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Babey & McCarthy. Synthesis of the May 3, 2017 Kaiser Permanente/American Heart Association Expert Roundtable on Added/Free Sugar Consumption discussion

Disclaimer: Kaiser Permanente and the American Heart Association were pleased to sponsor the May 3, 2017, Expert Roundtable on Added/Free Sugar Consumption. Views and opinions expressed by panelists, participating organizations or their representatives at the roundtable and in this synthesis report are not those of Kaiser Permanente or the American Heart Association. Kaiser Permanente does not support or endorse any specific legislative or policy interventions discussed, but supports broad dialogue identifying evidence-based strategies to limit consumption of excess added and free sugar.

Thirty-three experts on added/free sugars representing a variety of disciplines and recruited from all over the U.S. and Mexico convened at UCLA's Luskin Conference Center on May 3, 2017 to review the latest science on added/free sugars and to discuss clinical and policy approaches to reducing population excess consumption of added/free sugars.

Organizers Susan Babey and William McCarthy intentionally recruited experts whose disciplinary perspectives ranged widely, from bench scientists studying the impact of fructose intake on liver function to policy experts who have participated in legislative efforts to curb population sugary beverage intake through excise taxes and warning labels.

Kaiser Permanente Senior Health Policy Consultant Brian Raymond kicked off the meeting with a brief explanation of why Kaiser Permanente and the American Heart Association felt it was important to sponsor this meeting. As the scientific literature increasingly documents the negative health consequences of excess added/free sugar consumption, Kaiser Permanente's clinical staff have sought guidance with respect to evidence-based clinical strategies for reducing those harms. But if interventions to address problematic patient health behaviors are limited to the clinic setting, the experts say that the magnitude and sustainability of the desired improvement in population health will fall short of what is needed.[1] Hence this meeting was expected to review policy approaches as well as evidence-based interventions and clinical approaches to reducing excess added/free sugar intake to curb its negative health consequences. Raymond encouraged wide-ranging discussion but reminded observers that the views and opinions expressed by panelists, participating organizations or their representatives are not those of Kaiser Permanente or the American Heart Association.

Definitions and Recommended Consumption Limits

The common goal shared by all the attendees of working one way or another on reducing excess added sugar intake contributed to an instant camaraderie even though most of the participants had not met each other before this meeting. However, because the assembled experts included bench scientists, lawyers, physicians, social marketing experts, epidemiologists and community public health interventionists, there was a need to review some definitions and metrics to ensure common terminology. McCarthy briefly reviewed the definitions of sugar and non-nutritive sweeteners.

McCarthy prefaced his presentation by asking, "Why did evolution equip humans with genes to taste sweetness and to prefer sweet-tasting foods in the first place?" Expert speculation is that it was evolutionarily adaptive for humans to be able to taste sweetness because sweetness was associated with foods that were safe to eat (no toxins) and were energy dense.[2] The ability to detect sweetness provided a competitive survival advantage to our hominid forebears. But, thanks to human ingenuity, the sweetness signal that used to be associated with food safety is increasingly found in processed foods that are calorie rich but nutrient poor.[2]

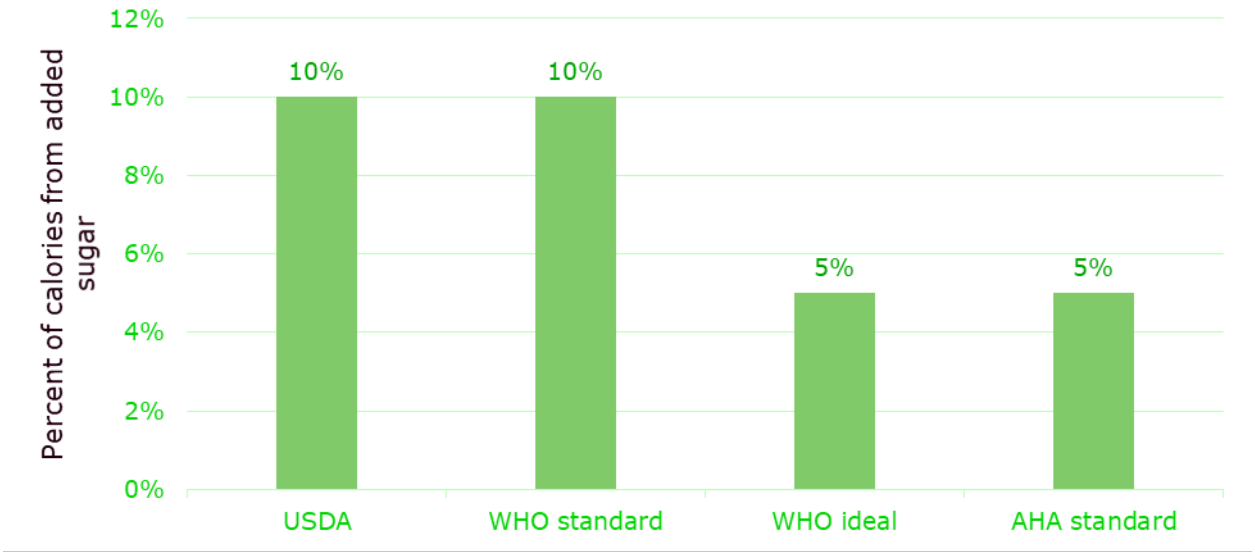
McCarthy discussed different kinds of sweeteners, including the following:

