AHA Conference Proceedings

Translation and Implementation of Added Sugars Consumption Recommendations

A Conference Report From the American Heart Association Added Sugars Conference 2010

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Background**—**A 2-day forum was convened to (1) discuss ways to translate the 2009 American Heart Association added sugars recommendations into actions in areas such as regulation, food labeling, nutrient content claims, and practical application in the American diet; (2) review surveillance methodology and metrics for tracking and understanding the impact of reducing added sugars in the diet; and (3) initiate the development of a framework for future collaboration to help Americans implement science-based guidance relative to added sugars.

Methods and Results**—**More than 100 multinational participants representing scientists from academia and government and stakeholders engaged in food production, development, and processing, food manufacturing and servicing, food and nutrition policy, and nutrition recommendations for the public attended the conference. Presentations included definitions and examples of added sugars, current US and international added sugars perspectives, added sugars in diets of individuals and in the food supply, food technology behind added sugars, added sugars and health, food manufacturer perspectives, added sugars food-labeling considerations, and examples of positive approaches to improve eating behaviors and the food environment. Facilitated breakout sessions were conducted after the plenary sessions to allow participants to contribute their expertise and thoughts.

Conclusion**—**The American Heart Association Added Sugars Conference is the first step in an important process that facilitates collaboration across science, public health, and industry to foster innovation, partnerships, policy, and implementation of new products and services for the benefit of the health and well-being of the American public. Science has advanced in the area of added sugars and health, creating mounting pressure to use better methods for translation and dissemination of the science for consumer education and for food companies to respond by producing foods and beverages with fewer added sugars. The new science also reinforces the importance of preventing, rather than simply treating diseases, especially overweight and obesity, diabetes mellitus, high blood pressure, heart disease, and stroke. Reducing added sugars consumption is a good target for addressing obesity, along with other sources of excess calories. However, the potential unintended consequences of substituting added sugars with ingredients that may not reduce calories and of increasing other macronutrients or food groups that may not result in a net health gain must be considered. Although there are many challenges to incorporating added sugars to the food label as was discussed during the conference, disclosure of added sugars content on food and beverage labels is an essential element in consumer education and can provide the information and motivation for making healthier food choices. This conference

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demonstrated the value of interactive dialogue among multiple sectors and disciplines. More disciplines should be at the table to bring expertise to discuss cross-cutting issues related to public policies and offer diverse insights to finding a solution. (*Circulation*. 2010;122:2470-2490.)

Key Words: AHA Conference Proceedings ■ diet ■ sugar ■ carbohydrate ■ nutrition ■ nutritional sciences ■ food labeling

On May 5 to 6, 2010, in Washington, DC, the American Heart Association (AHA) convened >100 multinational scientists from academia and government and stakeholders engaged in food production, development, and processing, food manufacturing and servicing, food and nutrition policy (regulation and legislation), and nutrition recommendations for the public to participate in a conference focused on issues surrounding added sugars. The AHA published a scientific statement in August 2009[1] providing specific guidance on limiting the consumption of added sugars and identifying data on the relationship between excess added sugars intake and metabolic abnormalities, adverse health conditions, and shortfalls in essential nutrients. This conference provided a public forum for reinforcing and further discussing the implications for these findings.

Added sugars are defined as sugars and syrups added to foods during processing or preparation, and sugars and syrups added at the table. The 2001 to 2004 National Health and Nutrition Examination Survey (NHANES) database estimated the average intake of added sugars for all Americans at the time was 22.2 teaspoons per day or about 345 calories,[2] far more than the recommended limit proposed in the AHA scientific statement.

It is challenging for Americans to accurately monitor their intake of added sugars and to recognize the foods and beverages that contribute the greatest amounts of added sugars. Calculating added sugars intake can be difficult because the US Food and Drug Administration (FDA) does not currently require food companies to differentiate added sugars from naturally occurring sugars on the Nutrition Facts label. The AHA has submitted public comments to the FDA encouraging the Agency to revise the Nutrition Facts label to include disclosure of added sugars.[3]

The interactive and collaborative forum allowed stakeholders to engage in conversation, receive updates from experts in the field, and share current data. The objectives included (1) discussing ways to translate the AHA's added sugars recommendation into action in areas such as regulation, food labeling, nutrient content claims, and practical application in the American diet; (2) reviewing surveillance methodology and metrics for tracking and understanding the impact of reducing added sugars in the diet and health outcomes; and (3) initiating development of a framework for future collaboration to help Americans implement science-based guidance relative to added sugars.

Definitions and Examples of Added Sugars

Common terms used around the world to categorize sugars include:

- Simple carbohydrates (sugars): monosaccharides and disaccharides
- Naturally occurring (intrinsic) sugars such as glucose, fructose, and sucrose in fruits and lactose in dairy products
- Added (extrinsic) sugars; that is, sugars and syrups added to foods during preparation or processing, or added at the table
- Total (naturally occurring and added) sugars

Names for added sugars that appear on food label ingredient lists include agave nectar, brown sugar, corn sweetener, corn syrup, dextrose, evaporated cane juice, fructose, fruit juice concentrates, glucose, high-fructose corn syrup (HFCS), honey, invert sugar, lactose, maltose, malt syrup, maple syrup, molasses, raw sugar, sucrose, sugar, and syrup. More complex carbohydrates — glucose-containing oligo- and polysaccharides — are not considered added sugars by the US Department of Agriculture (USDA).[4]

According to the USDA, the teaspoons per capita availability of sugars in the United States has increased since 1970, peaking around 1999 (Figure 1).[5] HFCS became widely available after 1970 and replaced about half of the refined cane and beet sugars (sucrose) as a source of sugars. It is often overlooked that HFCS has been in decline since 1999. Worldwide, sucrose is the overwhelming sugar choice.[6]

Table 1 shows that food groups contributing >5% of the added sugars in the American diet based on an analysis of NHANES 2005 to 2006 were sodas/energy/sports drinks (35.7%), grain-based desserts (12.9%), fruit drinks (10.5%), dairy desserts (6.6%), and candy (6.1%).[7]

Added Sugars Recommendations

From the 2002 Dietary Reference Intakes Macronutrient Report to the 2005 Dietary Guidelines for Americans

In the United States, the concerns about added sugars focus not so much on sugar itself as a contributor to dental caries, because this can be readily addressed with proper dental care. Of greater concern is sugar's contribution to energy intake above requirements and decreased micronutrient intake or nutrient dilution. Most added sugars are in energy-dense, nutrient-poor foods, whereas naturally occurring sugars are primarily found in fruits, milk, and dairy products that contain essential micronutrients. As foods with added sugars are substituted for more nutrient-dense foods, nutrient dilution can occur.

As indicated in the 2002 Dietary Reference Intake Macronutrient Report, a number of cross-sectional studies conducted between 1970 and 2000 found a significant negative association between total and added sugars intakes and the body mass index (BMI).[8] The report noted that "there is no clear and consistent association between increased intake of added sugars and increased rates of obesity" and "published reports disagree about whether a direct link exists between the trend toward increased intakes of sugars and increased rates of obesity." Modeling of micronutrient intakes against the percentage of energy from added sugars found that the group of Americans consuming 5%

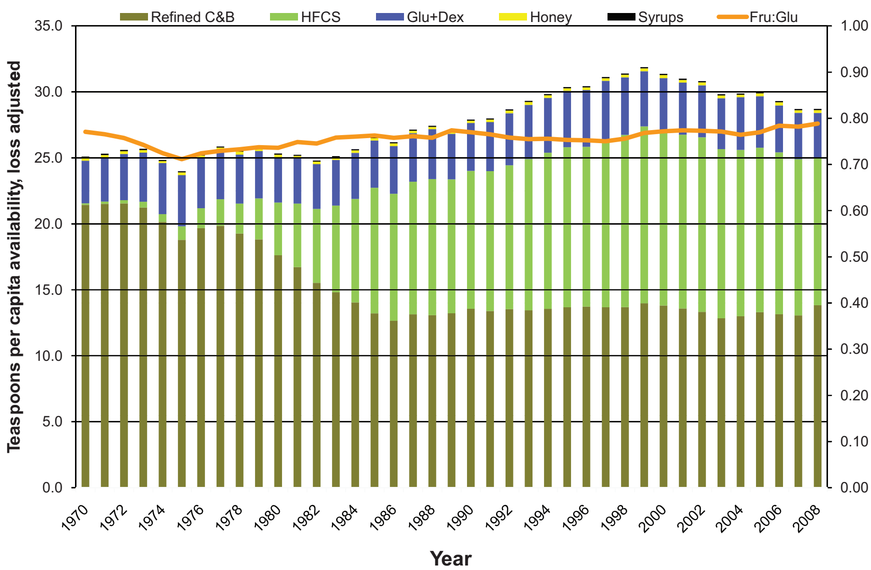

Figure 1. US per capita availability of sugars. Refined C&B indicates refined cane and beet sugar; HFCS, high-fructose corn syrup; Glu+Dex, glucose and dextrose; Fru:Glu, fructose to glucose ratio. Source: Sugars and Sweets Datasets. US Department of Agriculture Economic Research Service.[5] The Fru:Glu values were calculated from these datasets.

to 10% of energy from added sugars had the highest amounts of micronutrient intakes and micronutrient intakes significantly decreased once added sugars consumption exceeded 25% of energy.[9] Therefore, the 2002 report recommended that added sugars not be more than 25% of total energy intake; this recommendation was based on micronutrient intake data, not on associations with BMI.

In the early 2000s, an increasing number of longitudinal studies showed an increase in weight gain because of excess calorie consumption of added sugars from certain sources.[10–13] Therefore, the 2005 Dietary Guidelines Committee based its added sugars recommendation on the concept of discretionary calorie allowance. Discretionary calories were described as the difference between total energy requirements and the energy consumed to meet recommended nutrient intakes through diet. Note, however, that two thirds of US adults are sedentary and overweight or obese and many others are not meeting their essential micronutrient requirements through their usual dietary intake. Thus, most Americans have low or no discretionary calorie allowances.

Table 1. Major Sources of Added Sugars in the American Diet, by Age, NHANES 2005–2006

		All Persons	2–18 Years of Age	19+ Years of Age
Sample size		8272	3553	4719
Mean intake of added sugars (tsp)		21	23	20
Rank*	Food Group†‡			
1	Soda/energy/sports drinks	**35.7**	**31.8**	**37.1**
2	Grain-based desserts	**12.9**	**10.9**	**13.7**
3	Fruit drinks	**10.5**	**15.0**	**8.9**
4	Dairy desserts	**6.6**	**7.9**	**6.1**
5	Candy	**6.1**	**6.8**	**5.8**
6	Ready-to-eat cereals	3.8	6.4	2.9
7	Sugars/honey	3.5	1.4	4.2
8	Tea	3.5	2.1	4.0
9	Yeast breads	2.1	1.9	2.2
10	*Syrups/toppings*	*1.9*	*2.8*	*1.5*

*Rank for all persons only. Columns for other age groups are ordered by this ranking. The top 5 food groups for each age group are bolded.

†Specific foods contributing at least 2% of added sugar for all persons in descending order are listed. Specific foods contributing at least 2% of added sugar for any given subgroup are then also listed in *italics*.

