

# THE HEALTH AND ECONOMIC IMPACT OF A TAX ON SUGARY DRINKS IN CANADA

SUMMARY

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## ACKNOWLEDGEMENTS

FUNDING FOR THIS STUDY WAS PROVIDED BY THE CANADIAN CANCER SOCIETY, DIABETES CANADA, THE CHILDHOOD OBESITY FOUNDATION, THE CHRONIC DISEASE PREVENTION ALLIANCE OF CANADA, AND THE HEART & STROKE FOUNDATION. ADDITIONAL SUPPORT WAS PROVIDED BY A CANADIAN INSTITUTES OF HEALTH RESEARCH CHAIR IN APPLIED PUBLIC HEALTH (HAMMOND). WE WOULD LIKE TO ACKNOWLEDGE DR. DOUG MANUEL (STATISTICS CANADA) AND DR. PAT NEWCOMBE-WELCH (SOUTH-WESTERN ONTARIO RESEARCH DATA CENTRE) FOR THEIR ASSISTANCE WITH ACCESSING CANADIAN DATA SOURCES.



## SUGGESTED CITATION

JONES AC, VEERMAN JL. HAMMOND D. THE HEALTH AND ECONOMIC IMPACT OF A TAX ON SUGARY DRINKS IN CANADA (SUMMARY). JANUARY 2017.

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## BACKGROUND

Sugary drinks represent an important source of sugar consumption among Canadians.<sup>1,2,3,4</sup> Excess consumption of sugary drinks is associated with an increased risk of type 2 diabetes, metabolic syndrome, cardiovascular disease (CVD) and cancer, primarily through its association with weight gain, as well as increased risk of dental caries.<sup>5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20</sup>

Sugar intake from beverages is commonly defined in one of two ways. The term 'sugar-sweetened beverage' (SSB) is based on criteria for 'added sugars', and typically includes non-diet carbonated soft drinks, ready-to-drink sweetened teas and coffees, energy drinks, sports drinks, flavoured bottled water, and 'fruit drinks' with less than 100% fruit juice.<sup>21</sup> Most definitions of SSBs also include flavoured milk and drinkable yogurts with added sugars. The term 'sugary drinks' is based on the criteria for 'free-sugars', which is broader than added-sugars. Free-sugars include monosaccharides and disaccharides added to foods and beverages, plus sugars naturally present in honey, syrups, fruit juices, and fruit juice concentrate. Therefore, 'sugary drinks' include SSBs but also beverages containing 100% juice on the basis that free-sugars contribute to the overall energy density of beverages and are metabolized the same way as 'added-sugars'.<sup>22</sup>

An increasing number of jurisdictions have enacted a tax on SSBs as a fiscal measure to reduce excess sugar intake from beverages. Countries including Mexico, France, Hungary, Finland, Norway, Belgium, Chile, Barbados and a growing list of jurisdictions in the United States (e.g., Berkeley and Philadelphia) have implemented, or are in the process of implementing, excise taxes.<sup>23,24,25,26,27,28,29</sup> The United Kingdom (UK), Ireland and South Africa are among the countries that have proposed sugary drink taxes.<sup>30,31,32</sup>

The tax amount varies across these jurisdictions. For example, Mexico, Cook County (Illinois) and four Californian cities have enacted taxes of approximately 1 cent per ounce or 34 cents per litre, Philadelphia has implemented a tax of 1.5 cents per ounce or 51 cents a litre, while the Boulder (Colorado) tax is equivalent to 2 cents per ounce or 68 cents per litre.<sup>28,29,33,34,35,36,37</sup> The UK's proposed tax classifies beverages based on sugar content, with a lower tax rate for drinks with total sugar of 50 grams or more per litre, and a higher rate for those with 80 grams or more per litre. Proposed tax rates are 18 pence (~25 cents Canadian) and 24 pence (~34 cents Canadian) per litre, respectively.<sup>30,38</sup> To date, the evidence indicates that excise taxes are an effective measure for reducing SSB consumption, while also generating substantial government revenue.<sup>39,40,41</sup> The effect of a tax is influenced by the amount of the tax and the number of sugary drinks to which it applies.

The current study examined the health and economic impact of sugary drinks in Canada, as well as the potential health and economic benefits of a sugary drink tax. The study consisted of three components: (1) an analysis of national data on sugary drink consumption among Canadians, (2) estimates of the health and economic impact of sugary drinks in Canada, and (3) estimates of any potential health and economic benefits of an excise tax on sugary drinks.

## METHODS

### SUGARY DRINK SALES

Sales data were purchased from Euromonitor International for the years 2001 to 2015. Euromonitor provides market reports for food and beverage sales in Canada and globally.<sup>42</sup> Euromonitor sources its data from a range of industry sources; however, the methods used are proprietary and cannot be independently validated.

Euromonitor data was purchased for the following beverage categories: non-diet cola and non-cola carbonated soft drinks, ready-to-drink teas and coffees, energy drinks, sports drinks, flavoured bottled water, flavoured milk, drinkable yogurt, concentrates (defined as fruit drinks), juice drinks (up to 24% juice), nectars (24-99% juice), and 100% juice.<sup>43</sup> Data are reported for each category in terms of total volume (millions of litres) of beverage sales per calendar year. The correspondence between population-based beverage intake data and Euromonitor estimates of food and beverages sales is not known. Sales estimates include any 'waste' from beverages sold but not consumed.