- Natural sugars are sugars that are intrinsic in the structure of intact fruits and vegetables as well as sugars naturally present in milk and milk products.[3,4] Examples include the whole apple, whole banana, whole corn kernel, all containing sugar as well as water, fiber, and starch.
- Added sugars are sugars added to food products that did not originally contain that sugar.[5] These sugars can be natural sugars such as sugar cane or free sugars such as high fructose corn syrup or concentrated fruit juice. They can be added during processing by the manufacturer, during preparation by the cook, or by the consumer, for example, when fructose is added to peanut butter. Added sugars are viewed as “empty” calories because they tend to be low in essential micronutrients such as vitamin C.[6]
- Free sugars is a term used by the World Health Organization to refer to monosaccharides and disaccharides added to foods and beverages as well as sugars naturally present in fruit juice, fruit juice concentrates, honey and syrups.[3,7] For example, apple sugar, without the apple, otherwise known as apple juice, is a type of free sugar.
- Non-nutritive sweeteners also known as artificial sweeteners are non-caloric or minimally caloric chemicals that taste often thousands of times sweeter than sugar.[5] These chemicals include aspartame (Nutrasweet),

saccharin (Sweet N Low), stevia and sucralose. Non-nutritive sweeteners were not a focus of this roundtable.

It is important to point out that a common metric used in public health to characterize the total quantity of added sugar intake is the percent of total energy intake attributable to added sugars.[5] Major health organizations such as the World Health Organization (WHO) and the U.S. Department of Agriculture have recommended an upper limit of 10% of calories from added sugars (Figure 1).[8,9] American Heart Association Director of State and Local Obesity Policy Initiatives Carter Headrick segued from McCarthy's review of sugar terminology and metrics to inform the audience that the American Heart Association, after reviewing the impact of added sugar intake on heart disease risk, recommended that no more than 5% of a consumer's calories should come from added sugars, for optimal health.[10] He also noted that the most recent edition of the *Dietary Guidelines for Americans* [9] now recommends that Americans consume no more than 10% of calories from added sugars, a less stringent standard but one nonetheless strenuously opposed by the sugar industry.[11] He also noted that the official WHO recommendation is an upper limit of 10% but WHO also recommends that if countries have the wherewithal to achieve an upper limit of added sugar intake of no more than 5%, even greater health benefits could be achieved.[8]

Figure 1. Recommended Limits on Percent Calories from Added/Free Sugar



Cristin Kearns presented research suggesting that the sugar industry has attempted to influence the evidence base through research they have funded. For example, Kearns and colleagues conducted an analysis of historical documents that showed that highly respected researchers, conducting research funded by the sugar industry, downplayed the role of sugar in heart disease and instead singled out fat and cholesterol as contributors to heart disease.[12] The evidence of bias associated with industry funding of research is supported by systematic reviews of the link between industry funding of studies of sugar-

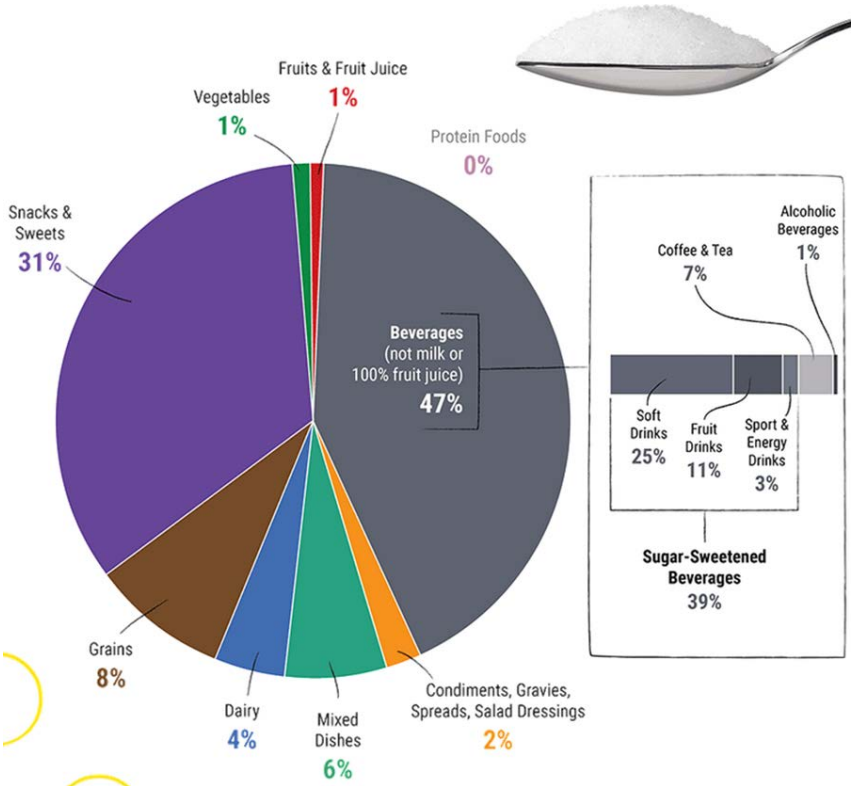
sweetened beverage (SSB) consumption and probability of reporting no effect on obesity status or weight gain.[13] Reviews reporting conflicts of interest due to industry funding were five times more likely than reviews with no industry conflicts to conclude that SSB consumption was not related to obesity or weight gain.