‡Specific foods contributing at least 1% of added sugar for all persons in descending order: syrups/toppings.

Source: National Cancer Institute.[7]

AHA Recommendation

Given that improving diet has tremendous potential to prevent disease and improve cardiovascular health, the AHA Nutrition Committee released in August 2009 a scientific statement that, for the first time, quantified the consumption recommendation for added sugars.[1] The AHA recommends reductions in added sugars with an upper limit of 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, or about 6 teaspoons of added sugars a day for women and 9 teaspoons a day for men. As a reference, one 12-ounce can of regular soda contains 140 calories (about 9 teaspoons) from added sugars, one 16-ounce bottle of sugar-sweetened iced tea contains 184 calories (about 11.5 teaspoons) from added sugars, and one regular-sized chocolate candy bar contains 120 calories (about 7.5 teaspoons) from added sugars.

People can choose to use their discretionary calories in several different ways, including eating larger portions of foods from a food group above their daily recommendations, selecting a higher-calorie form of a food that is higher in fat or contains added sugars, adding fats or sweeteners to the leanest versions of foods, or choosing to consume foods and beverages that are mostly fat, added sugars, or alcohol. The specific limit recommended for consumption of added sugars can vary based on energy needs and age, sex, weight, height, and physical activity level. The AHA recommendation focuses on all added sugars, without singling out any particular types such as HFCS.

In the Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 2010, the concept of discretionary calories was dropped. The report cited that Americans should "significantly reduce intake of foods containing added sugars and solid fats," especially in the form of sugar-sweetened beverages, "because these dietary components contribute excess calories and few, if any, nutrients."[14]

International Perspective

There is no universally accepted definition of the term "added sugars" and other terms are preferred by some international organizations and in some countries. For example, the "Choices International Program" suggests that fruits and fruit concentrate added to foods and beverages during processing and home preparation should not be regarded as added sugars. The World Health Organization (WHO) prefers the term "free sugars," defined as all mono- and disaccharides added to foods by the manufacturer, cook, and consumer, plus sugars naturally present in honey, syrup, and fruit juices.[15] In the United Kingdom, the terms extrinsic sugars, nonmilk extrinsic sugars, and intrinsic sugars are preferred.[16] In addition, terms such as discretionary sugars, refined sugars, and natural sugars are used without specific definitions in some countries. Not surprisingly, therefore, recommendations differ from country to country.

Some countries offer quantitative recommendations. For example, Italy recommends that "simple sugars not exceed 10% to 12% of total energy for adults to 15% to 16% of total energy for children."[17] Other countries offer qualitative recommendations. South Africa suggests that "sugars be used sparingly." When quantitative recommendations have been made, they are primarily based on the relationship between dental caries and increasing sugar consumption.

The WHO Technical Report states that a "convincing" positive relationship exists between the frequency and amount of free sugars and dental disease, and that sugar-sweetened soft drinks and fruit juices "probably" increase the risk of obesity.[18] The report does not explicitly state any relationship between added sugars and type 2 diabetes mellitus and cardiovascular disease.

Most recently, in 2010, the European Food Safety Authority (EFSA) published a scientific opinion that states "there is some evidence that sugar-sweetened beverages might contribute to weight gain" but "there are insufficient data to set up an upper limit for (added) sugar intake."[19] EFSA also concluded that the evidence was insufficient to set an upper limit for added or total sugars on the basis of a risk reduction of dental caries, micronutrient shortfalls, serum triglycerides, cholesterol, and glucose and insulin response. A number of health organizations, including the WHO, disagree with this scientific opinion and recommend looking into setting guidance to reduce added sugars intake.[20] The Diet and Health Subgroup of the newly formed WHO Nutrition Guidance Advisory Group has been charged with the responsibility of developing evidence-based international recommendations related to the effects of sugars intake on health.

Added Sugars in the Food Supply

Measuring Added Sugars

Added sugars can be assessed at multiple levels. Although most assessments are made at the individual level to capture dietary choices, assessments of the food environment can also be made to evaluate the amount of added sugars available to a community or in the entire food supply. Methods used to assess individual dietary intakes are mostly self-reported, including food records (ie, a respondent writes down or records everything he/she ate and drank over a period of time), 24-hour dietary recalls (ie, a respondent tells an interviewer everything he/she ate and drank over the past 24 hours), and food frequency questionnaires (ie, a participant answers questions about how many times he/she ate and drank different types of foods and beverages over the past prespecified time period). Each assessment method has its own strengths and weaknesses.

Self-reported intake measures may not be completely valid because of error related to bias and memory. A more objective measure such as urinary sucrose and fructose in a 24-hour urine sample may be a promising biomarker for sugars intake, but it is impractical for large population-based research and is not indicative of *added* sugars per se.[21]

Regardless of the assessment method, individual food intake data must be evaluated for dietary components of interest by use of food and nutrient databases. In the United States, the MyPyramid Equivalents Database from the USDA provides the food equivalents per 100 g for major food groups, such as total vegetables, total fruits, discretionary solid fat, and added sugars.[22] Food components are disaggregated from mixtures and foods are placed into one or more of the 32 food groups. In the MyPyramid Equivalents Database, units are set as "equivalents," a comparable amount of various foods used as a standard of comparison for food groups. For added sugars in a particular food, the unit is the amount equivalent to 1 teaspoon of sucrose or white sugar.

At the community level, the amount of added sugars can be determined by identifying the set of foods under consideration offered or sold in establishments, such as grocery stores, restaurants, and schools, linking to survey databases, and assigning MyPyramid Equivalents Database values for the foods. To assess added sugars in the macro food environment, the flow of agricultural commodities through the US marketing channels adjusted for food spoilage, plate waste, and other losses is used to estimate the amount of added sugars per capita in the population available for consumption.[23]

Added Sugars in Diets of Individuals and the Food Environment

The AHA recommends an added sugars consumption limit of half of the discretionary calorie allowance. The majority of American adults and children currently exceed the recommended consumption limit.[24] More specifically, >90% of American children aged 2 to 8 are getting more than half of their discretionary calorie allowance from added sugars. The top 5% of American teenage boys aged 14 to 18 years consume >1000 calories from added sugars daily.

The Healthy Eating Index-2005 (HEI-2005), developed jointly by the USDA and the National Cancer Institute, assesses and scores various components of the diet simultaneously to give an indication of diet quality (Table 2).[25] HEI-2005 includes 12 components, with a total score ranging from 0 to 100. Among the components is calories from Solid Fats, Alcoholic Beverages, and Added Sugars (SoFAAS),

Table 2. HEI-2005 Components and Associated Standards*

Component	Standard for Maximum Score	Standard for Minimum Score of Zero
Total fruit (includes 100% juice)	≥0.8 cup equiv. per 1000 kcal	No fruit
Whole fruit (not juice)	≥0.4 cup equiv. per 1000 kcal	No whole fruit
Total vegetables	≥1.1 cup equiv. per 1000 kcal	No vegetables
Dark green and orange vegetables and legumes†	≥0.4 cup equiv. per 1000 kcal	No dark green or vegetables or legumes
Total grains	≥3.0 oz equiv. per 1000 kcal	No grains
Whole grains	≥1.5 oz equiv. per 1000 kcal	No whole grains
Milk‡	≥1.3 cup equiv. per 1000 kcal	No milk
Meat and beans	≥2.5 oz equiv. per 1000 kcal	No meat or beans
Oils§	≥12 g/1000 kcal	No oil
Saturated fat	≤7% of energy‖	≥15% of energy
Sodium	≤0.7 g/1000 kcal[5]	≥2.0 g/1000 kcal
Calories from solid fats, alcoholic beverages, and added sugars (SoFAAS)	≤20% of energy	≥50% of energy

*Intakes between the minimum and maximum levels are scored proportionately, except for Saturated Fat and Sodium (see note ‖).

†Legumes counted as vegetables only after Meat and Beans standard is met.

‡Includes all milk products, such as fluid milk, yogurt, and cheese, and soy beverages.

§Includes nonhydrogenated vegetable oils and oils in fish, nuts, and seeds.

‖Saturated Fat and Sodium get a score of 8 for the intake levels that reflect the 2005 Dietary Guidelines, <10% of calories from saturated fat and 1.1 g of sodium per 1000 kcal, respectively.

Source: Healthy Eating Index-2005 fact sheet, National Cancer Institute.[25]

with a maximum score of 20 if they comprise no more than 20% of energy and a minimum score of 0 if they are at least 50% of energy. SoFAAS carry twice as much weight as the other components because they not only contribute "empty" calories but tend to displace foods with essential nutrients as well. The US population gets a poor HEI-2005 total score of 58 of 100 (Figure 2), including a SoFAAS score of 10, which represents about 35% of calories coming from SoFAAS. This population average represents far more calories from solid fats, added sugars, and/or alcohol than the allowance permits.

At the community level, energy-dense snack foods are widely available and easily accessible at retail stores, even those that are not primarily food stores.[26] A recent study estimated that such snack foods are available at 96% of pharmacies and 94% of gasoline stations and that about one-third of retail stores sell candy and 20% sell sugar-sweetened beverages.[26] Although not its traditional use, the HEI-2005 methodology was used to evaluate the "dollar" menu (a select set of foods that each costs $1) at a fast-food establishment.[27] The analysis reported that the total HEI-2005 score for the "dollar" menu is a very poor 43 of 100, lower than the US population score of 58. The score for SoFAAS is nearly zero, because nearly 50% of calories in the dollar menu are from SoFAAS.

At the macro level in the US food supply, the HEI-2005 score is 55 of 100, close to the score of 58 for the American diet. From 1970 to 2007, the quality of the US food supply with regard to calories from SoFAAS remained relatively unchanged, with only a little improvement since 2005.[27] The HEI-2005 score for SoFAAS was close to 10 and more than half of the SoFAAS calories came from added sugars. Between 1970 and 2000, per person daily consumption of full-calorie soft drinks increased 70%, from 7.8 ounces to 13.2 ounces.[28] Overall, added sugars and energy-dense foods are ubiquitous in the food environment.

Food Technology Behind Added Sugars

Role of Sugars in Foods

Chemical definitions of sugars include monosaccharides like fructose and glucose, and disaccharides like sucrose, lactose, and maltose. Regular corn syrup contains monosaccharide glucose, disaccharide maltose, and mixtures of oligosaccharides—glucose polymers between 3 and 9 repeating units (degree of polymerization 3 to 9)—plus polysaccharides of glucose above degree of polymerization 10, depending on the product. Regular corn syrup thus contains no fructose; it is not considered an added sugar by the USDA.[4,29]

Sucrose (glucose bonded to fructose) is readily hydrolyzed to monosaccharides during digestion or in acidic foods and beverages. Fructose and glucose are structural isomers with different functional properties. For example, glucose has far less sweetness intensity than fructose, with about 65% the sweetness of sucrose in the dissolved state.[30] Most of the added sugars commonly used today, including sucrose, HFCS, honey, and fruit juice concentrates, contain about half fructose and half glucose, as do the naturally occurring intrinsic sugars in most fruits and vegetables (Table 3). Agave nectar contains the most fructose, nearly 75%, comparable to the ratio in pears. Functional properties depend on the composition of the intact sweetener (mono- or disaccharide) in the food or beverage, and metabolic properties depend on the proportions of monosaccharide (free fructose and glucose) that reach the bloodstream after digestive hydrolysis. Added sugars are similar in terms of the composition, fructose-to-glucose ratio, sweetness, absorption, and metabolism, and reformulation by substituting one added sugar for another may not significantly change the nutritional value.

