Ethnic Group	1988 to 1994	1999 to 2000	1988 to 1994	1999 to 2000
Black (non-Hispanic)	58.2	60.1	68.5	78
Mexican American	69.4	74.4	69.6	71.8
White (non-Hispanic)	61.6	67.5	47.2	57.5

Source: CDC, National Center for Health Statistics, National Health and Nutrition Examination Survey. Health, United States (Table 70) 2002.

Increase in Obesity (BMI ≥ 30) Prevalence Among U.S. Adults (Ages 20 to 74) by Racial / Ethnic Group and Gender		
	Men Prevalence (%)	Women Prevalence (%)

Racial / Ethnic Group	1988 to 1994	1999 to 2000	1988 to 1994	1999 to 2000
Black (non-Hispanic)	21.3	28.8	39.1	50.8
Mexican American	24.4	29.4	36.1	40.1
White (non-	20.7	27.7	23.3	30.6

Hispanic)				
Source: CDC, National Center for Health Statistics, National Health and Nutrition Examination Survey. Health, United States (Table 70) 2002.				

Increase in Severe Obesity (BMI \geq 40) Prevalence Among U.S. Adults (Ages 20 and older) by Racial / Ethnic Group and Gender		
	Men Prevalence (%)	Women Prevalence (%)

Racial / Ethnic Group	1988 to 1994	1999 to 2000	1988 to 1994	1999 to 2000
Black (non-Hispanic)	2.4	3.5	7.9	15.1
Mexican American	1.1	2.4	4.8	5.5
White (non-Hispanic)	1.8	3	3.4	4.9
Source: CDC, National Center for Health Statistics, National Health and Nutrition Examination Survey. Flegal et. al. JAMA 2002;288:1723-7.				

Socioeconomic Status (SES)

Overweight affects African American women and men across all SES levels. Minority women with low income appear to have the greatest likelihood of being overweight.

Among Mexican American women, age 20 to 74, the rate of overweight is about 13 percent higher for women living below the poverty line versus above the poverty line.

Causes of Childhood Obesity

There are many factors that contribute to causing child and adolescent obesity - some are modifiable and others are not.

Modifiable causes include:

Physical Activity - Lack of regular exercise.

Sedentary behavior - High frequency of television viewing, computer usage, and similar behavior that takes up time that can be used for physical activity.

Socioeconomic Status - Low family incomes and non-working parents.

Eating Habits - Over-consumption of high-calorie foods. Some eating patterns that have been associated with this behavior are eating when not hungry, eating while watching TV or doing homework.

Environment - Some factors are over-exposure to advertising of foods that promote high-calorie foods and lack of recreational facilities.

Non-changeable causes include:

Genetics - Greater risk of obesity has been found in children of obese and overweight parents.

2. The American Diet: Linking obesity to sugar

Despite having been labeled as "empty calories," sugars are truly important compounds from the perspective of the human organism. Humans have retained the ability to synthesize all forms of carbohydrates the body needs from simple sugars. This is not the case with the other dietary macronutrients, fats, and proteins. Following ingestion, all digestible complex dietary carbohydrates are broken down in the gut to simple sugars before they are absorbed into the body. Because simple sugars are all identical chemically, the absorption process cannot distinguish simple sugars resulting from the breakdown of complex dietary carbohydrates from corresponding simple sugars occurring naturally in the foods themselves or from corresponding simple sugars added to foods during processing. Within the body, most dietary sugars are converted to glucose, a major fuel used by all cells and the primary fuel required by brain tissue for normal function. Low levels of glucose in the blood will impair the brain and cause permanent mental impairment or worse--coma or death. The body can store a limited amount of glucose as glycogen, which it can draw upon for less than a day. After this, other sources such as proteins, from the breakdown of body tissues, must be used to synthesize glucose for the cells (15).

The consumption of total sugars has increased significantly in the past 30 yr in the U.S. with shifts in the sources of sweeteners. Before the late 70's-early 80's, carbonated soft drinks were sweetened with sucrose, a 50% fructose containing sugar. Currently the leading source of fructose in the U.S. diet is most likely sucrose, given that USDA data indicate per capita consumption of this caloric sweetener is higher than other caloric sweeteners. High fructose corn syrup, however, is the principle sweetening agent in carbonated soft drinks and is 5% higher in fructose than sucrose for beverage applications, but lower in fructose (42% versus 50%) for other applications (breads, yogurts, etc). It has been argued that increased consumption of fructose in the diet may be a contributing factor to the dramatic increase in obesity in the U.S. and developing countries, because fructose, unlike glucose, does not stimulate the production and secretion of insulin from the pancreatic Beta cells.