Epidemiological Evidence

Epidemiologist Vasanti Malik reviewed nutrition and cardiovascular mortality data collected by the Centers for Disease Control that illustrated the negative impact of added sugar intake on risk of death from cardiovascular disease when it exceeded the ten percent of calories standard.[14] U.S. epidemiological data showed that sugary beverages were a disproportionately important source of added sugar, particularly for adolescents.[9,15] Results of a meta-analysis of five cohort studies showed that frequent consumption of sugary beverages significantly increased risk of both strokes and myocardial infarctions.[16] Results of another meta-analysis of 17 international cohort studies showed that frequent consumption of sugary beverages significantly increased risk of incident type 2 diabetes.[17]

Mexican nutritional epidemiologist Jorge Salmeron confirmed that added sugar consumption patterns in Mexico resembled the U.S. patterns just described, with adolescents leading all other age groups in the consumption of added sugar.[18] He summarized epidemiological research that he has published in the last decade showing associations between sugary beverage intake and increased risk of obesity,[19] metablic syndrome,[20] and blood uric acid levels.[21]

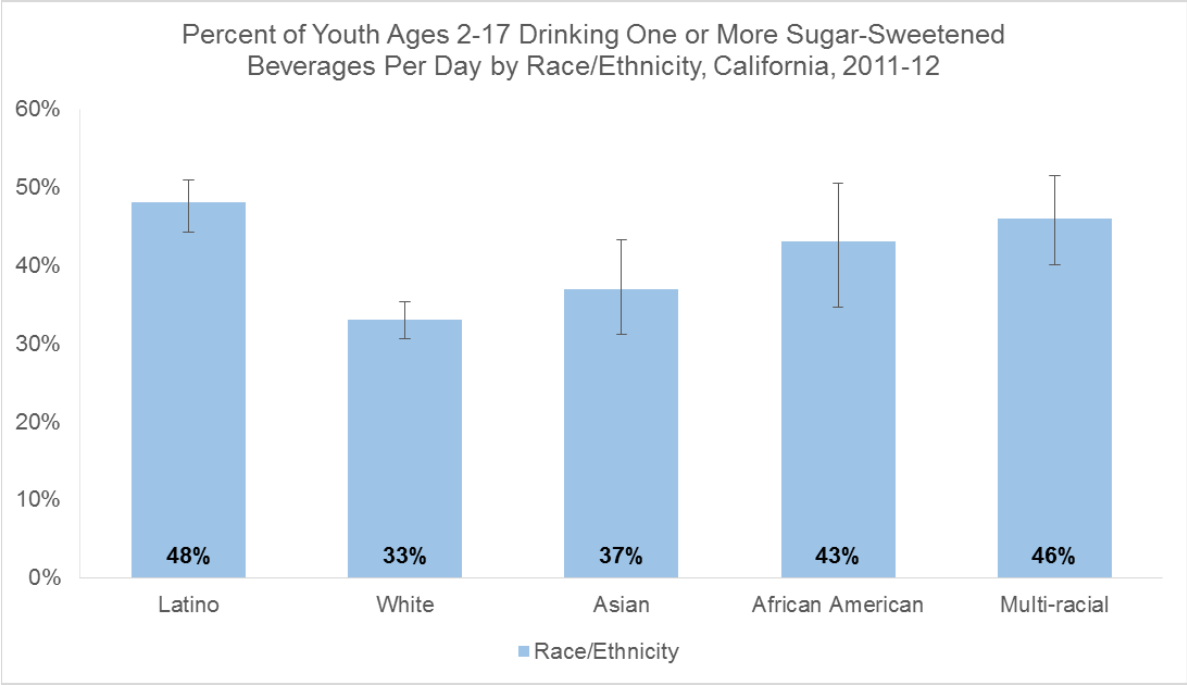
Figure 2. Food Category Sources of Added Sugars in the U.S. Population Ages 2 Years and Older



Source: U.S. Department of Agriculture (USDA). Dietary Guidelines for Americans 2015-2020. Eighth Edition. 2016; http://health.gov/dietaryguidelines/2015/guidelines/. What We Eat in America, NHANES 2009-2010

Sugar-sweetened beverages are a major contributor to daily added sugar intake (Figure 2).[9,18,22] These include sodas, juice drinks, sports drinks and energy drinks. They are noteworthy for typically including no dietary fiber and for eliciting less appetite control than when sugar is consumed in solid foods.[23] Babey summarized the epidemiology of sugary beverage consumption in California, using data from the California Health Interview Survey. Babey reported that the percent of youth ages 2-17 drinking one or more SSBs per day is highest among Latino youth (48%) and lowest among White youth (33%), with Asian youth (37%) and African American youth (43%) evincing intermediate prevalence rates (Figure 3).[24] Prevalence rates for adults from these ethnic groups were in line with the corresponding rates for youth from the same ethnic groups.

