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

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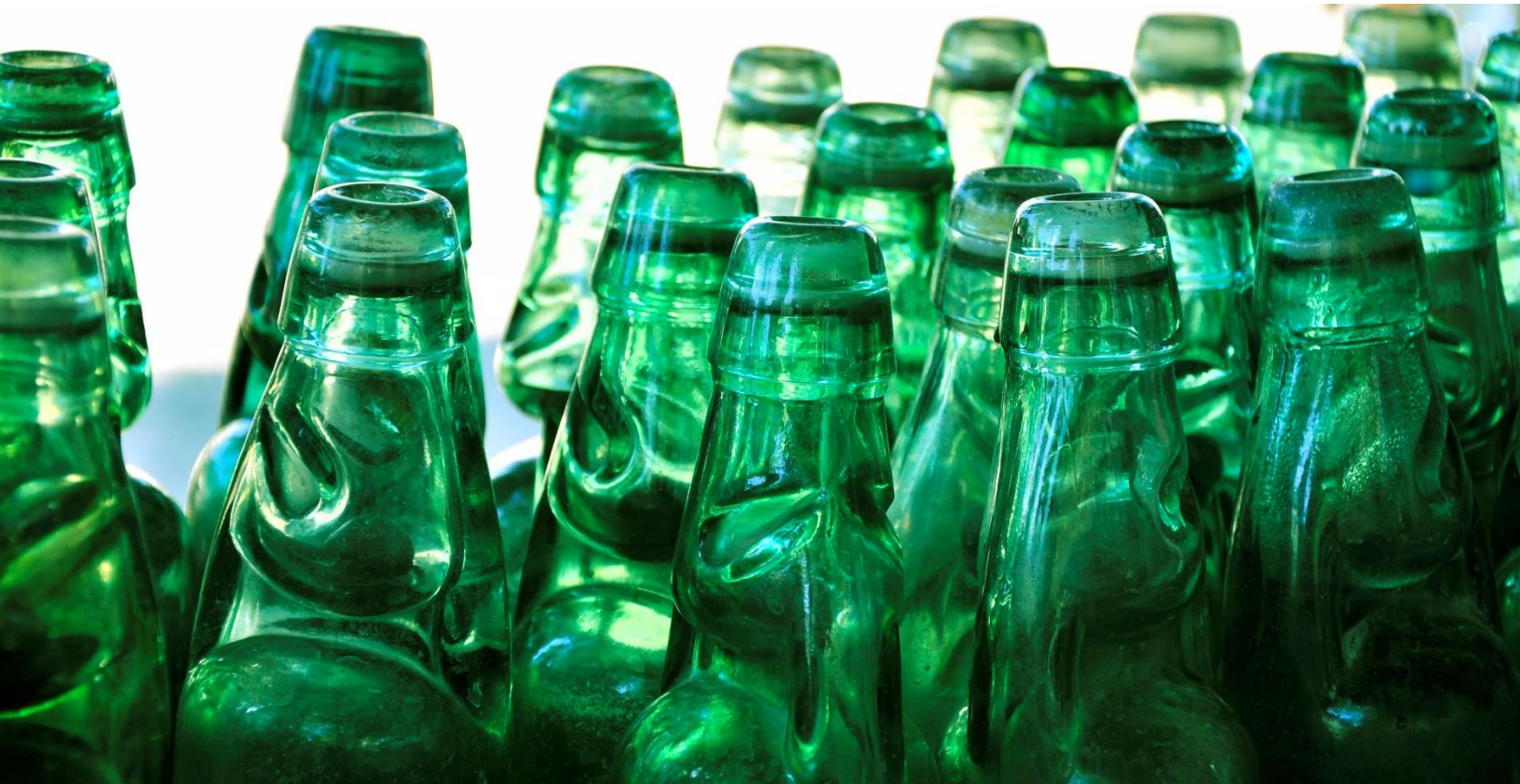

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BACKGROUND

The consumption of sugar-sweetened beverages (SSBs) is a well-established and important dietary risk factor for chronic disease.[1] Excess consumption of SSBs directly increases the risk of type 2 diabetes, cardiovascular disease, and dental caries.[2–5] SSBs also contribute to excess weight gain[6] through rapid delivery of high levels of sugar, low nutrient density, and low satiety that inhibits subsequent energy compensation.[7,8] Therefore, SSBs increase the risk of obesity-mediated disease, including type 2 diabetes, metabolic syndrome, cardiovascular disease, and cancer, among other conditions.[9–17]