A. Carbohydrate consumption data

1. Monosaccharides – glucose, fructose, galactose
2. Disaccharides – sucrose . lactose, maltose

3. Polysaccharides – starch, glycogen, fiber

B. Metabolic processes of carbohydrates

1. discuss differences in absorption and metabolism of sucrose, glucose, and fructose
2. differences between high fructose corn syrup (HFCS) and sucrose

There is no scientific evidence to suggest that high fructose corn syrup is uniquely responsible for people becoming obese. Obesity results from an imbalance of energy consumed vs energy expended.

- Corn syrup: 100% glucose, is used as a thickening agent
- High fructose Corn Syrup: a sweetening agent made from 42% or 55% fructose and the rest from glucose
- Sucrose (table sugar): a sweetening agent made of 50% fructose, 50% glucose

3. Sugar and its association with chronic diseases

A. Diabetes: Research evidence shows the leading cause of diabetes is obesity, advancing age, and heredity. All caloric sweeteners trigger an insulin response in the body. In fact, table sugar, honey, and high fructose corn syrup trigger about the same insulin release because they contain nearly equal amounts of fructose and glucose.

The relationship between dietary carbohydrates and insulin resistance (a risk factor for diabetes mellitus, ischemic heart disease, and hypertension) is not clear based on available research (7). In two studies based on a large, prospective study of U.S. women, sucrose and carbohydrate intake were not associated with an increased risk of diabetes (6,27). However, based on the same population, associations were found between a diet with high glycemic load[2] (26) and high intake of refined grains (21) and the risk of diabetes. The general consensus, based on epidemiological studies, is that sugar intake alone is not associated with the development of diabetes mellitus. Sugars fed at levels equivalent to those consumed by the U.S. population do not produce adverse glycemic effects in non-diabetics (23). The effects of sugar intake on glucose tolerance, insulin levels, and plasma lipids are confounded by other dietary components. The American Diabetes Association has also acknowledged, in its nutrition recommendations for people with diabetes, that there is no evidence that refined sugars such as sucrose or high fructose corn syrup behave any differently from other types of simple carbohydrates (1).

B. Heart Disease

The Sugars Task Force of the U.S. Food and Drug Administration (29) presented a comprehensive review of epidemiological, clinical, and animal studies dealing with the relationship between sugar intake and heart disease or risk factors for heart disease (14). The report concluded that at current levels of consumption, sugar is not an adverse risk factor in heart disease. The same conclusion was made by the National Research Council in its report on chronic disease risk (23). There is no conclusive evidence that dietary sugar is an independent risk factor for coronary artery disease in the general population. However, hypertriglyceridemia[3] and central fat distribution,[4] consequences of abnormal glucose tolerance and diabetes mellitus, are independent risk factors for coronary heart disease (8). A 1996 randomized study of 32 hypertriglyceridemic patients provided evidence that an "extrinsic sugar-free" diet significantly lowers abnormally elevated plasma triglyceride levels (28). Evidence also suggests that insulin resistance and compensatory hyperinsulinemia[5] have major roles in the regulation of blood pressure in subjects predisposed to hypertension due to hereditary or environmental factors, possibly mediated by activity of the sympathetic nervous system. But there are multiple metabolic abnormalities associated with hyperinsulinemia in hypertensive patients that increase the risk of coronary heart disease (24).

4. Dietary Therapy

Despite popular belief that sugar causes obesity, a number of studies show an inverse relationship between reported sugar consumption and degree of overweight (10,11,20,25). An increase in the percentage of calories from sugar is, by definition, associated with a decreased consumption of calories from fat. Obesity is basically a consequence of higher energy intake than energy expenditure, where excess calories are stored as fat (5). The type of calories consumed is the subject of much study in obesity research. For instance, extra calories consumed as sugar cause an appropriate compensatory increase in carbohydrate oxidation (metabolism of carbohydrates for energy), whereas extra calories consumed as fat do not (17). Simply stated, obesity results from energy intake in excess of energy requirements. Many factors contribute to obesity, but evidence does not single out dietary sugar as a cause (25).

A. Dietary therapy involves instruction on how to adjust a diet to reduce the number of total calories eaten.

B. Reducing calories moderately is essential to achieve a slow but steady weight loss, which is also important for maintenance of weight loss.

C Strategies of dietary therapy include

1. teaching about calorie content of different foods
2. food composition (fats, carbohydrates, and proteins)
3. reading nutrition labels
4. types of foods to buy

5. how to prepare foods

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