Figure 3. Percent of Youth Ages 2-17 Drinking One or More Sugar-Sweetened Beverages per Day by Race/Ethnicity, California, 2011-12



Source: 2011-12 California Health Interview Survey. Babey SH, Wolstein J, Goldstein H. Still Bubbling Over: California Adolescents Drinking More Soda and Other Sugar-Sweetened Beverages. UCLA Center for Health Policy Research and California Center for Public Health Advocacy, 2013.

Physiological Mechanisms

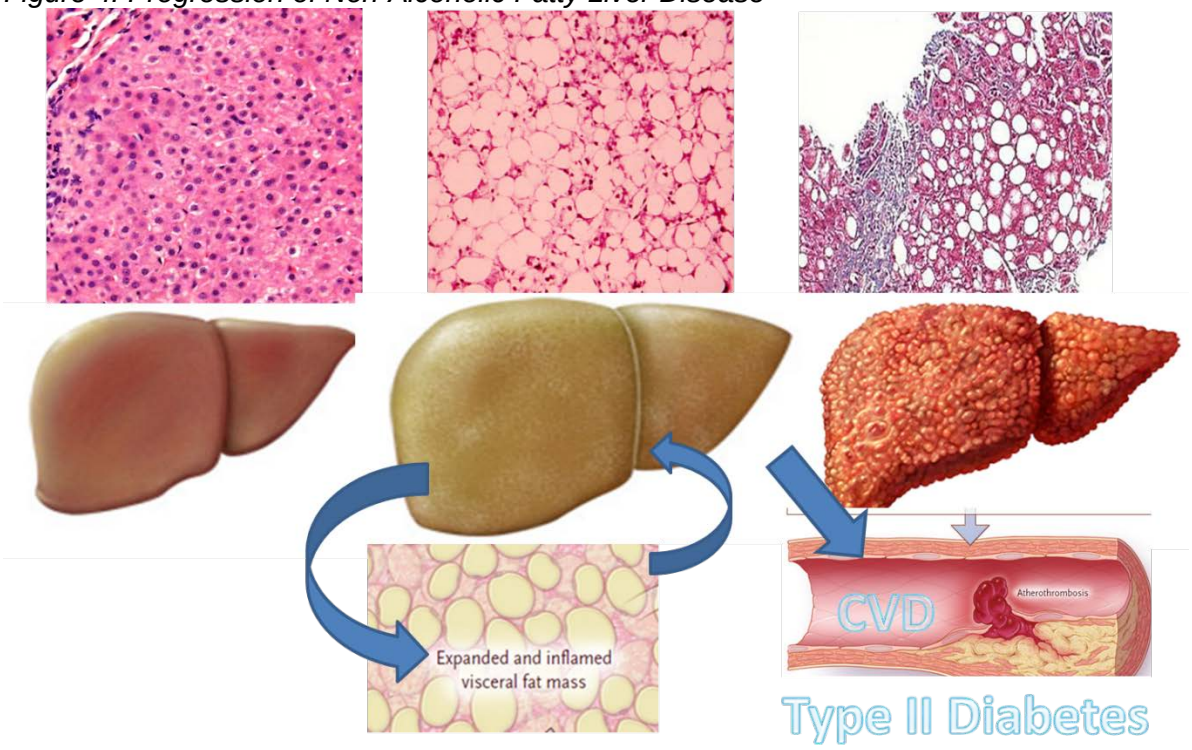
As the evidence that excess sugar intake contributes to preventable disease has grown, so has the interest in identifying the physiological mechanisms that link excess sugar intake to cardiometabolic outcomes. [25]

The emerging science of the gut microbiome is highlighting the negative health impact of removing fiber from naturally sweet foods such as fruit to concentrate the sweetness. [26] McCarthy noted that eight ounces of fresh apple and eight ounces of apple juice have similar nutritional compositions, so similar that until recently they were viewed as nutritionally equivalent – both were considered to be fruit. To be sure, both are mostly water by weight, with 84% of the apple consisting of water and 88% of the apple juice consisting of water; both have close to 30 g of sugar. [27] The major difference, of course, is fiber, which has traditionally been ignored by nutrition researchers as being non-nutritive and therefore irrelevant to energy balance. But the emerging science of the gut microbiome is highlighting the important role that soluble polysaccharides also known as soluble fiber such as pectin play in nourishing the commensal or "friendly" bacteria in our gut. [28] Well-nourished gut microbes, in turn, play an under-appreciated role in glucose metabolism, glucose management and satiety-signaling. [29]