*Sugary drink* sales were defined as the total sales volume from the following beverage categories, consistent with the World Health Organization's definition of 'free sugar': regular carbonated soft drinks, regular fruit drinks, non-diet sports drinks, non-diet energy drinks, sugar-sweetened coffees and teas, hot chocolate, non-diet flavoured water, sugar-sweetened milk (e.g. chocolate milk), sugar-sweetened drinkable yoghurt, and 100% juice. Estimates for *sugar-sweetened beverage* (SSB) sales were the same as sugary drinks, with the exception of 100% juices was omitted –see Figure 1.

The Euromonitor data was purchased in August 2016. Due to Euromonitor's standard data agreement, specific estimates of individual beverage categories for a given year cannot be reported. Therefore, data are presented showing changes in a single beverage category over time, or showing aggregated beverage categories within a single year.

FIGURE 1

#### Sugar-sweetened beverages (SSBs)



REGULAR SOFT DRINKS, SWEETENED TEA & COFFEES, SPORTS DRINKS, FRUIT DRINKS, ENERGY DRINKS, FLAVOURED WATER, FLAVOURED MILK & DRINKABLE YOGURT

#### Sugary drinks



REGULAR SOFT DRINKS, SWEETENED TEA & COFFEES, SPORTS DRINKS, FRUIT DRINKS, ENERGY DRINKS, FLAVOURED WATER, FLAVOURED MILK & DRINKABLE YOGURT  
**100% JUICE**

## **SUGARY DRINK INTAKE**

The most recent national estimates of beverage intake are from the 2004 Canadian Community Health Survey (CCHS 2004 Cycle 2.2).<sup>44</sup> The dietary intake data from the 2004 CCHS are more than a decade old; therefore, Euromonitor sales data were used to estimate projected drink intake for 2015. According to Euromonitor data, the per capita volume of sugary drink sales decreased by 12.6% between 2004 and 2015, after accounting for population growth. Accordingly, the volume and energy of SSB and sugary drink intake assessed in 2004 was reduced by 12.6% for each individual who consumed any of the 10 beverages. The mean per capita daily intake (volume and energy) of total SSBs and total sugary drinks was calculated for representative age and sex sub-groups.

## **HEALTH AND ECONOMIC COSTS MODEL**

The Assessing Cost-Effectiveness (ACE) model was used to estimate the health and economic impact of Canadians' sugary drink consumption, and the potential benefits of a tax on sugary drinks.<sup>45,46,47</sup> The model simulates the 2015 Canadian adult population over their lifetime using a Markov cohort macrosimulation with a proportional multi-state life table.

In the ACE model, the health effects of sugary drinks are mediated primarily through increased body mass index (BMI). Estimates of the relative risks of disease due to high BMI were drawn from the *Global Burden of Disease Study* (GBD) 2015 for each of the 19 diseases included in the model: type 2 diabetes, 11 cancers (breast [females], colon and rectum, esophageal, gallbladder and biliary track, kidney, leukemia, liver, ovarian, pancreatic, thyroid, uterine), 4 cardiovascular conditions (ischemic heart disease, ischemic stroke, hemorrhagic stroke, hypertensive heart disease), chronic kidney disease, osteoarthritis and low back pain.<sup>48</sup> Non-BMI mediated health effects from SSB consumption on type 2 diabetes were included. The relative risk of type 2 diabetes incidence increased by 1.13 (95% CI 1.06, 1.21) per serving (250ml/day) of sugar-sweetened beverages.<sup>49</sup> Other non-BMI mediated risks from sugary drinks were not included in the model. Accordingly, the model outputs may be considered conservative estimates of the health burden associated with sugary drinks and the potential health improvements from a sugary drink tax.

Epidemiology and cost data on diseases of interest were selected based on disease definitions specified by the Global Burden of Disease (GBD) 2015 Study using International Classification of Diseases (ICD) codes.<sup>48</sup> Direct health care costs for each disease were calculated from Canada's most recent national disease-specific costs study, the *Economic Burden of Illness in Canada* (EBIC) 2005-2008, and the Canadian Institute for Health Information's (CIHI) *National Health Expenditure Database* (NHEX). Direct health costs consisted of hospital care, physician care, drugs, other professionals, public health and other health spending.<sup>50,51,52</sup> Indirect costs, such as the value of lost production due to one's illness, injury or premature death, were not included. Costs were estimated in 2015 dollars<sup>53</sup>, and the health and economic impacts were modelled over a 25-year period, from 2016-2041. Tax revenue estimates are based on beverage consumption for the entire Canadian population and are therefore not limited to Canadian adults.

Overall, the model provides projections of disease morbidity, disability-adjusted life years (DALYs)\*, mortality and health care costs associated with Canadians' consumption of sugary drinks, as well as the health and economic benefits from a tax applied to sugary drinks.