Sugars are used in foods for functions beyond sweetness. As an example, sugars are added to beverages to balance tartness, for flavor enhancement, and to improve mouth feel. In dry mixes, crystallized sugar is needed; therefore, sucrose is used. Compared with sucrose, HFCS has the advantages of wide availability, price stability, ease of handling as a liquid, along with acid stability in food and beverage products over the time between manufacture and consumption. In candies, sucrose is the favorite for properties such as recrystallization (glassy surface and texture) and inversion (cherry cordials). Sugars are also added for moisture management to improve palatability and retard spoilage, flavor enhancement, and acid balance. In baked goods, sugars are used for functions such as fermentation, browning, and providing volume and structure.

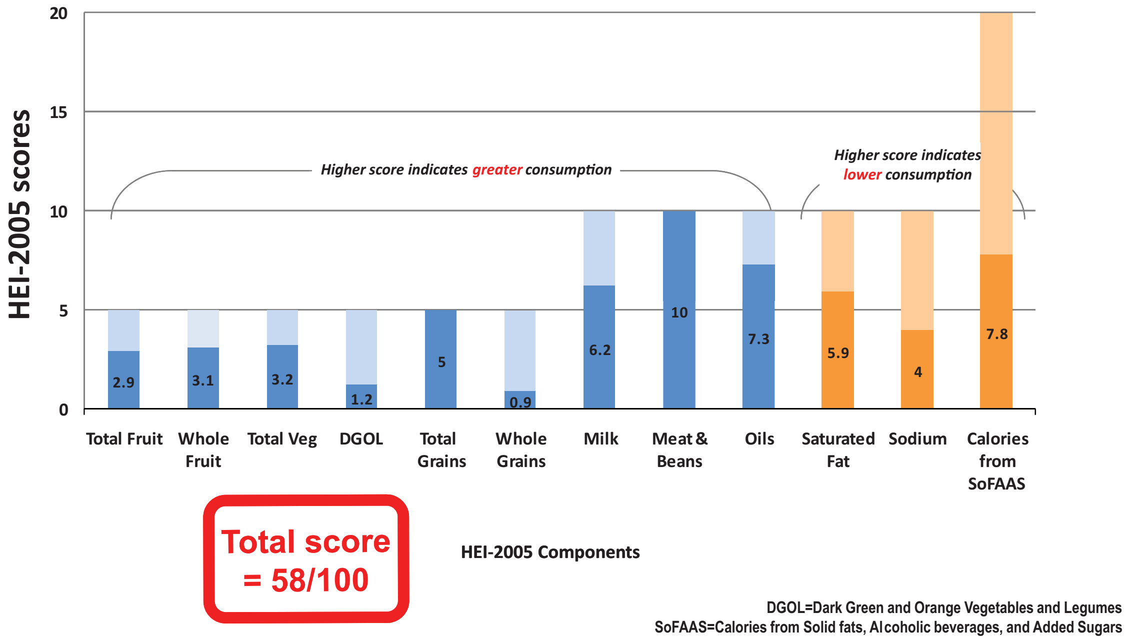

Figure 2. US population: HEI-2005 scores. Source: National Cancer Institute - National Health and Nutrition Examination Survey Data, 2003–2004.[25]

In dairy foods, sugars are added as a fermentation source, for flavor enhancement, freezing-point balance in ice creams, and preservation of frozen-fruit integrity. In cereals, sugars are added for properties such as browning, volume, structure, texture, and flavor enhancement.

Sugar Substitutes and Functionality

In the past decades, consumers using low-calorie, sugar-free foods and beverages have almost tripled, from 78 million Americans in 1986 to 194 million in 2007.[31] Sugar substitutes help to expand food choices, control carbohydrate and calorie intake, manage weight, control blood glucose levels in people with diabetes mellitus,[32] reduce the potential for dental caries, and enhance the stability and delivery of pharmaceuticals.

Sugar substitutes include (1) intense sweeteners, with sweetness ranging from about 200 to 8000 compared with 100 for sucrose; (2) polyols or sugar alcohols; and (3) fructosaccharides or oligofructans, fructose polymers from inulin produced by many plants. Common intense sweeteners used in the United States include aspartame, saccharin, sucralose, and, the latest, stevia. Because intense sweeteners lack bulk, product reformulation needs to consider the loss in granulation and texture in foods and viscosity and mouth feel in beverages with the replacement of sugar by intense sweeteners. Sugar alcohols, including erythritol, xylitol, sorbitol, and maltitol, are derived from sugar and can serve as sugar replacers because they are close in sweetness and bulk to sucrose, are not associated with dental caries, and are lower in calories. However, they lack the crystallization ability and have potential laxative side effects in high concentrations. Oligofructans are prebiotic dietary fibers used to provide mouth feel and viscosity in low-sugar dairy products and

Table 3. Added Sugars and Their Carbohydrate Compositions

Type of Sugar	Glucose	Sucrose	High Fructose Corn Syrup	Honey	Fruit Juice Concentrates*	Agave Nectar†
Monosaccharides						
Fructose (Fru)			√	√	√	√
Glucose (Glu)	√		√	√	√	√
Disaccharides						
Sucrose (Fru-Glu)		√		√	√	
Oligosaccharides			Not considered added sugars by USDA			
Corn syrup (Glu-Glu-Glu-. . .)						

*USDA National Nutrient Database for Standard Reference, Release 22. Available at: http://www.ars.usda.gov/ba/bhnrc/ndl. Accessed August 13, 2010.

†Colibree Company (2010). Introduction to agave nectar and product profile. Available at: http://www.agavenectar.com/product.html. Accessed August 4, 2010.

retain moisture in baked goods. They are also used in combination with intense sweeteners to improve the sweetness profile and reduce the aftertaste.

When sugars are removed from a product, they need to be replaced with a sugar substitute or a combination of sugar substitutes for product optimization. The final decision of whether to use sugar substitutes depends on government regulatory status, and the functional and sensory properties, nutritional impact, and availability and cost feasibility for practical application in manufacturing.

Challenges, Successes, and Unintended Consequences of Reducing Sugars Added to Foods and Beverages

Sugars are added to foods and beverages for various reasons such as flavor, texture, and as humectants; therefore, reducing the levels of sugars added can have effects on the safety, texture, and chemistry of the product. Regarding safety, stability and reaction rates are functions of water activity and moisture content. When sugars are added, the water activity is reduced. Therefore, bacteria and mold growths are decreased and product stability is increased.

In terms of texture, sugars are added to affect the viscosity, crispness, and hardening and softening of the product. Specifically, when sugars are added to foods, the glass transition temperature is reduced so that, even with more solids, the product can stay soft. Therefore, reducing sugars added to foods can increase the breaking force and cause the product to become more brittle. This could be an opportunity for a more nutritious product as the product undergoes reformulation. For example, in the case of cereals, fibers may be added as sugars are reduced to increase the breaking strength while creating an overall healthier product.[33] In bread, sugars are added to reduce starch crystallinity formation to extend the shelf life.[34] Sugars and sugar substitutes also have variable interaction with fat replacers. For example, in reduced-fat cookies, replacing sucrose with a sugar alcohol such as sorbitol can benefit the product properties by lowering the hardness and brittleness.[35]

In terms of chemistry, reducing sugars affects the rate of color change and the loss of nutrients. Most sugars have a browning effect, which is desired in some products, such as bread, but not so in some others, such as milk powder. For example, reducing HFCS in a protein bar and substituting it with maltitol can help maintain its clarity and available lysine, an essential amino acid.[36] However, the laxative effect of sugar alcohols such as maltitol needs to be considered depending on the amount and frequency of consumption. The selection of added sugars and sugar substitutes affects the product texture, stability, and nutritive value. Therefore, in many cases, the reduction of sugars added will require a complete redesign, not a simple reformulation of the product.

Added Sugars and Health

The following section covers the research reviewed at the AHA Added Sugars Conference. It does not attempt to be a complete review of the totality of the science.

Sugar-Sweetened Beverages (SSBs) and Health: Selected Epidemiological Studies in Adults

Many studies have been conducted to examine the effects of SSBs on the relationship to energy intake and weight, with a limited number of studies (or emerging research) on the association with coronary heart disease (CHD), hypertension, obesity, diabetes mellitus, and triglycerides and high-density lipoprotein cholesterol (HDL-C). The 24-year follow-up in the Nurses' Health Study (n=88 520) found that consumption of SSBs is associated with a higher risk of CHD in women, even after accounting for other risk factors for CHD or unhealthful lifestyle or dietary factors.[37] In this study, women who consumed >1 SSB a day had a higher risk of CHD (Figure 3). SSBs increased the risk of CHD above and beyond obesity, with obesity accounting for about half of the increased risk and SSB consumption more than once a day accounting for the other half. In the Framingham Heart Study, consumption of at least 1 soft drink a day significantly increased the odds of developing hypertension.[38]

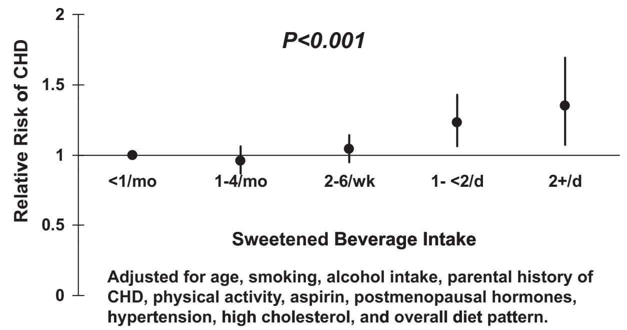

Figure 3. Sweetened beverages and risk of CHD: 24-year follow-up in the Nurses' Health Study (n=88 520).[37]

Regarding SSB consumption and weight gain, the 8-year (from 1991 to 1999) Nurses' Health Study II (n=91 249) found that the level of SSB consumption was predictive of the increase in the mean body weight over time.[39] Nurses who increased their consumption of SSBs to more than once a day from 1995 to 1999 compared with 1991 to 1995 gained significantly more weight than nurses who kept their consumption of SSBs to once a day or less during the same time frame. Nurses who stopped drinking high (more than once a day) levels of SSBs stopped gaining weight. Across multiple populations, the black Women's Healthy Study and Singapore Chinese Health Study had similar findings on the change in SSB consumption and magnitude of weight gain over time.[40,41]

Overall, a meta-analysis of 88 cross-sectional and prospective studies found that higher intake of soft drinks was associated with greater energy intake and a higher body weight.[42] Separately, a meta-analysis of 6 studies that added nutritively sweetened beverages (eg, SSBs, soft drinks) to peoples' diets showed dose-dependent increases in weight.[43] The analysis also found that reducing nutritively sweetened beverage consumption in adults who were overweight or obese is effective for reducing BMI. However, when studies were included that had subjects with normal body weight, there was no overall effect on BMI. Taken together, the findings from epidemiological studies and clinical trials show that SSBs contribute to weight gain, and their reduction in the diet produces weight loss in those who are overweight or obese.