The metabolic fate of 8 ounces of fresh whole apple is now recognized to be quite distinguishable from the metabolic fate of 8 ounces of apple juice; they are not metabolically equivalent.[30] The American Academy of Pediatrics, as a result, issued new guidance[31] indicating that no babies under the age of 1 should be fed fruit juice unless the child has significant problems with constipation and that 100% fruit juice should be provided in only limited amounts to older infants. Nutritional biologist Kimber Stanhope presented findings from well-controlled diet intervention studies highlighting the increased risk for cardiovascular disease associated with increased consumption of added sugar. Her presentation focused on how consuming sugar specifically in the form of fructose could be contributing disproportionately to dyslipidemia and insulin resistance.[32] For example, in a clinical trial of healthy adults, Stanhope and colleagues found that consumption of beverages containing increasing amounts of high-fructose corn syrup resulted in corresponding increases in established risk factors for cardiovascular disease within two weeks.[33]

Pediatric hepatologist Miriam Vos discussed the natural history of steatohepatitis as the liver changes from its originally smooth appearance when healthy to showing signs of fat infiltration at the height of fatty liver disease to obvious fibrosis after the diagnosis of steatohepatitis (Figure 4). In agreement with two other presenters she said that excess added sugar intake typically contributes to the development of fatty liver disease by inducing the liver to cope with the excess sugar intake by converting some of the excess sugar into triglycerides and then storing them in the liver. A proof of this concept was a demonstration by Danish researchers that drinking a liter of sucrose-sweetened beverage every day for 6 months contributed to increased visceral fat whereas drinking a liter of mineral water, skim milk or aspartame-sweetened beverage did not. [34]

Figure 4. Progression of Non-Alcoholic Fatty Liver Disease



But conversion to triglycerides of excess sugar, especially fructose found in sugary drinks is only one pathway to fatty liver disease; another pathway is by way of the gut microbiota. There is no fructose in artificially sweetened beverages and yet artificially sweetened beverages have also been shown to contribute to metabolic dysfunction, through effects on the gut microbiota.[35] More specifically, citing scientific literature,[36] Vos identified the gut microbiota as an important modulator of endotoxemia, which in turn could induce increased systemic inflammation and thereby stimulate further pathophysiological changes in liver function. A plausible causal narrative would start with reduced fiber intake consequent to high sugar intake,[37,38] which leads to reduced fuel for commensal bacteria in the large bowel [39] which would lead to reduced bacterial generation of short chain fatty acids [40] which would lead to impaired intestinal barrier function [41] which would lead to translocation of lipopolysaccharides into the host circulation,[36] eliciting an inflammatory immune system response which could over time contribute to the development of steatohepatitis.[42]

McCarthy presented a different perspective on mechanisms by which added sugar consumption could affect metabolism when he discussed a recent laboratory study of satiety involving low-income urban adolescents.[43] The study stratified participants by their customary sugary beverage consumption (less than 1 sugary beverage/day vs 1-2 sugary beverages/day vs 2+ sugary beverages/day). Results showed an inverse association between sugary beverage intake and satiety-signaling as reflected by self-reported fullness, with

maximum satiety ratings occurring 3.5 hours after the last meal (lunch).[43] The time scale is important because with the typical meal the food residue transits and escapes the small bowel in under 3 hours,[44] suggesting that the self-reported satiety at 3.5 hours was influenced at least in part by an heretofore ignored role of the colon in satiety-signaling.[45]