### **TAXATION LEVELS MODELLED**

An *ad valorem* excise tax was modelled at the following levels: 10%, 20% and 30% of the beverage's pre-tax price. These tax levels are consistent with existing measures in other jurisdictions. For example, based on an average price of \$2.50/litre, the 10% increase is similar to the taxes in Mexico, Cook County (Illinois) and four Californian cities (approximately 1 cent per ounce or 34 cents per litre); the 20% tax is similar to the tax implemented in Philadelphia (1.5 cents per ounce or 51 cents a litre); and the 30% tax is similar to the tax passed in Boulder, Colorado (2 cents per ounce or 68 cents per litre).<sup>29,34,35,36,37</sup> Note that these comparisons may vary based on actual price per litre, and that many existing taxes are designed as specific volumetric excise taxes which account for price per litre. The ACE model simulates *ad valorem* excise taxes set at rates consistent with existing volumetric taxes. Based on the best available evidence, the World Health Organization recommends a minimum 20% tax as best practice, as it has been found substantive enough to change behaviour.<sup>26</sup>

A pooled own-price elasticity of demand for sugary drinks of -1.20 (95% CI -1.34,-1.06) was used in the model, based on a meta-analysis of studies from the USA, Mexico, Brazil and France.<sup>54</sup> A price elasticity of -1.20 indicates that for every 1% price increase, demand for sugary drinks decreases by 1.2%. Given the broad definition of sugary drinks, the model did not incorporate caloric compensation from switching to non-taxed beverages and foods. A 100% tax pass-on rate was assumed; however, sensitivity analyses modelled 80% and 120% pass-on rates.

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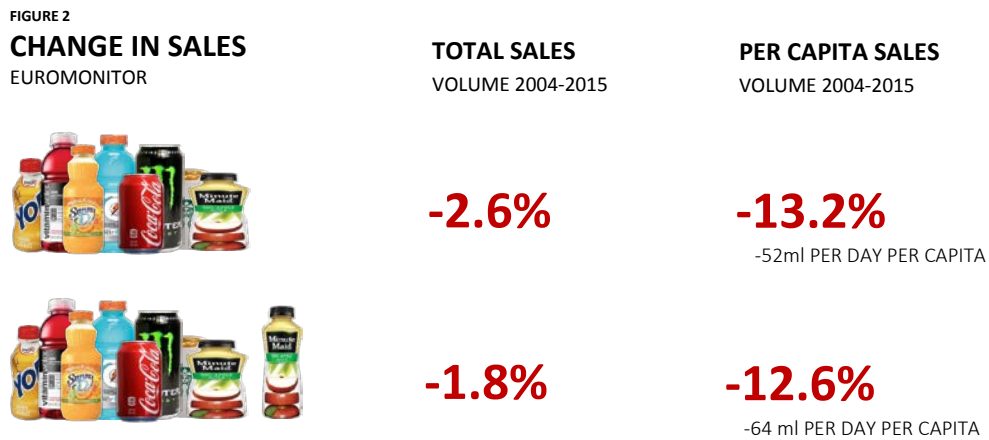
\* Disability-adjusted life years (DALYs) are a population health summary measure that conveys the burden of disease from premature death (years of life lost) and the disabling results of an illness (years lived with disability).

## SUMMARY OF FINDINGS

### SUGARY DRINK SALES IN CANADA

In 2015, Canadians purchased an average of 341ml of SSBs per day, and an average of 444ml of sugary drinks per day when accounting for 100% juice.

The total volume of SSBs and sugary drinks sold in Canada has remained steady between 2004 and 2015 (-2.6% and -1.8%, respectively); however, the per capita sales of SSBs and sugary drinks decreased (-13.2% and -12.6%, respectively) due to increasing population size (see Figure 2).<sup>43</sup> While non-diet soft drink sales have decreased over the 12-year period, the decrease was largely offset by the emergence of newer beverage categories, including flavoured waters, energy drinks and flavoured dairy products.



Between 2004 and 2015, the per capita sales volume decreased for three types of sugary drinks: regular soft drinks, fruit drinks, and 100% juice (Figure 3). In contrast, the per capita sales volume increased for energy drinks, sweetened coffee, flavoured water, drinkable yoghurt, sweetened tea, flavoured milk, and sports drinks (Figure 4).



FIGURE 4

**INCREASED SALES**

VOLUME, PER CAPITA, 2004-2015



Overall, despite modest reductions over the preceding decade, SSB and sugar drink sales in 2015 remained near historic highs, with the emergence of new beverage categories helping to offset larger declines in soft drink sales.

**SUGARY DRINK INTAKE IN CANADA**

Based on projections from CCHS 2004 dietary intake and Euromonitor sales estimates, Canadians consumed an average of 227ml (102 kcal) of SSBs per day in 2015. Including 100% juice, sugary drink intake was 334ml (148 kcal) each day. Consumption of sugary drinks was highest among young Canadians: for example, the average Canadian youth consumed an estimated 578ml of sugary drinks per day, whereas children up to age 8 consumed 326ml per day (Figure 5). For many Canadians, the mean caloric intake from these sugary drinks alone exceeds dietary recommendations to limit free sugar intake to less than 10% of total energy intake.