Regarding SSB consumption and type 2 diabetes mellitus, the Nurses' Health Study II concluded that higher consumption of SSBs is associated with a greater magnitude of weight gain and an increased risk for the development of type 2 diabetes mellitus in women, possibly by providing excessive calories and large amounts of rapidly absorbable sugars.[39] Women consuming ≥1 sugar-sweetened soft drinks per day had a relative risk (RR) of type 2 diabetes mellitus of 1.83 (95% confidence interval (CI), 1.42 to 2.36; $P<0.001$ for trend) compared with those who consumed <1 of these beverages per month. Similarly, consumption of fruit punch was associated with increased diabetes mellitus risk (RR for ≥1 drink per day compared with <1 drink per month, 2.00; 95% CI, 1.33 to 3.03; $P=0.001$). As in CHD, about half of the increase in the incidence of type 2 diabetes mellitus was attributable to the consumption of SSBs and above and beyond obesity.

Across multiple populations, consumption of SSBs was found to be positively associated with incidence of type 2 diabetes mellitus.[40,41] In the black Women's Health Study, African American women who consumed ≥2 soft drinks per day had a 24% increase in incidence relative to women who drank <1 soft drink per month.[40] A similar association was observed for sweetened fruit drinks, with a 31% increase observed for ≥2 drinks per day relative to <1 drink per month. However, in this study, the association of diabetes mellitus with soft drink consumption was almost entirely mediated by BMI, whereas the association with fruit drink consumption was independent of BMI. The Singapore Chinese Health Study found that people consuming ≥2 soft drinks per week had a RR of type 2 diabetes mellitus of 1.42 compared with those who rarely consumed soft drinks.[41]

Regarding SSB consumption and gestational diabetes mellitus, it was found that consuming SSBs at least 5 times per week was associated with a modest risk of gestational diabetes mellitus in US women compared with women consuming 0 to 3 servings per month (RR 1.16, 95% CI, .98 to 1.37; $P=0.06$ for trend).[44]

A cross-sectional analysis of NHANES 1999 to 2006 found that increased added sugars intake was associated with lower HDL-C and higher triglyceride levels among US adults.[45] Adults consuming ≥25% of energy from added sugars had a mean HDL-C of 47 mg/dL and those consuming <5% of energy from added sugars had a mean HDL-C of 58 mg/dL.

Epidemiological Aspects of Added Sugars and Obesity and Diet Quality in Children

The prevalence and severity of overweight are increasing in children and adolescents. With the increase in the prevalence and severity of obesity, many problems commonly associated with adults, including type 2 diabetes mellitus, hypertension, and dyslipidemia, have also increased in prevalence among young people.[46–48]

Most childhood obesity is a result of energy imbalance, with too high a caloric intake and/or too low a caloric expenditure. Data appear to point to a relationship between increases in caloric intake among children and adolescents in recent years and increased consumption of SSBs. In boys aged 2 to 17 years, the average caloric intake increased by 275 calories in 1994 to 1995 compared with 1989 to 1991 and 228 or 83% of the additional 275 calories came from calories related to carbohydrates.[49] Between the 2 time periods, there was a 41% increase in the consumption of soft drinks and a 35% increase in the consumption of fruit drinks. Among the different age groups of children and adolescents, the usual intake of added sugars was the highest among teenage boys aged 14 to 18 years, at 34.3 teaspoons, and teenage girls aged 14 to 18 years, at 25.2 teaspoons.[1] In teenagers aged 12 to 17 years, regular soda consumption accounted for as high as 39% of added sugars in their diets.[50] In addition, the consumption of sugar-sweetened sports beverages by children in nonathletic situations is increasingly common.[51]

In addition to a higher average caloric intake, the childhood diet by food group has changed over time as well. For example, compared with 1977–1978, in 1994–1996, more calories came from sugars and sweets (41 versus 28 calories for girls and 42 versus 30 calories for boys), and SSBs (370 versus 250 calories for girls and 413 versus 264 calories for boys) in the diets of both girls and boys aged 6 to 11 years.[52] Specifically, compared with 1977–1978, in 1994–1996, calories related to carbohydrates increased by 38.1%, from 211.9 in 1977–1978 to 250.0 in 1994–1996, in girls aged 6 to 11 years and by 53.3%, from 226.2 in 1977–1978 to 279.6 in 1994–1996, in boys aged 6 to 11 years.

The relationship of the intake of foods and beverages high in added sugars and overall diet quality was also examined. A nationally representative sample (n=3038) of children and adolescents found that the consumption of sweetened dairy foods and beverages and presweetened cereals had a positive impact on diet quality, some of this is related to the fortification of these foods, whereas the consumption of SSBs, sugars and sweets, and sweetened grains had a negative impact on diet quality.[9] The intake of calcium, folate, and iron decreased as the consumption of SSBs and, to a lesser extent, sugars and sweets and sweetened grains increased (Tables 4 through 8).

Specifically about the potential relationship between SSBs and obesity, in a sample of >2000 children 2.5 years of age who were monitored for 3 years, children who regularly consumed SSBs between meals were two and half times more likely to be overweight compared with nonconsumers.[53] However, total daily consumption of SSBs was not related to overweight status.

Dietary Sugars and Risk Factors for Cardiovascular Disease in Childhood

In children and adolescents, the presence of obesity is strongly associated with the development of hypertension, dyslipidemia, type 2 diabetes mellitus, and the metabolic syndrome (Met S).[54–58] A combination of long-term epidemiological studies and autopsy studies strongly links the presence of these risk factors in childhood to accelerated atherosclerosis, early cardiovascular disease, and premature death.[59–64] The Bogalusa Heart Study, which examines the relationship of antemortem risk factors at autopsy in young people, found that target organ damage occurs in children and is associated with obesity and hypertension.[65]

A preference for sweet-tasting foods underlies high sugar consumption. Diet preferences including the preference for sweetness are present in infancy and persist into adult life. A longitudinal study of non-Hispanic white girls and their parents assessed biennially from age 5 to 15 years by use of 24-hour diet recalls found that soda consumers had higher

Table 4. Measures of Diet Quality by Consumption Level of Sweetened Dairy Products*

	Children Aged 6–11 Years				Adolescents Aged 12–17 Years			
	Non (n=807)	Low >0 <90 g (n=339)	Moderate >90 <180 g (n=412)	High >180 g (n=335)	Non (n=655)	Low>0 <120 g (n=156)	Moderate>120 <240 g (n=195)	High >240 g (n=119)
Calcium (% AI)	87[a]	87[a]	94[b]	99[c]	70[a]	70[a]	79[b]	85[b]
Folate (% DRI)	115[a]	107[b]	112[a]	101[c]	72[a]	74[a]	74[a]	73[a]
Iron (% DRI)	173[a]	158[b]	164[a,b]	161[a,b]	153[a]	156[a]	153[a]	160[a]
Added sugars (g)	81[a]	93[b]	92[b]	93[b]	115[a]	118[a]	120[a]	116[a]

DRI indicates dietary reference intake and AI, adequate intake.

*Sweetened Dairy Products include: flavored milks, flavored yogurts, ice creams, and puddings. Measures are per day, for children 6 to 11 years (n=1913) and adolescents 12 to 17 years (n=1125) adjusted for age, race, sex, and total energy intake.

[a,b,c]Means in a row with different superscripts are significantly different ($P<0.05$).

Adapted with permission from Frary et al.[9]

subsequent soda intake, lower milk intake, higher intakes of added sugars, and lower intakes of vitamins and minerals.[66] Parents powerfully shape children's early experience with food by determining the selection and availability, modeling eating behavior, and including the use of food as reward in the feeding style. In addition, mothers' and children's food preferences are significantly correlated.[67]

Combined dyslipidemia or hyperlipidemia, that is, mild elevation in low-density lipoprotein cholesterol, moderate to severe elevation in triglycerides, and reduced HDL-C, is the dyslipidemic pattern associated with obesity and is the most common referral pattern in pediatric lipid clinics. The prevalence of abnormal lipid levels is strongly correlated with the obesity status.[57] From NHANES data for 1999 to 2006, 42.9% of the adolescents with obesity have at least one lipid abnormality.[57]

Although there is no established definition of Met S in children, hyperinsulinemia is often substituted for type 2 diabetes mellitus in children for the analysis of the prevalence of Met S. The prevalence of Met S is also correlated with obesity. From NHANES 1999 to 2002, the prevalence estimates for Met S for all teens ranges from 2.0% to 9.4% and for teens with obesity from 12.4% to 44.2%.[58] No studies have been done in children to analyze the potential relationship between the consumption of SSBs and the prevalence of Met S.

Treatment of Obesity and Dyslipidemia With Changes in Dietary Sugars in Childhood

A weight loss program, involving a change in the diet composition, is used clinically to treat obesity and/or dyslipidemia in childhood. A limited number of intervention trials reducing energy intake by lowering fat and/or added sugars consumption show an improved cardiovascular risk profile. In a 12-week trial with 30 adolescents with obesity 12 to 18 years of age, randomly assigned to a low-fat diet with no juice or SSB or a low-carbohydrate diet, reductions in the BMI and triglycerides and increases in the HDL-C were seen in both groups, but more so in the low-carbohydrate group.[68]

In a study to examine the effect of decreasing SSB consumption on body weight, 103 adolescents who regularly consumed SSBs were randomly assigned to intervention and control groups. The intervention, 25 weeks in duration, relied largely on home deliveries of noncaloric beverages to displace SSBs and thereby decrease consumption. Change in BMI between the entire intervention and control groups was not significant overall. However, the adolescents in the upper BMI tertile at baseline in the intervention group had a decrease in their average BMI ($-0.64\pm0/23$ kg/m^2) compared with those in the control group, who had an increase in their average BMI ($+0.12\pm0.26$ kg/m^2), a net effect of 0.75 ± 0.34 kg/m^2 that was significant.[69]

Table 5. Measures of Diet Quality by Consumption Level of Presweetened Cereals*

	Children Aged 6–11 Years				Adolescents Aged 12–17 Years			
	Non (n=1021)	Low >0 <15 g (n=106)	Moderate >15 <30 g (n=353)	High >30 g (n=433)	Non (n=772)	Low >0 <30 g (n=118)	Moderate >30 <45 g (n=117)	High >45 g (n=118)
Calcium (% AI)	89[a]	87[a,b]	92[a,b]	95[b]	69[a]	76[b]	77[b]	89[c]
Folate (% DRI)	95[a]	100[a]	114[b]	145[c]	62[a]	76[b]	89[c]	118[d]
Iron (% DRI)	155[a]	164[a]	161[a]	197[b]	141[a]	150[b]	168[c]	222[d]
Added sugars (g)	83[a]	99[b]	94[b]	93[b]	116[a]	120[a]	119[a]	114[a]

DRI indicates dietary reference intake and AI, adequate intake.

*Presweetened cereals include: ready-to-eat presweetened cereals. Measures are per day, for children 6 to 11 years (n=1913) and adolescents 12 to 17 (n=1125) adjusted for age, race, sex, and total energy intake.