Intervention Strategies and Policy Approaches

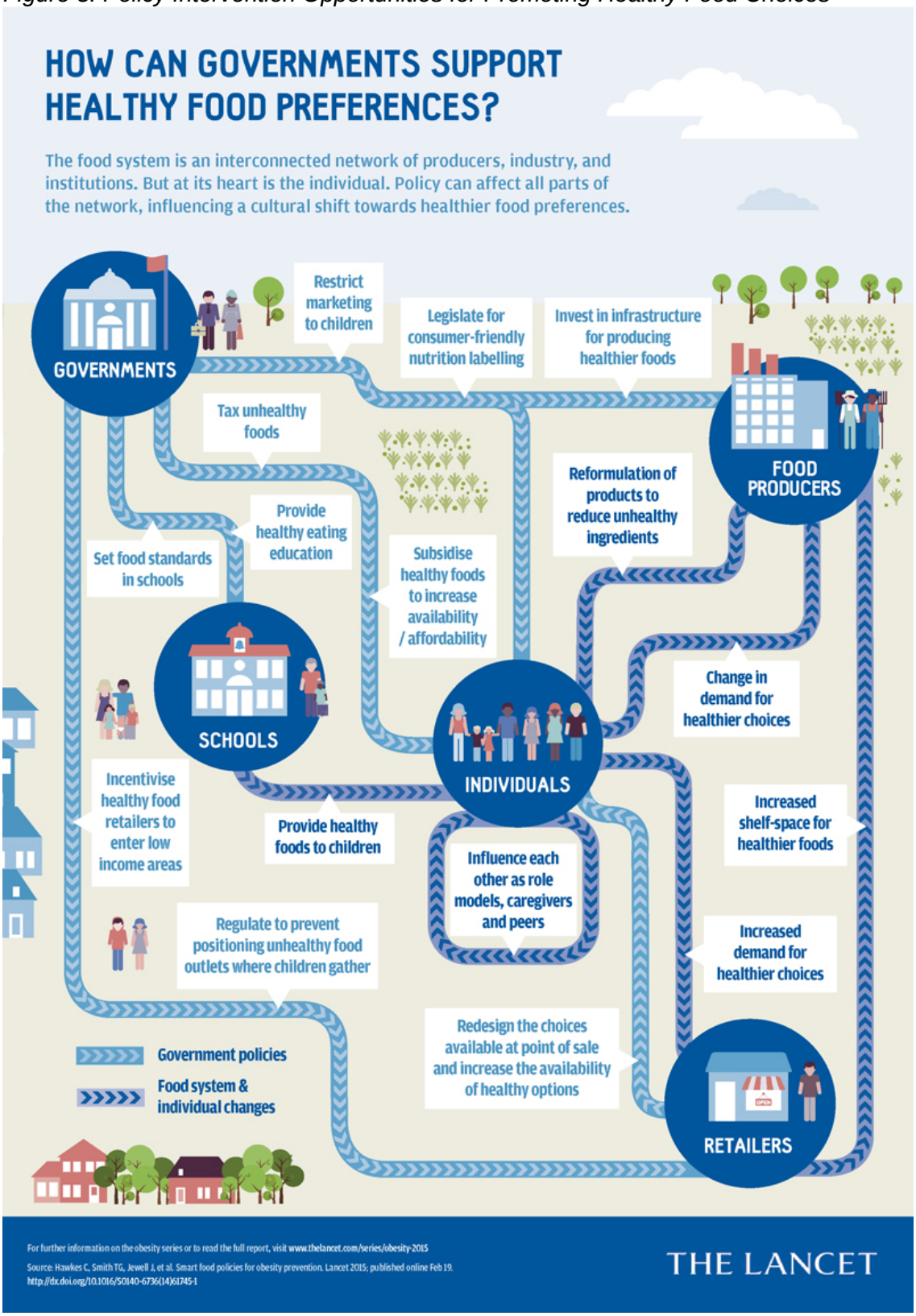
A key objective of this roundtable was to discuss strategies for limiting excess consumption of added/free sugar. Thus, after review and discussion of the epidemiology of sugar consumption and putative mechanisms by which consuming excess added sugar may impact health, the roundtable presentations turned to addressing strategies for reducing excess sugar consumption in the population. Many of the strategies discussed appear in Figure 5 which illustrates policy opportunities to create food environments that support healthy choices.[46] Several presenters discussed intervention strategies and policy approaches for limiting or reducing excess sugar consumption. Cara Ebbeling presented results from a randomized trial testing an intervention designed to reduce SSB consumption among overweight and obese adolescents that involved home delivery of non-caloric beverages to intervention group participants.[47] The intervention did result in lower body-mass index (BMI) among the intervention group than among the control group at the end of the 1-year intervention. However, this difference was not maintained at 2 years follow-up.

Jamie Chriqui discussed state and school district policy approaches to reducing students' access to added sugars while at school. Research conducted by Chriqui and her colleagues suggests that policies that ban soda but allow other types of SSBs in schools are not sufficient to reduce access and purchasing because students often substitute the purchase and consumption of other types of SSBs (for example sports drinks) for the sodas.[48] Moreover, research by Chriqui and colleagues suggests that school policies that ban school sale of all types of SSBs do, indeed, reduce access to and purchase of SSBs by students as well as in-school SSB consumption, but do not reduce overall consumption when out-of-school consumption is taken into account.[49] Chriqui concluded that her findings suggest that school policies can contribute to the goal of reducing student SSB consumption, but that schools cannot achieve the goal alone.

Dannon dietitian Jessica Smerling acknowledged her perspective as a dietitian working in the food industry. She discussed Dannon's recent voluntary efforts to reduce the sugar content of its products as part of their commitment to the Partnership for a Healthier America (PHA). PHA works with the private sector to increase the supply of healthier food options while also working on initiatives to increase demand for healthier options among consumers. In part because of their commitment to PHA, Dannon has reduced the sugar content in 100% of their products for children and 78% of their products overall. Experts in the room noted that although Dannon's efforts are a step in the right direction, even at these reduced levels, the sugar levels of many of the products may still make it

difficult for consumers to adhere to recommended federal limits on daily sugar intake. However, Dannon does have plans to further reduce the sugar content of its products by 2020.

Figure 5. Policy Intervention Opportunities for Promoting Healthy Food Choices



Source: Hawkes C, Smith TG, Jewell J, et al. Smart food policies for obesity prevention. The Lancet.385(9985):2410-2421.