FIGURE 5

**DAILY INTAKE**

PROJECTED 2015, PER CAPITA\*

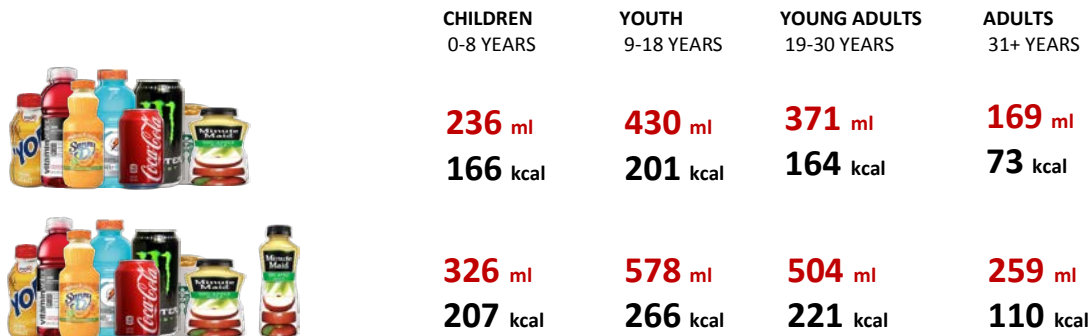
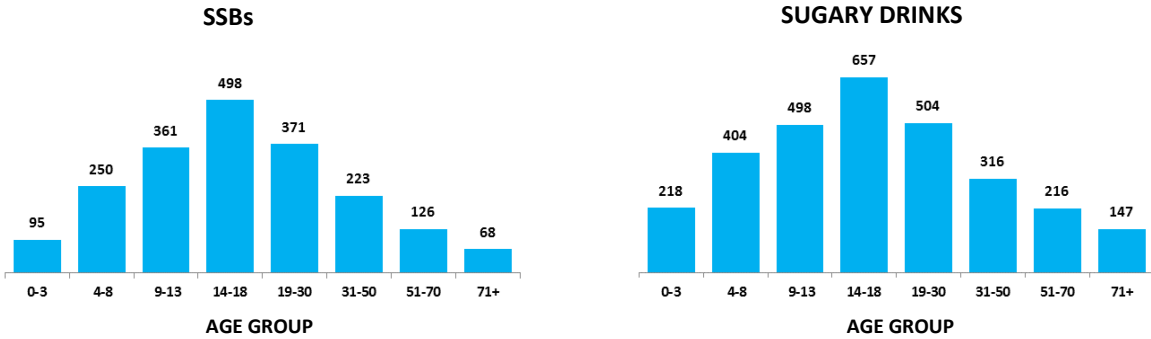




FIGURE 6

**VOLUME OF INTAKE**

ML PER DAY, PER CAPITA, PROJECTED 2015



**ENERGY INTAKE**

KCAL PER DAY, PER CAPITA, PROJECTED 2015

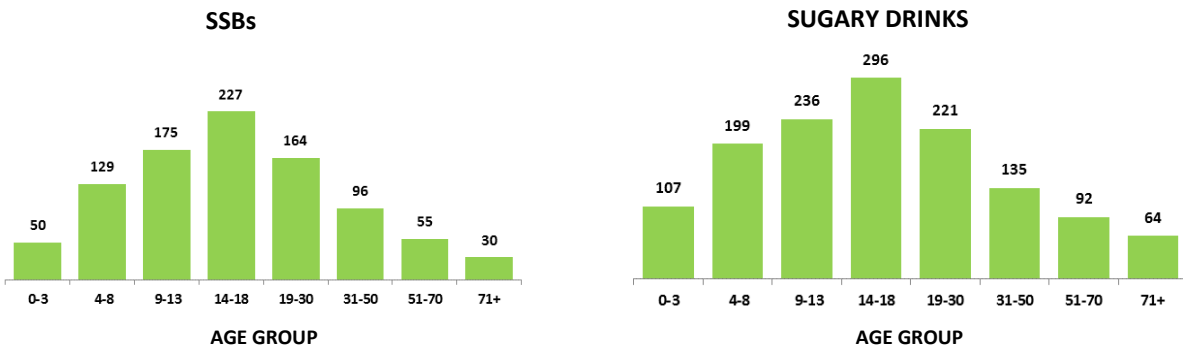
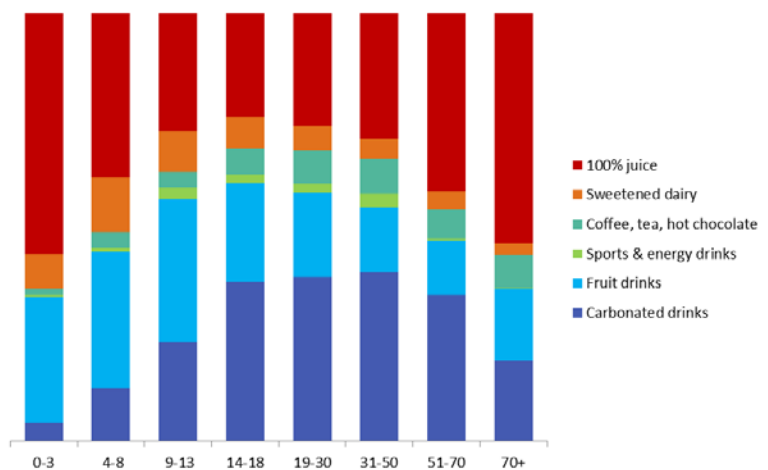


Figure 7 shows the contributions of individual beverage types (by volume) to overall sugary drink intake in 2004. Among children up to age 3 and adults age 70 and older, 100% juice accounted for more than half of sugary drink intake (56%). In contrast, carbonated beverages were the largest contributor among Canadians aged 14 to 50.