[a,b,c,d]Means in a row with different superscripts are significantly different ($P<0.05$).

Adapted with permission from Frary et al.[9]

Table 6. Measures of Diet Quality by Consumption Level of Sugar-Sweetened Beverages*

	Children Aged 6–11 Years				Adolescents Aged 12–17 Years			
	Non (n=351)	Low >0 <240 g (n=546)	Moderate >240 <480 g (n=476)	High >480 g (n=523)	Non (n=140)	Low >0 <360 g (n=266)	Moderate >360 <720 g (n=362)	High >720 g (n=357)
Calcium (% AI)	107[a]	94[b]	89[c]	75[d]	89[a]	82[b]	73[c]	60[d]
Folate (% DRI)	122[a]	114[a]	111[a]	95[b]	86[a]	82[a]	73[b]	60[c]
Iron (% DRI)	183[a]	169[b]	166[b]	147[c]	174[a]	165[a,b]	156[b]	136[c]
Added sugars (g)	58[a]	75[b]	93[c]	122[d]	73[a]	85[b]	114[c]	159[d]

DRI indicates dietary reference intake and AI, adequate intake.

*Sugar-sweetened beverages include: nondiet soft drinks/ades, lemonade. Measures are per day, for children 6 to 11 years (n=1913) and adolescents 12 to 17 (n=1125) adjusted for age, race, sex, and total energy intake.

[a,b,c,d]Means in a row with different superscripts are significantly different ($P<0.05$).

Adapted with permission from Frary et al.[9]

Fructose Versus Glucose

Studies have examined the health effects of fructose versus glucose. Fructose and glucose have biological differences and are metabolized differently, which can be impacted by their presence in combination as found in sucrose, HFCS, honey, and many fruit sugars.[70] In adults with overweight and obesity consuming glucose- or fructose-sweetened beverages providing 25% of energy requirements for 10 weeks, the fructose group had higher abdominal fat than the glucose group, although both groups exhibited similar weight gain.[71] Fructose intake (30% of energy requirements) increased plasma triglycerides more than glucose intake.[72] A cross-sectional study found that increased fructose consumption, ≥7 servings per week of SSBs, was associated with fibrosis severity in patients with nonalcoholic fatty liver disease.[73] A cross-sectional study in adolescents found that increasing consumption of SSBs is associated with higher serum uric acid levels and higher systolic blood pressure.[74]

Overall, there are multiple pathways by which high dietary sugar and, more specifically, SSB consumption can impact health. It is not simply fructose versus glucose or HFCS versus sucrose. It is debatable whether findings about fructose are clinically applicable because the fructose levels used in many studies were much higher than what is consumed in the typical human diet and dietary consumption of fructose is accompanied by other sugars.[75]

Successes, Challenges, and Opportunities in Food Manufacturing (5 Case Studies)

Some of the top sources of added sugars in the United States are regular (full-calorie) soft drinks, sugars and candy, baked goods, dairy products, and cereals.[1] This conference included case studies from The Cola-Cola Company, National Confectioners Association, American Institute of Baking (AIB) International, Innovation Center for the US Dairy, and General Mills to address added sugars from these 5 sources, respectively.

The Coca-Cola Company

Summary of Presentation by Margaret M. Leahy, PhD

The Coca-Cola Company recognizes that the world of beverage consumption is changing and the company is changing too. The changes have taken place in 3 areas: products, policies, and programs. In products, the company has expanded no- and low-calorie offerings. Beverages are essentially the only foods that can be calorie-free (with the exception of chewing gum). The Cola-Cola Company has >150 low- and no-calorie beverage products in the United States and >800 globally, of >3300 beverage products sold in >220 countries around the world. Different sweeteners have different taste profiles preferred by different people. The company has launched many zero-calorie colas in the past few decades, from the first zero-calorie soft drink, Tab, introduced in 1963 and sweetened with saccharin, to Diet

Table 7. Measures of Diet Quality by Consumption Level of Sugars and Sweets*

	Children Aged 6–11 Years				Adolescents Aged 12–17 Years			
	Non (n=413)	Low >0 <15 g (n=466)	Moderate >15 <60 g (n=639)	High >60 g (n=395)	Non (n=400)	Low >0 <15 g (n=214)	Moderate >15 <45 g (n=242)	High >45 g (n=269)
Calcium (% AI)	96[a]	92[a,b]	89[b]	88[b]	73[a]	75[a]	72[a]	72[a]
Folate (% DRI)	118[a]	114[a]	111[a]	98[b]	74[a]	76[a]	76[a]	66[b]
Iron (% DRI)	175[a]	171[a]	165[a,b]	152[b]	155[a]	166[b]	162[a,b]	135[c]
Added sugars (g)	73[a]	75[a]	89[b]	115[c]	102[a]	105[a]	118[b]	147[c]

DRI indicates dietary reference intake and AI, adequate intake.

*Sugar and sweets include: white, brown, and raw sugars, edible syrups, molasses, jellies, sweetened toppings, nondiet gelatins, and candies. Measures are per day, for children 6 to 11 years (n=1913) and adolescents 12 to 17 (n=1125) adjusted for age, race, sex, and total energy intake.

[a,b,c]Means in a row with different superscripts are significantly different ($P<0.05$).

Adapted with permission from Frary et al.[9]

Table 8. Measures of Diet Quality by Consumption Level of Sweetened Grains*

	Children Aged 6–11 Years				Adolescents Aged 12–17 Years			
	Non (n=602)	Low >0 <30 g (n=493)	Moderate >30 <60 g (n=377)	High >60 g (n=441)	Non (n=477)	Low >0 <30 g (n=188)	Moderate >30 <60 g (n=183)	High >60 g (n=277)
Calcium (% AI)	94[a]	93[a]	89[a,b]	86[b]	75[a]	78[a]	72[a,b]	67[b]
Folate (% DRI)	116[a]	109[a,b]	112[a,b]	104[b]	74[a]	77[a]	76[a]	66[b]
Iron (% DRI)	176[a]	165[a,b]	163[a,b]	159[b]	156[a,b]	161[a]	152[a,b]	147[b]
Added sugars (g)	81[a]	85[a,b]	87[b]	100[c]	109[a]	105[a]	120[b]	135[c]

DRI indicates dietary reference intake and AI, adequate intake.

*Sweetened grains include: cakes, cookies, pies, cobblers, doughnuts, sweetened granola bars, breakfast bars, sweetened waffles and pancakes. Measures are per day, for children 6 to 11 years (n=1913) and adolescents 12 to 17 (n=1125) adjusted for age, race, sex, and total energy intake.

[a,b,c]Means in a row with different superscripts are significantly different ($P<0.05$).

Adapted with permission from Frary et al.[9]

Coke in 1982, sweetened with aspartame and targeted at women, and Coca-Cola Zero in 2005, sweetened with aspartame and acesulfame potassium and targeted at younger men. With the increasing popularity of zero-calorie soft drinks, the US liquid refreshment beverage market has seen calories per ounce produced decrease from 9.0 in 1988 to 6.8 in 2008, according to the American Beverage Association.[76]

The Coca-Cola Company initiated calorie labeling on the front of labels in 2009. The industry has responded to First Lady Michelle Obama's Call for Action with a "Clear on Calories" initiative. This extends the beverage industry's commitment to include more prominent calorie labeling on front-of-pack product labels for the entire container, up to and including 20-ounce products, and on beverage vending and fountain beverage machines that are company-controlled. As part of The Coca-Cola Company's commitment to the US School Beverage Guidelines, the Company has removed its full-calorie drinks from the nation's schools, replacing them with more no- and low-calorie options. This beverage industry-wide collaboration has reduced calories shipped to schools by >88% in the first half of the 2009 to 2010 school year compared with the first half of the 2004 to 2005 school year, and a 95% reduction in the shipments of full-calorie soft drinks to schools.[77]

The Coca-Cola Company is also working in collaboration with government, academic, and other public and private organizations to advance active and healthy living. Notable programs include Heart Truth with the National Heart, Lung, and Blood Institute to raise the awareness of heart disease in women. Although many low- or zero-calorie beverages options are available, opportunities exist to promote the safety and benefits of low-calorie sweeteners to help achieve healthy weights.

National Confectioners Association

Summary of Presentation by Alison Bodor, MBA

In the published literature, sugar intake from candy and candy consumption is difficult to track because the definition for candy is often inconsistent, sometimes including foods that are "sweets" (like honey and jelly) rather than candy. Although overall calories have increased over the past 20 to 25 years, candy intake continues to account for only a small percentage, about 2% of total caloric intake.[78] Analyzing NHANES 1999 to 2004 data, candy consumption in children and adults was not associated with increased weight, BMI, or waist circumference. Candy consumption was also not associated with the risk of metabolic syndrome in adults.[79]

Sugars are an essential ingredient in candy. They determine crystallization and texture, act as a bulking agent, influence water activity, impart sweetness, and develop flavor. Although it is impossible to duplicate the characteristics of sugar, candy makers have had great success with some sugar alternatives, and reduced sugar or sugar-free options are available for most types of confections. However, limitations to using sugar alternatives in candy include their impact on flavor, color, digestion, bulk, sweetness, texture, caloric reduction, shelf life, and global regulatory acceptance. Furthermore, the standards of identity for chocolate require nutritive carbohydrate sweeteners.

Perhaps the biggest hurdle to the use of alternative sweeteners in confections is the reluctance of consumers to accept changes in the sweetness, texture, and flavor of confections – foods they consider a treat. There are exceptions though, because sugar-free gum now accounts for the majority of total gum sales. Only 2% to 3% of total candy and chocolate sales are sugar-free.

The candy industry offers a variety of options to meet consumer needs. In addition to sugar-free candies, candy makers offer many portion sizes including snack and bite-size pieces and resealable containers. Candies are also packaged with a Nutrition Facts label.

In addition to adding pleasure and joy to the diet, certain confections have positive impacts. There are benefits for cardiovascular disease from moderate intake of some dark chocolates and cocoas[80–82] and chewing sugar-free gum is helpful in maintaining oral health.[83–86] There is a role for little pleasures like confections in an overall lifestyle that supports wellness and happiness.

AIB International

Summary of Presentation by Brian L. Strouts

Sweeteners are heavily used in bakery applications, both in terms of the type as well as the quantity. In many baked goods, the sweetener is simply sucrose or plain white sugar, in granulated, powdered, or liquid form. The specific functionality required depends on the product, including fermentation in yeast-leavened goods, influence on the gelatinization point of starch in cakes, texture influence in cookies, bulking in icings, the Maillard (browning) reaction, water activity control for food safety and shelf life, the masking of undesirable flavors, and, of course, sweetness and flavor. The functionality requirements yield more challenges than successes when it is necessary to reduce sugars added to baked goods.

Several examples were presented to demonstrate the challenges of reducing added sugars in baked goods. For example, a cookie baked with an intense sweetener was much smaller in diameter than a cookie baked with sugar. A food manufacturer would need to address the difference in the packaging and product information in this case. In another example, the cake baked with an intense sweetener (the "substitute") was lighter in color on the outside, did not rise as much, and was more dry and crumbly compared with the "control," baked with sugar. In the case of doughnuts, replacing sugar with another sweetener might mean the need to add water to enhance the volume. More water absorbs more fat and oil during frying. Therefore, the "substitute" doughnut might be lower in sugar but higher in fat versus the "control."

