

# Last Nail in the Coffin for Sugar-Sweetened Beverages

## Now Let's Focus on the Hard Part

Article, see p 2113

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**S**ugar-sweetened beverage (SSB) intake has consistently been associated with increased risk for type 2 diabetes mellitus, coronary heart disease, hypertension and excess body weight, and potentially frailty.<sup>1-3</sup> To date, no clear and independent benefits of consuming SSB have been identified within the context of our current global food landscape. In this issue of *Circulation*, we are provided with robust prospective data from 2 cohorts, the NHS (Nurses' Health study) and HPFS (Health Professional's Follow-Up study), demonstrating that SSB intake, in a graded dose-dependent manner, was positively associated with cardiovascular disease (CVD) and all-cause mortality but not consistently with cancer mortality.<sup>4</sup> In contrast to consistent data for SSB intake, results from prior studies testing associations of artificially sweetened beverages (ASBs) with a range of health outcomes have been mixed.<sup>5,6</sup> The associations between ASB intake and CVD and all-cause mortality in the NHS and HPFS were significant only at the highest level and for women only.<sup>4</sup> As cautioned by the authors, these findings related to ASB await confirmation. How should the findings from this important new study be interpreted?

### SUGAR-SWEETENED BEVERAGES

The association between SSB intake and all-cause mortality is driven primarily by CVD rather than cancer. The positive associations were significant for all categories of age, body mass index, physical activity, estimation of diet quality, and types of SSB. Reporting this detailed assessment was particularly important because individuals who admit to consuming the highest amount of SSB tended to have a constellation of characteristics that covaried, raising the question of whether the effect of SSB was independent. The highest consumers of SSB tended to be younger; engage in less physical activity; be more likely to smoke; have higher rates of hypertension; be less likely to take multivitamins; have higher intakes of total energy and red and processed meat; have lower intakes of whole grains, vegetables, and alcohol; and have a higher dietary glycemic load and lower diet quality. Although each of these factors, in different ways, could have contributed to the findings of SSB intake and mortality, to the extent possible, the authors went to great lengths to limit this possibility. Although a cause-and-effect relationship cannot be definitively established, this should not detract from the general message that benefit will likely be derived from reducing the intake of SSB and that there are no signals for potential adverse effects of making this change that would lead to unanticipated consequences. The association of SSB and cancer mortality is more difficult to interpret, is attenuated or became nonsignificant after controlling for confounders, and was only significant in women. Cancers of different sites have different causes. Some, particularly

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endocrine cancers, have been linked to excess body fat.<sup>7</sup> Consistent with these data, the strongest relationship between SSB intake and cancer was for breast cancer. Body mass index tended to be higher in women reporting the highest intakes of SSB but not in men, perhaps explaining the sex differences.

## ARTIFICIALLY SWEETENED BEVERAGES

The relationship between ASBs and mortality is less clear. ASB intake was positively associated with CVD and all-cause mortality in the women, although this association was weakened after correction for confounding factors, resulting in a significant effect for all-cause mortality and nonsignificant effect for CVD mortality. When women at the highest level of ASB intake were separated out ( $\geq 4$  servings per week), the relationship with mortality became stronger. Similar relationships were not observed in men or in either sex for cancer mortality. Of note, the data for ASB need to be interpreted with caution given that the category of sweeteners was chemically heterogeneous during the period of data collection and is even more heterogeneous at present. Within this context, the authors estimated from their data that substituting 1 serving of an SSB with an ASB was associated with a 4% lower risk of all-cause mortality, 5% lower risk of CVD mortality, and 4% lower risk of cancer mortality.<sup>4</sup>

## CURRENT LANDSCAPE AND TACKLING THE PROBLEM

With these findings taken together, what we now have is a long-term, prospective, comprehensive assessment of both SSB and ASB intake and mortality, the most extensive to date. The limited generalizability of the cohorts should not detract from the findings because no indications have been identified to suggest that individuals with different demographic characteristics would respond differently. Although attenuated by certain covariates, the findings, for the most part, remained robust. An important observation is that the data were consistent across all categories of SSBs. The findings clearly demonstrated that substitution of ASB for SSB would be predicted to have a positive impact on mortality.

So where are we with respect to SSB? In the 21st century, there appears to be no benefit to consuming SSBs, and there appears to be benefit from not consuming SSBs. However, there is some reason for caution. In the past, when the nutrition community has overemphasized an isolated dietary component or single nutrient rather than the whole dietary pattern, we have met with disappointing outcomes at best (eg, vitamin E,<sup>8</sup> vitamin D<sup>9</sup>) and adverse outcomes at worst (eg, low-fat diets<sup>10</sup> and  $\beta$ -carotene<sup>11</sup>). However, SSBs are unique. Besides contributing, for the most part, unneeded di-

etary energy and rapidly absorbable simple carbohydrate, unless fortified, they are devoid of essential nutrients. The conclusions of these new data<sup>4</sup> and the vast majority of prior work<sup>12,13</sup> are unusually consistent for the field of nutrition. What should we do with these data? To a certain extent, as a community, we can take the high road about beverage recommendations: Drink water (or flavored water) in place of SSBs. However, continuing this simple approach would be disingenuous because we know that it has not worked well in the past and there is little reason to expect that it will work well in the future, particularly for the subgroups of the population bearing the largest burden from the adverse effects of SSBs. Why so disenchanting? Consistently, starting with the Dietary Goals for Americans published in 1977 and through various editions of the Dietary Guidelines for Americans starting in 1980, there has been a recommendation to reduce sugar intake.<sup>14</sup> The 2000 edition of the Dietary Guidelines for Americans intentionally added specifically to this recommendation by advocating a reduction in SSB intake. Nevertheless, as demonstrated in the NHS and HPFS cohorts, SSB intake increased until the turn of this century, although it is now declining.<sup>4</sup> Even with this decline, intake levels are still at alarmingly high levels.

Knowledge of and behavior concerning the adverse effects of SSB may not be as closely related as expected.<sup>15</sup> Traditionally, we have relied on recommendations from the government or health advocacy organizations to change behavior, frequently with disappointing effects. Other approaches have been more successful but do not provide a viable template for SSBs. Removal of the major source of dietary *trans* fatty acids from the food supply, partially hydrogenated fat, and substitution of vegetable oils did not affect the appearance or taste of food. Hence, the phase-out of partially hydrogenated fat essentially went under the radar, and for the average person, the default option became the healthier option. In contrast to *trans* fatty acids, removing sugar from foods and beverages alters their appearance and taste. In addition, from a young age, we are habituated to sweet (eg, fruit juice), and from a teleological perspective, some have hypothesized that preferences for sweet resulted in our survival, coupled with an aversion to bitter and sour.

So where do we go from here? Rather than generating more data on the adverse effects of SSBs, we need to move on to the harder task and aim to make greater strides in understanding what the motivation is for choosing SSBs despite knowledge of the risks. We need to go out of our comfort zones and partner more closely with our behavioral colleagues. We need to develop new approaches to understand what drives the choice of SSBs. These new understandings may be transferable to other areas of adverse health behaviors, or they may be unique to SSB. At this point, that is not

important. What is important is that we have identified a problem, and we need to focus a concerted effort on fixing it permanently.

## ARTICLE INFORMATION

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### Disclosures

None.

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