FIGURE 7

**DISTRIBUTION OF TYPES OF SUGARY DRINKS CONSUMED**

PROPORTION OF TOTAL VOLUME BY BEVERAGE CATEGORY, 2004 CCHS

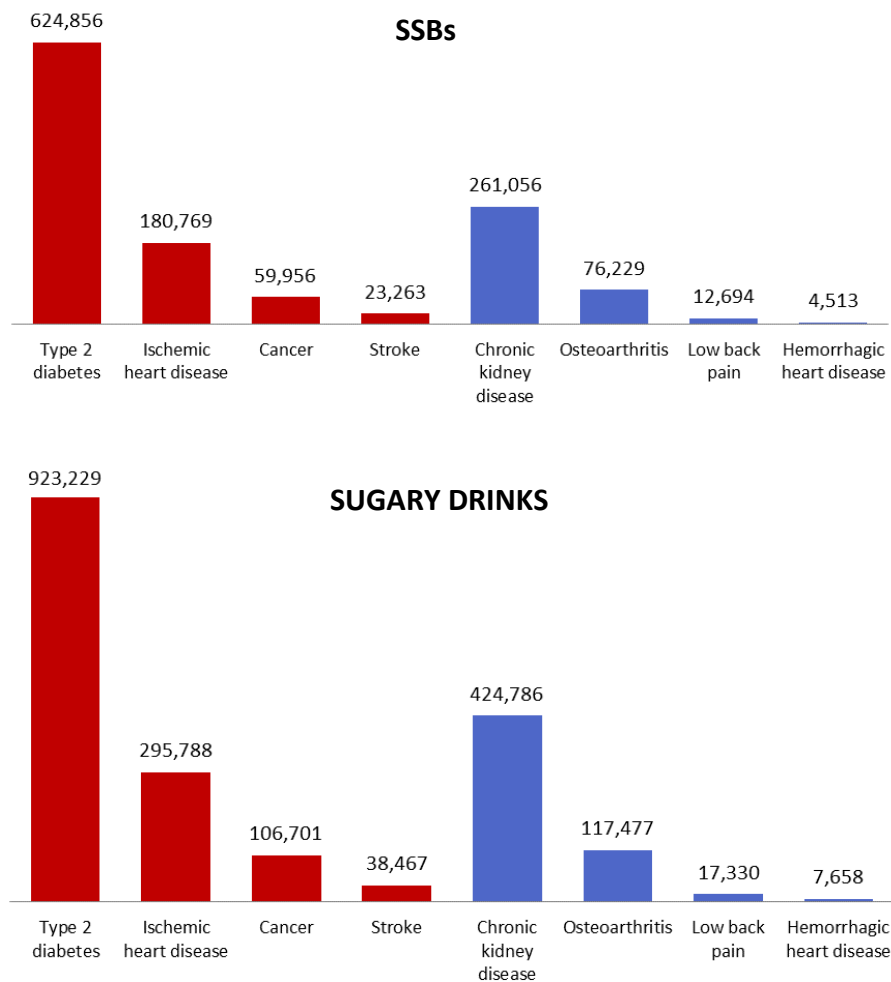


## HEALTH CARE BURDEN AND ECONOMIC COSTS OF SUGARY DRINKS IN CANADA

The avoidable health burden from SSB and sugary drink intake in Canada was estimated based on projected 2015 consumption levels. Over the next 25 years, SSB intake is estimated to be responsible for an estimated 650,488 cases of overweight and 2,101,399 cases of obesity. As shown in Figure 8, the specific diseases attributable to SSBs over the next 25 years include 59,956 cancer cases, 180,769 cases of ischemic heart disease, 23,263 strokes, and 624,856 cases of type 2 diabetes.

The health burden from sugary drinks is substantially higher than SSBs. Over the next 25 years, sugary drink consumption is projected to be responsible for 1,056,916 cases of overweight and 3,036,414 cases of obesity, as well as 106,701 cancer cases, 295,788 cases of ischemic heart disease, 38,467 strokes, and 923,229 cases of type 2 diabetes—see Figure 8 below.



**FIGURE 8**  
**DISEASE CASES ATTRIBUTABLE TO SSB AND SUGARY DRINK CONSUMPTION**  
 2016-2041



\*RED BARS REPRESENT NEW CASES IN 2016-2041 DUE TO SWEET BEVERAGES  
 \*BLUE BARS REPRESENT PREVALENT CASES IN 2041 DUE TO SWEET BEVERAGES

Overall, SSBs are projected to account for an additional 38,385 deaths and nearly 1,433,485 disability-adjusted life years (DALYs) in Canada. The direct health care costs from SSB consumption are estimated at \$33,735,536,562 over the following 25 years. In comparison, sugary drinks will account for an additional 63,321 deaths and 2,185,549 DALYs in Canada, and an estimated \$50,657,213,642 in direct health care costs over the following 25 years (Figure 9).