The industry tries to balance the flavor and quality against the need to reduce sugars to meet consumer demand. Many sugar-free bakery products and reduced sugars bakery mixes are on the market, as well as sugar substitutes for use by the home baker. In many products, a combination, rather than a single sweetener, is needed. The end product is also a result of a series of modifications. Opportunities exist to reduce added sugars while product reformulation is underway to reduce sodium in baked goods. Some manufacturers are reducing added sugars to make the flavor profiles more comparable to historical sweetness levels in the United States as well as those in non-US products.

Innovation Center for US Dairy

Summary of Presentation by Ann M. Ocana, MBA

Milk is a core component of a healthy diet. The 2005 Dietary Guidelines for Americans recommend 3 daily servings of low-fat and fat-free milk and milk products to improve overall diet quality.[87] Milk and milk products provide many essential nutrients, and milk is the number one source of calcium, potassium, vitamin D, and phosphorus.[88]

Flavored milk such as chocolate milk has the same 9 essential nutrients as white milk. Although formulations vary, only a portion of the sugar in flavored milk is added sugar. As an example, 8 oz of 1% flavored milk at 160 calories contains about 12 g of added sugar compared with white milk, because 8 oz of white milk has about 12 to 13 g of sugar (lactose) naturally. Flavored milk contributes only 2% to 3% of total added sugars to children's diets.[89] Children who drink flavored milk have better-quality diets than nondrinkers.[90] For example, flavored-milk drinkers consume more milk and less soda and fewer fruit drinks than nondrinkers, and milk drinkers (including flavored) have higher intakes of calcium, vitamin A, phosphorus, magnesium, and potassium than nondrinkers.[91] BMIs of white and flavored-milk drinkers are comparable to or lower than nondrinkers.[91]

From 2006 to 2010, the average calories per 8 oz of flavored milk in schools decreased from 165.8 to 154.0. Part of the decrease was due to going from 2% to 1% fat and fat-free, but part of it was the reduction of added sugars.[92] Primary drivers in creating flavored milk with reduced sugars that children will drink are chocolate flavor, creamy texture, sufficient sweetness, and the avoidance of the aftertaste commonly associated with sugar substitutes. Although reduced-sugar flavored milk is lower in calories, it tends to cost more and is sometimes not selected by school nutrition directors because of the higher cost.

The dairy industry recognizes the need to weigh the essential nutrients provided by flavored milk against added sugars. A study including nearly 700 measurement days over 3 months at 58 elementary and secondary schools found that eliminating flavored milk and serving only white milk would reduce milk consumption by 35% in these schools.[93] Two types of costs would increase if flavored milk were eliminated: (1) a fiscal cost of serving a different meal in the school feeding system to replace the essential nutrients previously supplied by flavored milk and (2) a nutrient cost of incurring a higher overall caloric intake. Therefore, the industry would like to present white and flavored milk as healthy options that both deliver 9 essential nutrients.

General Mills

Summary of Presentation by Kathryn L. Wiemer, MS, RD

General Mills helped define the ready-to-eat cereal category, with the introduction of its first ready-to-eat cereal in 1924 and first presweetened ready-to-eat cereal in 1953. Presweetened cereal was introduced to address the need of mothers for "less mess at the table" when sugar was added at home. Sugar has numerous functions in all types of cereals by contributing to the flavor and color development, crispness and crunchiness, and enhancement of other complex flavors. The challenge in lowering sugar content or using intense sweeteners in cereals is the need for other ingredients (such as bulking agents) to replace sugar. It is difficult to achieve significant calorie reduction in a food that is already relatively low in calories.

Cereal is part of a healthy breakfast. It is the lowest-calorie common breakfast choice, with an average of 150 calories per serving with skim milk, compared with an average of 250 calories for a doughnut, 315 calories for a bagel with light cream cheese, and 580 calories for a biscuit sandwich with sausage, egg, and cheese. In children aged 4 to 12 years, cereals account for about 4% of total caloric intake, while delivering much higher proportions of a number of important nutrients (eg, 17% of vitamin A, 24% of vitamin B6, and 34% of folate).[94] Numerous studies have shown that cereal eaters have healthier body weights.[95,96] Cereal eaters tend to be leaner than those who do not eat cereal, regardless of age, and regardless of whether the cereals consumed are presweetened.[95] For example, the National Growth and Health Study, a longitudinal study evaluating young girls, found a strong relationship between cereal consumption and lower BMI.[96] As cereal and breakfast consumption decreases with age, girls who continue to eat cereal have improved nutrient intakes and are less likely to become overweight as they mature.[96] Overall, ready-to-eat cereal is a nutrient-dense choice regardless of the sweetness level. Families tend to buy a variety of cereals as consumption options.

General Mills is committed to reducing sugar levels in its cereals, from 13 g per serving in 2007 to 11 g in 2009, and to the goal of 9 g or less in the future. The objective in product reformulations is to maintain the same product identity associated with the flavor, texture, and appearance, the same processability, and the same storage stability so that consumers can expect the same eating experience.

Translation and Implementation of Added Sugars Intake Recommendations

Historical Perspective of Sugars Labeling

Until the early 1970s, not much information on packaged foods was available to consumers in the form of nutrition labeling. In 1973, the FDA issued regulations providing for voluntary nutrition labeling; the labeling of sugars was not considered at the time. Mandatory nutrition labeling on all packaged foods was proposed in 1990. The Nutrition Labeling and Education Act (NLEA) was signed into law in November 1990, necessitating a revised proposed rule in 1991. The Nutrition Labeling and Education Act gave the FDA the authority to mandate nutrition labeling, define nutrient content claims, and regulate health claims. The criteria for mandatory declaration of nutrients were public health significance as defined in consensus documents at the time and the existence of specific quantitative recommendations. The 1991 proposed rule made the declaration of "sugars" mandatory in nutrition labeling, as consensus documents noted an effect of added sugars on dental health and gave general directions of recommended modifications to current intakes (eg, "limit their consumption and frequency of use of foods high in sugars"). However, consensus reports did not specify a recommended level that could be the basis for establishing a reference value to help consumers plan their diets.[97,98]

The final rule for nutrition labeling regulations, published on January 6, 1993 (21 CFR §101.9), is still in effect today. It requires the declaration of "sugars," defined as the sum of all free mono- and disaccharides. Regulations do not provide for "added sugars" nutrition labeling. As the sample Nutrition Facts label (Figure 4) indicates, the amount of (total) sugars in grams per serving is listed under Total Carbohydrates, accompanied by no % DV (daily value). Sweeteners are listed separately in the ingredient section in order of the amount used.

Current Considerations in Added Sugars Labeling

The FDA is in the process of updating the Nutrition Facts label. It published an advanced notice of proposed rulemaking in November 2007, including >70 questions on the revision of reference values that should be used to calculate % DVs in Nutrition Facts and Supplement Facts, factors the agency should consider, and the mandatory nutrients that should be added or removed from the label. One of the questions was whether total (not added) sugars should continue to be included on the Nutrition Facts label. More than 20 comments were received from various stakeholders and the majority supported maintaining sugars on the Nutrition Facts label. A few recommended the addition of added sugars to the Nutrition Facts label, and some suggested the FDA set a DV for added sugars. Because no reference value and no dietary reference intake have been set for added sugars, it would be difficult for the FDA to set a DV.

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving	
Calories 260	Calories from Fat 120
	% Daily Value*
Total Fat 13g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 2g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	
Vitamin A 4% •	Vitamin C 2%
Calcium 15% •	Iron 4%

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 4. Sample Nutrition Facts label. (Table from http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/ucm173838.htm - black and white). Source: US Food and Drug Administration. Available at: http://www.fda.gov/Food/GuidanceComplianceRegulatoryInformation/GuidanceDocuments/FoodLabelingNutrition/ucm173838.htm. Accessed July 27, 2010.

In addition, to consider incorporating added sugars into the Nutrition Facts label, added sugars need to be consistently defined. Currently, terms related to added sugars defined in regulation [21 CFR §101.60(c) (2)] for nutrient content claims are "no added sugar," "without added sugar," or "no sugar added." Added sugars also include any ingredient added during processing or packaging that is a sugar or any other ingredient that contains sugars that functionally substitute for added sugars. To set criteria for added sugars labeling, the FDA must look to an authoritative body such as the Institute of Medicine (IOM) to establish a DV and set the criteria.

Additional challenges to including added sugars on the Nutrition Facts label exist:

- It is not feasible to enforce such a requirement by verifying the amount declared by the manufacturer in the laboratory as no analytical methods currently exist to distinguish between added and naturally occurring sugars. The FDA would need to calculate the amount of added sugars in a product based on information identified and supplied by the manufacturer, such as recipes, formulations, or any information that reasonably substantiates the labeled level. This information is often viewed as proprietary by food companies.

- To comply with mandatory declaration of added sugars on the Nutrition Facts label, manufacturers would need to maintain records sufficient to substantiate the amount of added sugars and would provide records to the FDA on request and on a voluntary basis.

Front-of-pack (FOP) labeling is being independently reviewed and evaluated. Two independent consumer research surveys were conducted in December 2009 by the FDA to obtain consumers' feedback about different proposed labeling schemes and examine the impact of FOP labeling schemes on their viewing of the Nutrition Facts label. Analysis is underway to evaluate the findings. Consumer research would need to be conducted if added sugars were to become a part of the Nutrition Facts label.

In addition, in response to a congressional directive, the FDA and the Centers for Disease Control and Prevention have asked the IOM to conduct a review of FOP nutrition rating systems and symbols. The IOM is expected to issue a report in 2010. To fulfill this mandate, the IOM Committee considers recommendations about added sugars and total sugars on FOP labeling and the inclusion of only nutrients to limit on the FOP (ie, total fat, saturated fat, sodium, and added sugars). The IOM report will be considered carefully in the development of regulatory actions taken by the FDA relative to FOP nutrition labeling.

Modeling Food Intakes to Achieve Nutrient Adequacy With Limited Energy Intake

A modeling approach was used to develop the current Canadian Food Guide, which recommends the numbers of servings for main food groups that are age- and sex-specific, with one of the constraints being limiting overall energy intake.[99] People who follow the Food Guide will have a lower risk of nutrient inadequacy or excess, recommended macronutrient distribution, and energy intake consistent with maintaining a healthy weight.

The modeling approach included these four steps:

1. Developing food group composites based on the relative popularity of foods purchased and the relative contribution of energy and nutrients from these foods.
2. Using composites to develop preliminary food intake patterns for further testing, with preliminary targets including (a) for vitamins and minerals, the Recommended Daily Allowance or Adequate Intake levels and below the Upper Limit; (b) for macronutrients, within the Acceptable Macronutrient Distribution Range; and (c) for energy, limiting energy to underestimate the needs of most individuals by assuming a median BMI within the normal range and sedentary physical activity level.
3. Using the Dietary Reference Intake framework to assess the adequacy of 500 randomly generated 1-day diets using real foods selected based on relative popularity within each age-sex group from recent provincial surveys.
4. Refining the pattern based on the assessment results, which often included specific guidance about consumption.