Lori Dorfman discussed the challenges involved in the framing of public health messages such as those around reducing excess sugar consumption. The challenges include an individual responsibility framework that minimizes the role of environments in influencing food choice behavior and that minimize the impact of marketing and advertising by industries selling products that contain large amounts of sugar. For example, research by Dorfman and her colleagues highlights the high level of exposure that youth have to food and beverage marketing.[50] She also discussed Berkeley Media Studies Group's analysis of media coverage of Berkeley's soda tax measure, which was approved by 76% of the voters in November 2014 despite strong industry opposition. This analysis found that messages opposing the tax measure focused on fairness and local social justice issues. For example, they focused on what they called "loopholes" in the proposed measure that would allow certain drinks containing sugar not to be taxed.[51] Messages supporting the tax measure emphasized the negative health effects of sugar consumption and characterized the beverage industry as "Big Soda".

Marice Ashe discussed several policy strategies for limiting SSB consumption including sugary beverage taxes and warning labels for SSBs. She also emphasized the importance of access to clean, safe drinking water as a critical component to reducing consumption of SSBs. Currently no policies requiring warning labels on SSBs have been enacted, so there is no direct evidence about their effectiveness. However, the long history of warning labels on tobacco products suggests that they could be effective. A review of the research examining the effectiveness of tobacco warning labels found that these warning labels can increase health knowledge and are associated with reductions in number of cigarettes smoked and fewer smokers.[52] Another roundtable (virtual) attendee, Christina Roberto, has published two studies which shed some light on the possible impact of SSB warning labels. The first study suggested that warning labels led parents to believe SSBs were less healthy and also that labels may reduce parents' intentions to purchase SSBs for their children.[53] The second study found that warning labels may reduce adolescents' intentions to purchase SSBs.[54]

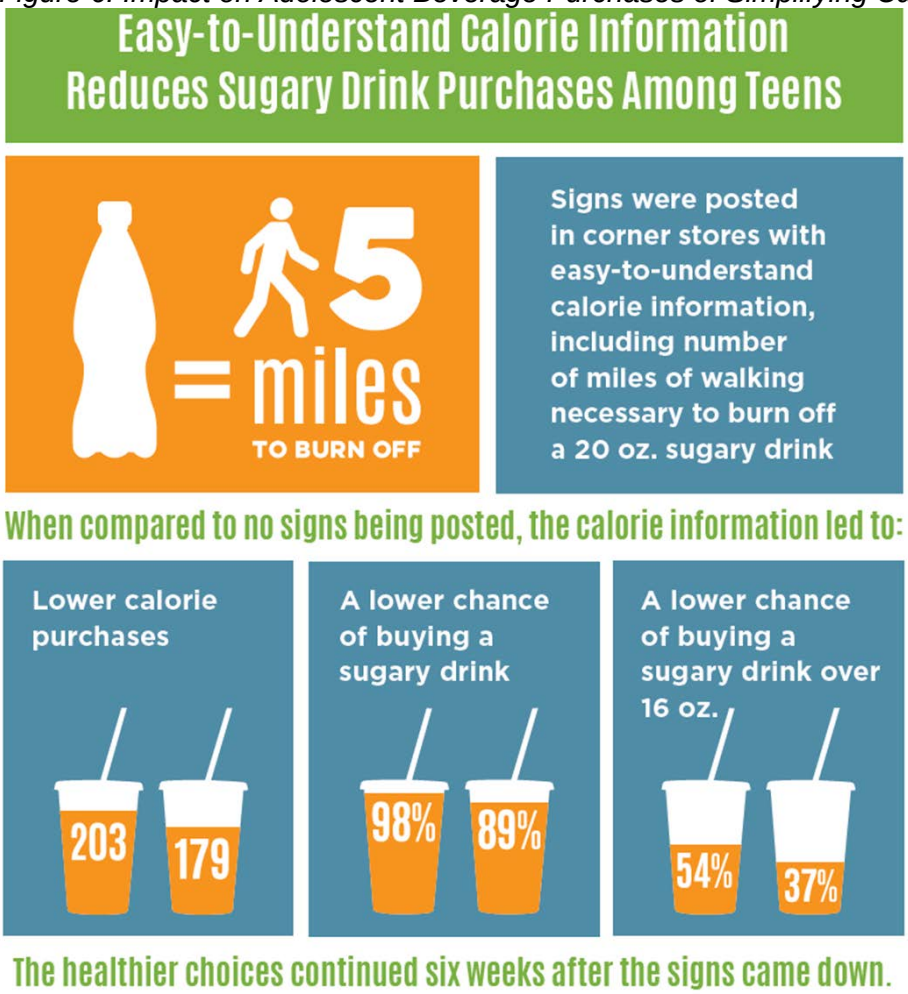
Recent research evaluating the impact of Berkeley's soda tax, which has been in effect since March 2015, suggests that it may be having the intended effects. Roundtable participant Kristine Madsen conducted research with several colleagues that found that the cost of sugary beverages increased 3 months after implementation of the measure.[55] In addition, they found that consumption of SSBs decreased in two low-income neighborhoods in Berkeley.[56] In comparison, SSB consumption in comparable neighborhoods in San Francisco and Oakland, which had no tax when the data were collected, actually increased slightly over the same time period. A large study examining pre- and post-tax prices, sales, and consumption of SSBs also provides some evidence about the effects of Berkeley's tax on sugary drinks.[57] This study by Silver and colleagues found that