**FIGURE 9**  
**HEALTH AND ECONOMIC COSTS**  
 2016-2041

	DALYs	DEATHS	DIRECT HEALTH CARE COSTS
	<b>1,433,485</b>	<b>38,385</b>	<b>\$33,735,536,562</b>
	<b>2,185,549</b>	<b>63,321</b>	<b>\$50,657,213,642</b>

**HEALTH CARE AND ECONOMIC BENEFITS FROM A TAX ON SUGARY DRINKS IN CANADA**

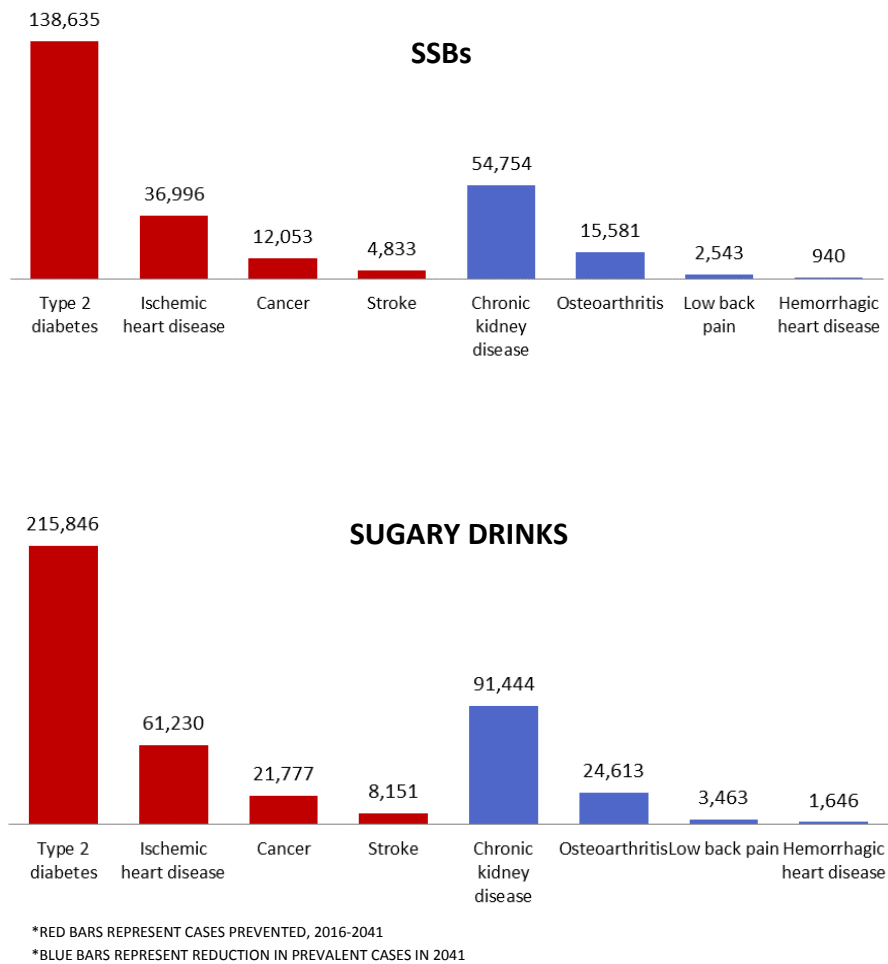
Over the next 25 years, a 20% tax on SSBs is projected to prevent 69,560 cases of overweight and 449,732 cases of obesity. By reducing obesity and overweight, the tax will prevent 12,053 cancer cases, 36,996 cases of ischemic heart disease, 4,833 strokes, and 138,635 cases of type 2 diabetes. Prevented incident and prevalent disease cases are illustrated in Figure 10.

The potential health benefits are greater for a sugary drinks tax. A 20% tax on sugary drinks is projected to prevent 96,807 cases of overweight and 667,431 cases of obesity among Canadian adults in the next 25 years. Prevented diseases include 21,777 cancer cases, 61,230 cases of ischemic heart disease, 8,151 strokes, and 215,846 cases of type 2 diabetes (Figure 10).

Overall, a 20% SSB tax is estimated to postpone 7,874 deaths and avert 309,441 DALYs in Canada over 25 years. The direct health care savings from a 20% SSB tax are estimated at almost \$7.4 billion (\$7,350,664,242) across 25 years. Annual tax revenue is projected to be almost \$1.2 billion (\$1,185,903,122), assuming an average price of \$2.50 per litre. The 25-year total tax revenue is an estimated \$29.6 billion (\$29,647,578,056), not adjusting for secular trends in beverage consumption or changes in population demographics. The combined health care savings and revenue from a 20% SSB tax over this period would be \$36,998,242,299.

In comparison, a greater number of deaths would be postponed and DALYs averted by a 20% sugary drinks tax: 13,206 deaths and 488,778 DALYs. The health care savings are estimated at \$11,456,596,995. Using the same average price, sugary drink tax revenue is estimated to be \$1.7 billion (\$1,744,438,002) per year, and \$43.6 billion (\$43,610,950,060) over 25 years. The combined health care savings and revenue from a 20% sugary drinks tax is estimated at \$55,067,547,055.