Added sugars are present in the Canadian Food Guide in many foods, including grain products, breakfast cereals, flavored yogurt, and flavored milk. "Limiting sugar" is part of the specific advice that accompanies the Food Guide to keep nutrient adequacy within the limited energy intake. Although the modeling approach did not address added sugars specifically, it would be possible to use the process to help translate dietary recommendations relative to added sugars.

Small Behavior Changes to Better Health

The America On the Move program examined the impact of promoting 2 small healthy lifestyle changes on preventing excessive weight gain in families with overweight children and evaluated the sustainability of the small changes approach to modifying diet and physical activity.[100] A total of 828 families from the Denver area were contacted during recruitment and each participating family had at least one 7 to 14 year old who was overweight or obese (≥85 percentile BMI) and one parent or guardian in the program. A total of 218 children (116 in the "small change" group and 102 in the "control" or self-monitoring group) began the program and 82% of the "small change" group and 87% of the self-monitoring group completed the program at the 6-month follow-up. The "small change" group was instructed to decrease sugar intake by 100 calories per day by using the no-calorie sweetener Splenda and/or beverages made with sucralose and to increase physical activity by about 2000 steps a day. The self-monitoring group was instructed to maintain lifestyle behaviors but given pedometers to track physical activity and asked to track their consumption of sweetened foods and beverages.

For the children participating in the America On the Move program, who continued to grow, the primary outcome measure was the change in the BMI-for-age percentile over time. It was found that both the "small change" and self-monitoring groups had fewer children who were in the ≥85 percentile BMI-for-age at the end of the first 6 months, with the "small change" group showing the greater decrease in the percentage of children who were overweight or obese. At the end of the next 6 months, a higher percentage of the "small change" children maintained or reduced their BMI-for-age percentiles than the self-monitoring group (67.4% versus 52.8%). The America On the Move program demonstrates the effectiveness of an evidence-based small-change approach to preventing excessive weight gain.

Positive Approaches to Improving Eating Behaviors and the Food Environment

Schools provide ideal settings for primary and secondary prevention intervention initiatives for these reasons: access to large numbers of children, minimal costs to families, integration into current curriculum, opportunities to practice healthy lifestyle behaviors, and, in theory, environments where healthy lifestyles are modeled by teachers, staff, and peers. However, school studies have not been very effective at moving the BMI, with a few exceptions. In 644 children aged 7 to 11 years in 6 primary schools in the United Kingdom, the prevalence of children who were overweight and obese increased by 7.5% over a 1-year period in the control and decreased by 0.2% in the group receiving nutrition education, which included the encouragement of drinking water instead of "fizzy" drinks.[101]

Most recently, a comprehensive school-based program was evaluated for its effects on obesity and other risk factors for type 2 diabetes mellitus.[102] The HEALTHY study used a cluster design in 42 schools throughout the United States. Half of the schools received a comprehensive school-based program that consisted of 4 integrated components: nutrition, physical activity, behavioral knowledge and skills, and communications and social marketing. Details of the intervention are available at www.healthystudy.org. The other half of the schools served as assessment-only controls. Among 4603 students, followed from the beginning of sixth grade to the end of eighth grade, researchers found that intervention and control schools both experienced reductions in the combined prevalence of overweight and obesity by about 4%. However, intervention schools had significantly greater reductions than did control schools in obesity, waist circumference >90th percentile, and insulin levels. These results are notable given the sample was 54% Hispanic and 18% black.

The School Nutrition Policy Initiative, a school-based obesity prevention program in Philadelphia, was shown to be effective at curbing the development of new cases of children who are overweight.[103] Children in the fourth to sixth grades at baseline were enrolled in the program, with follow-ups at year 1 and year 2. Participating schools had at least half of the students eligible for free or reduced-price meals. There were no significant differences in the weight status at baseline between the control (n=365) and intervention (n=479) groups. These components were included in the intervention group: school self-assessment, broadly defined nutrition education, social marketing to reinforce positive messages of interest to children (eg, being strong), parent outreach, and nutrition policy that made healthful foods and beverages (eg, 6-oz 100% real juice, water, and 8-oz. low-fat milk) available in the cafeteria and vending machines and through school fundraisers. The intervention halved the number of new cases of children who were overweight. Specifically, 14.9% of the children who were not overweight at baseline became overweight in the control, compared with 7.5% in the intervention group, which was still of concern.

The Healthy Corner Store Initiative targets environments beyond the school. Corner stores, with an average size of no more than 180 ft^2, are part of the urban landscape and typically sell predominately packaged foods. The Healthy Corner Store Initiative is a 2-year (2008–2010) study and data are collected twice a year about student purchases, shopping trends, BMI, and corner store inventory. At baseline, an analysis of 833 purchases indicated an average purchase of \$1.07±0.93 and 356.6±290.3 calories per trip.[104] Chips, candy, and beverages topped the list of items purchased. Close to half of the beverages purchased were artificially flavored sugar-sweetened fruit drinks, followed by regular sodas. These purchases had a very high average amount of added sugars of 31.8±35.8 g. The Healthy Corner Store Initiative focuses on community awareness and youth empowerment, with the goals of decreasing the purchase of high-calorie snacks and beverages and increasing the percentages of healthy snacks and beverages available at corner stores. To prevent and control overweight and obesity, changing the environment can be more effective than behavior modifications.

Summary of Breakout Sessions Discussions

After the plenary sessions, participants in the Added Sugars Conference convened into 6 preassigned groups facilitated by preappointed session leaders using a common discussion guide.

Afterward, the leaders summarized their discussions and reported back to the entire audience. The breakout sessions generated significant interactions, allowing participants to contribute their expertise and thoughts. The following summarizes the breakout sessions discussions:

- In prioritizing the appropriate method for reducing obesity, many breakout session participants felt that the focus should be on the total diet and calories, not added sugars specifically. It was mentioned that the nutrition and health science community needs to move away from micro/macro nutrient guidance and more toward total energy, food-based, holistic dietary guidance. In this context, the issue of concern should not be identified as "sugar" but as energy balance and calorie management. Participants expressed that sugar consumption as a whole is important and total sugars is an easier concept to communicate in consumer education than added sugars. Participants also mentioned that it is easier to monitor total sugars intake because the amount is on the Nutrition Facts label. When focusing on diet, added sugars come into play with discretionary calories. It is recognized that the rationale for supporting an added sugars emphasis is not to discourage the consumption of nutrient-dense foods such as fruits and low-fat and fat-free milk and dairy products. The key is how to fold that into the discussion of calories.
- Data supporting a relationship between added sugars intake and excess weight and cardiovascular disease are emerging but some participants questioned the strength of the data. Although reducing added sugars consumption is a good target for addressing obesity, along with other sources of excess calories, it was mentioned that the data are not definitive in cardiovascular disease, nor are they at the same level of strength as for other nutrients (eg, omega-3) to support a direct causal link. In addition, a concern was raised that the totality of science, which may offer alternative viewpoints, had not been presented.
- For the food industry, it is appropriate to reduce added sugars as a means to lower calories in foods and beverages.

Lowering added sugars gradually over time was considered a possible approach to moderate consumers' palates to find "less sweet" acceptable. It is not clear, however, to what level all manufacturers need to reduce added sugars in foods. Some industry participants also expressed the disappointment that they were unable to tout reductions in added sugars in their products unless the reduction was ≥25%, according to the FDA labeling requirements. Regarding ingredients, manufacturers need more low- and no-calorie sweeteners, bulking agents, and sweetness enhancers available to them as options but, at the same time, they are concerned about having to list "a chemistry set" on the label. Because the reduction of added sugars in foods requires a product redesign, lessening the sizing of packages, portion sizes served in restaurants, and the eating frequency is a good way to start decreasing added sugars intake without reformulating/redesigning products.

- Converting people from consuming SSBs to beverages with high-intensity sweeteners can have a big impact, because regular soft drinks and juice drinks are a major source of added sugars in the diet, and beverages is essentially the only category where zero-calorie options are available. In other food sectors, it may be a better approach to reduce the amounts eaten so people can eat the foods they really like or want as long as they consume smaller portions or eat them within their discretionary calorie allotment.
- Several potential unintended consequences related to reducing added sugars in the food supply were identified and discussed:

  - Reducing added sugars may not reduce calories. Ingredient substitution may end up with the same number of calories and have no positive impact on overweight or obesity.
  - Reducing added sugars may lead to increasing other macronutrients or food groups (eg, solid fats, refined carbohydrates) that may not result in a net health gain.
  - Restricting added sugars may lead to less palatability and perhaps the lower consumption of some nutrient-dense foods (eg, vegetables, breakfast cereals, yogurt, flavored milk, and cranberries, etc.).
  - Reducing added sugars may lead to the increased use of sugar substitutes in the food supply. The safety of sugar substitutes is supported by many authoritative bodies, including the FDA. However, there was concern expressed that the health effects of usage are not known longer term, in particular, relative to the outcomes of children eating artificial sweeteners from the toddler age throughout the life course. Consumers might also begin compensating for lower calories with the consumption of other caloric foods. Some epidemiological data suggest that people who use artificial sweeteners do not necessarily lose weight. Certainly, more data are needed.

- Given the current limitations around label enforcement and the challenges of consumer education, concerns were expressed related to quantifying and labeling added sugars on the food package. The following barriers were identified:
  - — Added sugars need to be clearly defined first.
  - — Issues exist with the calculation and measurement of added sugars and verification of the amounts. Because current analytical methods do not distinguish between naturally occurring and added sugars, the FDA cannot verify the amounts of added sugars declared by manufacturers for compliance. The amounts of added sugars might be obtained via recipes and formulations, which are proprietary and which the FDA cannot mandate manufacturers to provide.
  - — There is potential to add to consumer confusion by providing too much information on the Nutrition Facts label and misleading consumers into thinking that added sugars have a unique health impact above and beyond total sugars.
  - — There is skepticism that putting added sugars on the label would do little to help consumers make informed choices and improve the eating pattern and diet.