SSB prices increased and SSB sales decreased in Berkeley, even as SSB sales increased in non-Berkeley stores. However, self-reported consumption of SSBs did not significantly change. While these studies are preliminary and do not address the long-term impact of sugary drink taxes, their results are consistent with evaluations of the impact over two years of Mexico's 2014 national tax on sugary beverage purchases, showing decreased purchases of sugary beverages and increased purchases of water, especially among low-income consumers.[58]

As the field progresses in elucidating the causal mechanisms linking excess consumption of added sugars to cardiometabolic outcomes, there is a contemporaneous need to identify practical strategies for communicating to at-risk groups the importance of limiting daily intake of added/free sugars. Behavior change trialist

Sara Bleich shared some of her recent intervention efforts with Roundtable attendees, one of which nicely illustrated the benefits of translating laboratory concepts, such as calories, into conceptual equivalents immediately understandable to the target community. In one study involving local convenience stores Bleich serially tested different messages in the store setting that were designed to encourage youth to replace the purchase of sugary beverages with purchases of non-sugary beverages like milk or water. When the message focused on the excess "empty" calories represented by the typical sugary beverage, no change in sugary beverage purchases was seen.[59] When the message was translated into the miles of jogging needed to burn off the extra calories, a significant and sustained drop in sugary beverage purchases was observed (Figure 6).[59]

Figure 6. Impact on Adolescent Beverage Purchases of Simplifying Calorie Information



Source: Bleich, S. N., et al. (2014). "Reducing sugar-sweetened beverage consumption by providing caloric information: How black adolescents alter their purchases and whether the effects persist." Am J Public Health 104(12): 2417-2424.

McCarthy presented research findings of thought leaders in the field who could not make it to the Expert Roundtable but whose contributions to the literature he felt should be mentioned. One of these leaders is Barry Popkin, a prolific contributor to the literature on sugary beverage consumption and recent coauthor of a paper evaluating the impact of Mexico's 2014 one peso per liter excise tax on sugary beverages. [58] The impetus for the tax was evidence that Mexican consumers underconsume nutrient-rich foods such as legumes, fruits and vegetables and overconsume food products rich in added sugars, saturated fat and sodium.[60] The recent evidence supported the use of fiscal policies to reduce consumption of unhealthy beverages along with other interventions to reduce the burden of obesity-related chronic diseases. More specifically, using commercial store purchase data obtained from 6,645 Mexican households, they determined that purchases of taxed beverages decreased an average of 5.5 percent in 2014 and 9.7 percent in 2015 even as the purchases of untaxed beverages increased

2.1 percent. The largest decreases in purchases of taxed beverages in both years were observed in households at the lowest socioeconomic level.

Other thought leaders who could not participate in the Expert Roundtable were Lisa Powell and Sanjay Basu, two economists who have separately examined economic influences on sugary beverage consumption. [61,62] Epidemiological research indicated a negligible 1 percent reduction (from 70% to 69%) in the prevalence of daily sugary beverage consumption among recipients of government supplemental nutrition assistance (SNAP) during the 2003-2010 interval in contrast to a significant decline in daily sugary beverage consumption by both SNAP-eligible nonparticipants (from 65% to 57%) and consumers ineligible for SNAP benefits (from 55% to 46%).[61] Does receiving SNAP benefits make it easier for the poor to continue consuming sugary beverages even as non-SNAP recipients decrease their consumption? [61] Subsequent research indirectly re-examined the impact of SNAP benefits on sugary beverage consumption by examining associations between county-level cost-of-living metrics, SNAP participation status and an omnibus measure of diet quality.[62] In contrast to the earlier study, SNAP participation was associated with significantly higher diet quality than SNAP nonparticipants if the SNAP participants lived in high-cost-of-living areas but there was no difference in diet quality between SNAP participants and nonparticipants in low-cost-of-living areas.[62] If healthier choices are not available to residents of low-income areas, which typically have a lower density of full service supermarkets and sit down restaurants than high-income areas,[63] government provision of supplemental nutrition assistance may not translate to improved dietary quality or lower sugary beverage intake.

Summary and Conclusions

The strongest and most apparent conclusion to this roundtable is that more research is needed in a variety of areas including the description of any changing patterns in consumption of added sugar, the mechanisms through which added sugar consumption impacts health, and the effectiveness of different policy and intervention strategies to reduce consumption. The day's review of the state of the literature, however, also provided sufficient justification for clinicians and public health professionals to not wait for the results of additional research. As reviewed during the Roundtable, there are immediate, practical, evidence-based steps that clinicians and public health professionals can take to reduce population excess sugar intake, especially in the young, to protect them from a variety of medical conditions empirically linked to regular excess consumption of added/free sugars.

These steps include:

- Limiting child access to sugary beverages in schools
- Limiting added sugar in school lunches to no more than 10 percent of calories
- Assuring child access to potable water at every school
- Providing easy to understand added sugar information at the point of purchase

- Workplace and hospital food procurement contracts that require that less than 10 percent of calories come from added sugar.

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