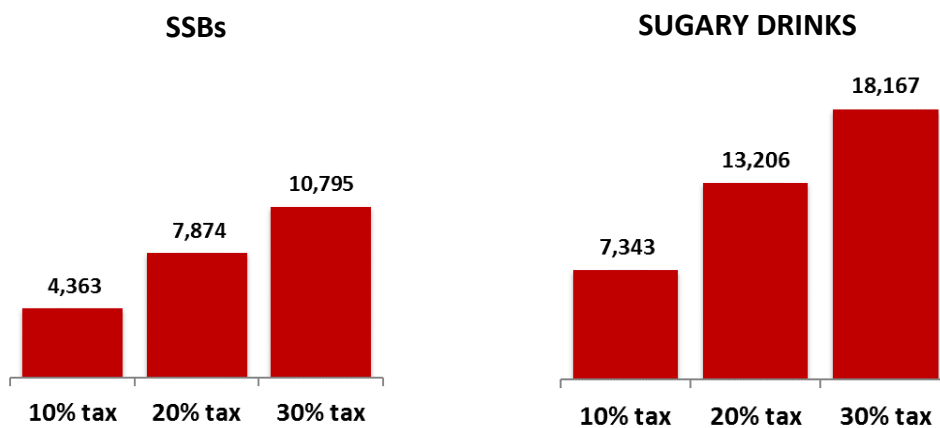
**FIGURE 10**  
**DISEASE CASES PREVENTED BY 20% BEVERAGE TAXES**  
 2016-2041



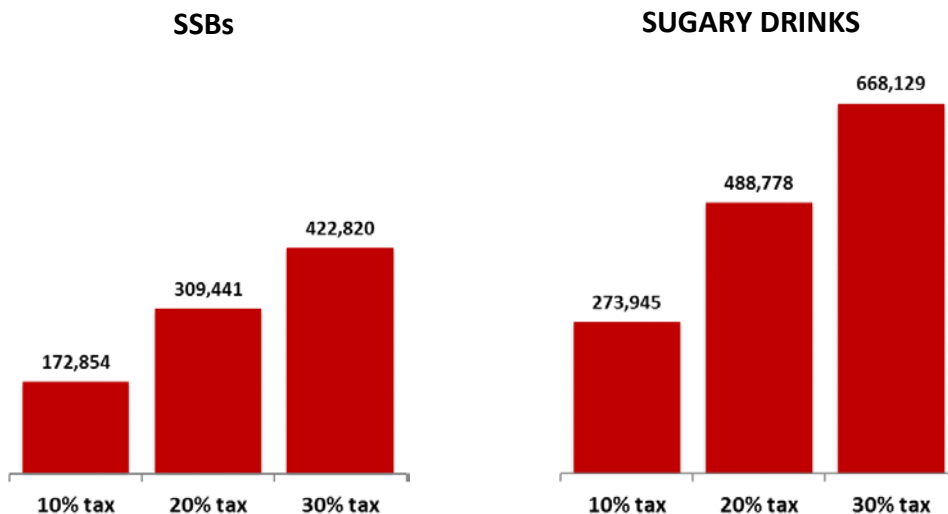
### HEALTH AND ECONOMIC IMPACT OF DIFFERENT TAXATION LEVELS

In addition to a 20% tax rate, the impacts of 10% and 30% tax rates were modelled for SSBs and sugary drinks. As illustrated in the Figure 11, for each beverage classification, a 10% tax would postpone and avert approximately 56% of the deaths and DALYs that a 20% tax would. A 30% tax would postpone or avert an additional 37% of deaths and DALYs, compared to a 20% tax. The absolute difference varies by beverage classification. For example, compared to a 20% tax, a 30% SSB would postpone 2,920 deaths, while a 30% sugary drinks tax would postpone 4,961 deaths.