- To establish a nutrient content claim for sugar, a DV would need to be determined. The FDA would traditionally defer to the IOM to set those reference levels. There is already a "no sugar added" claim. Food manufacturers currently could put the amount of added sugars on the front panel as long as they would be willing to substantiate the information. Concerns were raised about the helpfulness of nutrient content claims, in general, and a low-sugar claim, in particular, to consumers. Another concern was that consumers might focus on sugars and not on the total food. Participants noted that there may be a strong argument to include calories on FOP – but did not feel as strongly about including added sugars on the front label of a food product. Participants were also unsure as to whether including added sugars as part of the criteria for a "healthy" claim would offer enough benefits to consumers. It was noted that the FDA would have to do a lot of work to redefine "healthy."
- Many suggestions were made about the methodology and metrics for tracking and understanding the effects of reducing added sugars in the diet and health outcomes. Metrics to monitor include the BMI, blood glucose, lipid profiles, neck circumference and waist-to-hip ratio, the nutrient density of diet, consumer perceptions, and consumption patterns. Both pre- and postmonitoring are needed and the monitoring needs to be broad. Surveillance methodologies that capture measured health data are more accurate than and preferred over self-reports. However, NHANES has the limitations of not adequately capturing current product offerings in the marketplace and regional-specific foods as well as data inconsistency. Longitudinal data and real-time data of what people are eating today are also needed.
- Participants agreed that a comprehensive approach to address obesity and energy intake is needed, including policy and environmental changes, as well as individual behavior changes. Policies to date have focused on these areas:
  - — *Advertising:* Voluntary pledges by many food companies are currently in place to avoid targeting food advertising at children. It was reported that there are also efforts underway to strengthen and make consis-

tent the nutrition standards for foods and beverages marketed and advertised to children.
 - *Taxation:* Soda taxes and taxes on certain foods with added sugars are being proposed or have been instituted in selected localities around the country.
 - *Food Labeling:* Efforts are underway that are streamlining and improving the nutrition information on food and beverage packaging to make it more helpful to consumers.
 - *Availability:* Restricting the availability of certain foods and beverages and changing the environment in certain settings, such as schools.
 - *School Nutrition Standards:* Creating robust nutrition standards for foods and beverages served and sold in schools and in government feeding programs.
 - *Nutrition Standards for Government and Other Large Entities:* Developing nutrition standards within procurement policies for foods and beverages purchased by state, local, and federal government as well as large entities such as hospital systems.
 - *Incentives:* Zoning regulations and financial and other positive incentives for stores to offer healthy options.

Participants recommended that more disciplines should be at the table to bring expertise to discuss cross-cutting issues related to public policies and to offer diverse insights to finding a solution. Participants expressed the need for further scientific evidence to define and inform AHA's policy efforts for added sugars. It was noted that these efforts should be addressed from all the different socioeconomic perspectives and consider vulnerable populations.

- It was agreed that when communicating information related to added sugars to consumers, key educational messages related to diet might include:
  - First and foremost, know the number of total calories you should consume each day.
  - Eat an overall healthy diet and get the most nutrients for the calories, using foods high in added sugars as discretionary calories.
  - Lower sugars intake in the diet, especially when the sugars in foods are not tied to positive nutrients such as in sugar-sweetened beverages, candies, cakes, cookies and pies, and dairy desserts.
  - Focus on calories in certain food categories such as beverages and confections, and encourage the consumption of positive nutrients and food groups in other food categories such as cereals and low-fat or fat-free dairy products.

The educational messages must be simple, clear, and concise, and tailored to the distinct nutritional needs and issues of certain populations and specific to subtype and group (eg, region, age, income, socioeconomic status). Educational messages should be positive and motivate consumers to change behavior.

- Participants thought that a key focus for short-term actions would be to develop consumer education efforts about appropriate calorie levels and nutrient adequacy, combined with messaging about physical activity. Participants would like to see more stand-alone education efforts for heart health, not just weight. Participants expressed the need and value of interactive dialogue among multiple sectors and disciplines. Other conferences to consider would bring experts in the area of physical activity, and may involve food economists, the USDA, political scientists, global health experts, cultural sensitivity experts, food service experts, culinary experts, and sustainability experts. On a 3- to 5-year basis, the outcomes of tools, resources, and policy changes (eg, menu labeling, nutrition standards in schools) should be measured to establish the impact. Research should be conducted to continue to build an evidence base for policy work.

AHA Comments

The AHA Added Sugars Conference is the first step in an important process that facilitates collaboration across science, public health, and industry to foster innovation, partnerships, policy, and implementation of new products and services for the benefit of the health and well-being of the American public. The information presented here has informed the field of nutrition and consumer research, food labeling, government, and food manufacturing. As was demonstrated by the depth and breadth of the presentations, the science has advanced in the area of added sugars and health, creating mounting pressure to use better methods for translation and dissemination of the science for consumer education and for food companies to respond by producing foods and beverages with fewer added sugars. The new science also reinforces the importance of preventing, rather than simply treating diseases, especially overweight and obesity, diabetes mellitus, high blood pressure, heart disease, and stroke.

The AHA recommends limiting consumption of added sugars in foods and beverages. Data document relationships among excess added sugars intake and metabolic abnormalities, adverse health conditions, and shortfalls in essential nutrients. To put these AHA recommendations into action, the public needs point-of-purchase information to identify the added sugars content of foods and beverages.

The AHA will continue to encourage the FDA to revise the Nutrition Facts label to include disclosure of added sugars. The food label is a crucial tool to facilitate the public's ability to make healthier food and beverage choices according to the amounts of added sugars contained in them. The AHA will also continue to support new approaches to address obesity prevention. Research shows that limiting added sugars consumption, in particular, in beverages, can be effective. The AHA will advocate relevant nutrition standards for schools and government feeding programs that limit added sugars. The AHA will also advocate for a unified, robust set of nutrition standards for foods and beverages marketed and advertised to children regulated by the appropriate federal agency.

Finally, The AHA will support procurement strategies that are based on robust nutrition standards and encourage schools, government entities, hospital systems, and other large-scale organizations to purchase foods and beverages that adhere to science-based nutrition criteria.

The AHA has committed to, by 2020, improving the cardiovascular health of all Americans by 20% and reducing deaths from cardiovascular disease and stroke by 20%. The AHA has established metrics to track the population's movement along the continuum toward better health and ultimate achievement of its health impact goals. Among these metrics is the assessment of recommended dietary changes, including reducing the intake of added sugars, specifically, limiting the consumption of SSBs to no more than 450 calories (36 ounces) a week. The AHA recommendation focuses on all added sugars, without singling out any particular sugars such as HFCS.

The AHA's goals include leading efforts to achieve positive changes in health and wellness for all Americans. Because the science is increasingly evident among the health professionals and public health practitioners, the commitment to launch translational efforts toward the public becomes imperative. Although there are many challenges to incorporating added sugars to the label, as discussed during the Added Sugars Conference, disclosure of added sugars content on food and beverage labels is an essential element in consumer education and can provide the information and motivation for making healthier food choices. With the current obesity crisis, there are compelling reasons to guide nutrition choices and create heart-healthy eating environments. Moving forward, the AHA will lead efforts to achieve positive changes through:

- Raising awareness across all segments of the public and providing effective choice-making tools.
- Working with the industry to improve access to healthier choices for a comparable price at point-of-purchase.
- Taking the charge to change the food supply through voluntary agreements.
- Implementing policy priorities that concentrate on food labeling, nutrition standards in schools and government feeding programs and for foods and beverages marketed and advertised to children, and procurement strategies.

Appendix

This article represents a summary of a conference sponsored by the American Heart Association held on May 5 to 6, 2010. Most of the conference presentations are available online at http://www.heart.org/HEARTORG/GettingHealthy/NutritionCenter/HealthyDietGoals/Added-Sugars-Conference_UCM_306862_Article.jsp. The opinions expressed in this article, unless specified otherwise as in the "AHA Comments" section, are those of the authors and/or participants and do not necessarily represent those of the editor or the American Heart Association. The publication of these proceedings was approved by the American Heart Association Science Advisory and Coordinating Committee on September 9, 2010.

Conference participants explored ways to translate the 2009 American Heart Association added sugars recommendations for individuals and the population at large and considered the best approaches to implementing the recommendations to improve the diets of all Americans. Food industry-specific information is intended to reflect practical experiences and the expertise of the speakers. The presentations and subsequent summary of the food industry-specific information in this report do not necessarily reflect the opinions, support, or endorsement of the American Heart Association. The information is not intended to be exhaustive but will help inform nutrition education as well as efforts to establish relationships with stakeholders to make changes in our food environment.

The following speakers presented at the conference: Lawrence Appel, MD, MPH (Johns Hopkins Medical Institutions); Susan I. Barr, PhD, RD (University of British Columbia, Vancouver, Canada); Alison Bodor, MBA (National Confectioners Association); Stephen R. Daniels, MD, PhD (University of Colorado Denver School of Medicine); Kathy Ellwood, PhD (US Food and Drug Administration), Brent D. Flickinger, PhD (Archer Daniels Midland Company); Gary Foster, PhD (Temple University); Darryl Holliday (Louisiana State University); Rachel K. Johnson, PhD, MPH, RD (University of Vermont); Rae-Ellen W. Kavey, MD, MPH (University of Rochester School of Medicine); Susan M. Krebs-Smith, PhD (US National Cancer Institute); Margaret M. Leahy, PhD (The Coca-Cola Company); Rachel Lindstrom, PhD (America On the Move); Joanne R. Lupton, PhD (Texas A&M University); Jim Mann, CNZM, PhD, DM, FRACP, FFPHM, FRSNZ (University of Otago, Dunedin, New Zealand); Ann M. Ocana, MBA (Innovation Center for US Dairy); Frank Sacks, MD (Harvard School of Public Health); Eyal Shimoni, PhD (Technion – Israel Institute of Technology, Haifa, Israel); Brian L. Strouts (American Institute of Baking (AIB) International); Amy F. Subar, PhD, MPH, RD (US National Cancer Institute); Linda Van Horn, PhD, RD (Northwestern University); John S. White, PhD (White Technical Research); Kathryn L. Wiemer, MS, RD (General Mills Bell Institute of Health and Nutrition); and Virginia Wilkening, MS, RD (US Food and Drug Administration - retired).

Disclosures

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*Modest.

†Significant.

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Translation and Implementation of Added Sugars Consumption Recommendations: A Conference Report From the American Heart Association Added Sugars Conference 2010

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Correction

In the article by Van Horn et al, "Translation and Implementation of Added Sugars Consumption Recommendations: A Conference Report From the American Heart Association Added Sugars Conference 2010," which published ahead of print November 8, 2010, and appeared with the December 7, 2010, issue of the journal (*Circulation.* 2010;122:2470–2490), several corrections were needed.

1. On page 2481, in the left column, the last sentence read, "From 2006 to 2010, the average calories per 8 oz of flavored milk in schools decreased from 165.8 to 152.9." It has been updated to read, "From 2006 to 2010, the average calories per 8 oz of flavored milk in schools decreased from 165.8 to 154.0."

2. On page 2490, reference 92 read, "92. MilkPEP. Annual School Survey and Prime Consulting Analysis (unpublished data). School Nutrition Foundation Webinar. August 2010." It has been updated to read, "92. Milk Processor Education Program. Annual School Survey and Prime Consulting Analysis. Available at: http://www.milkdelivers.org/files/resources/final-version-for-md_082510_mdp.pdf. Accessed November 10, 2010."

These corrections have been made to the print version of the article in the journal as well as to the current online version of the article, which is available at http://circ.ahajournals.org/cgi/reprint/CIR.0b013e3181ffdcb0.

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Speaker	Employment (Where?)	Research Grant	Other Research Support	Speakers' Bureau/ Honoraria	Expert Witness	Ownership Interest	Consultant/ Advisory Board	Other
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Translation and Implementation of Added Sugars Consumption Recommendations
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Virginia Wilkening	retired	None	None	None	None	None	None	None

This table represents the relationships of speakers that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire which all speakers are required to complete and submit. A relationship is considered to be “Significant” if (a) the person receives $10,000 or more during any 12 month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10,000 or more of the fair market value of the entity. A relationship is considered to be “Modest” if it is less than “Significant” under the preceding definition.

*Modest
† Significant