FIGURE 11  
**TOTAL DEATHS POSTPONED BY TAX LEVEL**  
2016-2041

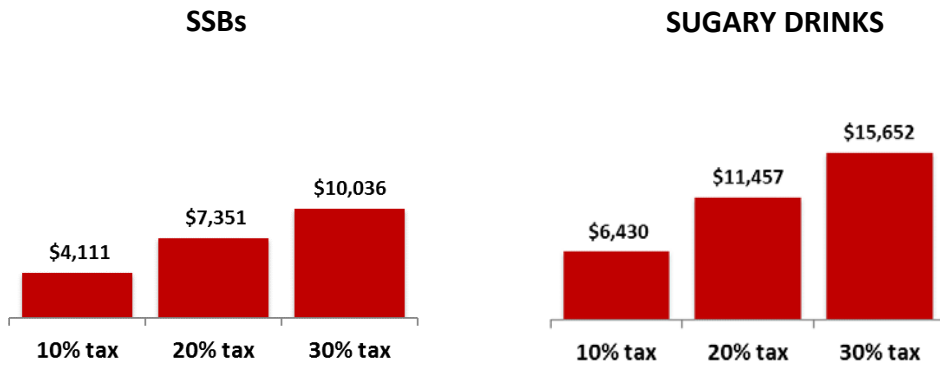


**TOTAL DALYS AVERTED BY TAX LEVEL**  
2016-2041

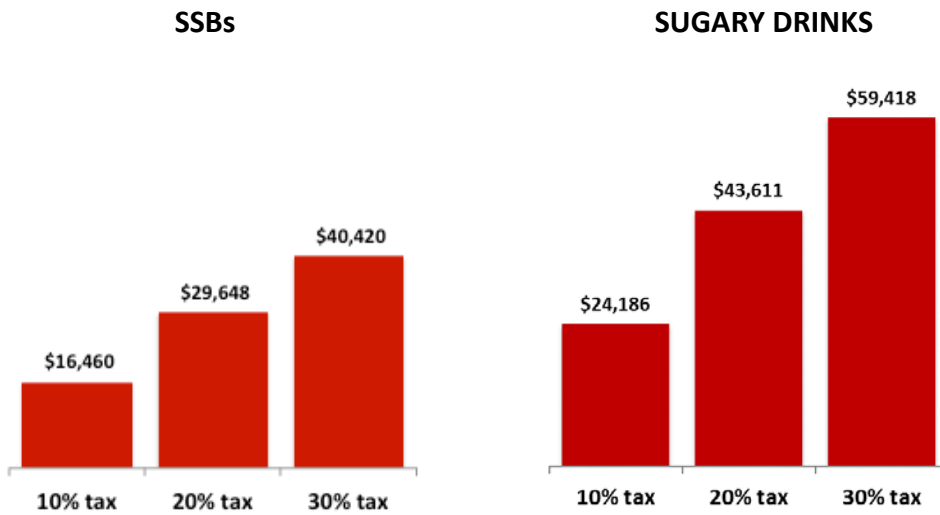


The projected changes in health care savings and revenue generated by the different tax levels are shown in Figure 12. For a SSB tax, the combined savings and revenue from a 10% tax are estimated at \$20.6 billion, and for a 30% tax at \$50.5 billion. For a sugary drinks tax, the combined savings and revenue from a 10% tax is \$30.6 billion, and \$75.1 billion for a 30% tax.

**FIGURE 12**  
**TOTAL HEALTH CARE SAVINGS BY TAX LEVEL**  
 2016-2041 (CAD MILLION)



**TOTAL REVENUE BY TAX LEVEL**  
 2016-2041 (CAD MILLION)



## SUMMARY

Sugary drink consumption has a substantial negative impact in Canada and a sugary drink tax is expected to mitigate some of this burden. The impact of the policy intervention depends on the scope of taxable beverages and the tax rate. Table 1 summarizes the health and economic benefits of a 20% tax on SSBs compared to a 20% tax on sugary drinks. A tax on sugary drinks is expected to bring greater health and economic benefits.

TABLE 1

### SUMMARY OF HEALTH AND ECONOMIC BENEFITS FROM 20% BEVERAGE TAXES

2016-2041

	20% SSB tax	20% sugary drink tax
<b>Deaths postponed</b>	7,874	13,206
<b>DALYs averted</b>	309,441	488,778
<b>Cases of overweight &amp; obesity prevented</b>	519,292	764,238
<b>New type 2 diabetes cases prevented</b>	138,635	215,846
<b>New ischemic heart disease cases prevented</b>	36,996	61,230
<b>New cancer cases prevented</b>	12,053	21,777
<b>New stroke cases prevented</b>	4,833	8,151
<b>Health care costs savings</b>	\$7,350,664,242	\$11,456,596,995
<b>Tax revenue</b>	\$29,647,578,056	\$43,610,950,060
<b>Health care costs savings &amp; revenue</b>	\$36,998,242,299	\$55,067,547,055

## ANALYSIS NOTES

Additional model inputs include incidence, prevalence and mortality data obtained from the Canadian Chronic Disease Surveillance System, CANSIM tables and the GBD Study 2015 online Results Tool.<sup>55,56,57,58,59,60,61,62</sup> Data limitations necessitate that some of the model's disease output be reported by incident cases or prevalent cases only. For example, hypertensive heart disease prevalent cases are reportable, but not incident cases.

To account for existing secular changes in BMI, the model incorporated predicted BMI trends using existing age- and sex-specific regression coefficients<sup>63</sup> derived from BMI data in serial cross-sectional surveys: CCHS 2001-2010.<sup>64,65,66,67,68,69,70</sup> CHMS 2012-2013 Cycle 3 data for population estimates of measured BMI.<sup>71</sup> Disability weights were calculated using GBD Study 2015 data and prevalent years lived with disability.<sup>57</sup> Disease cost calculations required incidence and prevalence data from the Canadian Chronic Disease Surveillance System, CANSIM tables and the GBD Results Tool.<sup>57,58,60</sup>

Analyses were conducted using Microsoft Excel and two add-ins: Risk Factor calculated potential impact fractions and Ersatz performed bootstrapping (2000 iterations) while accounting for uncertainty in model inputs and policy effects. 95% uncertainty intervals are not reported but were calculated. To prepare data for the model, DisMod II modelling software was used to replicate health states and derive case fatality based on population, population mortality rates and disease prevalence, incidence and mortality. Software programs (excluding Excel) are from Epigear.com (Brisbane, Australia).



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