Sugar intake from beverages is commonly defined in one of two ways. The term 'sugar-sweetened beverage' is based on criteria for 'added sugars', and typically includes non-diet carbonated soft drinks, ready-to-drink sweetened tea and coffee, energy drinks, sports drinks, flavoured bottled water, and 'fruit drinks' with less than 100% juice.[18] Most definitions of SSBs also include flavoured milk and drinkable yogurt 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 concentrates. The consumption of free sugars is a determinant of body weight and further influences cardiometabolic factors independent of weight.[19,20] 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'.[21]

An increasing number of jurisdictions have implemented, or are in the process of implementing, taxes on SSBs as a fiscal measure to reduce excess sugar intake from beverages and improve health. Jurisdictions include Mexico, the United Kingdom (UK), Ireland, France, South Africa, Chile, and a growing list of cities in the United States (e.g., Berkeley, Philadelphia, and Seattle).[22–30] The impact of a tax is influenced by several characteristics, including the type of tax, taxation level, and scope of taxable products. To date, the evidence indicates that excise taxes are an effective measure for reducing SSB consumption, while also generating substantial government revenue. Research from Mexico, Berkeley, France, Barbados, and Philadelphia indicates that after implementation of SSBs taxes, SSB prices rose,[31–37] SSB sales decreased and sales of untaxed beverages increased,[32,38] especially among low socio-economic groups,[39–41] and consumption of SSBs decreased.[32,42]

The purpose of the current study was twofold: 1) to investigate Albertans' sugary drink consumption using 2015 national nutrition survey data, and 2) to estimate the potential health and economic benefits of an excise tax on SSBs and sugary drinks in the Albertan adult population over a 25-year period using simulation modelling.

METHODS

SUGARY DRINK DATA AND ANALYSES

SUGARY DRINK INTAKE

Nutrition data analysis consisted of two components: first, to report consumption patterns, SSB and sugary drink intake among residents of Alberta was examined; second, to simulate the effects of a beverage tax, SSB and sugary drinks intake was quantified specifically for inclusion in simulation models.

SURVEY

Sugary drink intake was calculated from the 2015 Canadian Community Health Survey – Nutrition (2015 CCHS-Nutrition), a cross-sectional survey which provides the most recent national estimates of dietary intake (N=20,487).[43] The survey used a stratified multistage cluster design with probability sampling to obtain a representative sample of Canadians residing in the 10 provinces ages 1 year and older. Persons excluded from the survey's sampling frame were those living on reserve and other Indigenous peoples' settlements, full-time members of the Canadian Forces, and the institutionalized population. Using a computer-assisted interviewing tool, respondents were administered a General Health Survey and a dietary recall of all foods and beverages consumed over the previous day's 24-hour period (24-hour recall). Using probability sampling, approximately 30% of respondents were selected to complete a second dietary recall, conducted 3 to 10 days later.[43] The current study included only residents of Alberta (variable GEO_PRV) with a valid first dietary recall, and used first dietary recall data only. No respondents exclusively consumed breastmilk. Respondents who were pregnant or breastfeeding were eliminated, for a final sample size of N=2,353. Data was accessed through the South-Western Ontario Research Data Centre (SWO-RDC) at the University of Waterloo.

MEASURES

For the first component, intake was examined for all non-alcoholic beverages containing free sugars based on 16 mutually-exclusive categories grouped under two headings: '100% juice' and 'total sugar-sweetened beverages'. 'Total sugar-sweetened beverages' consisted of 15 categories of beverages: regular carbonated soft drinks, regular fruit drinks, regular sports drinks, regular energy drinks, coffee pre-sweetened with sugar, coffee with sugar added at the table by the consumer 'coffee sugar-sweetened at the table', tea pre-sweetened with sugar, hot chocolate pre-sweetened with sugar, hot chocolate prepared from scratch, sugar-sweetened milk (e.g., chocolate milk), sugar-sweetened drinkable yogurt, regular flavoured water, smoothies, sugar-sweetened protein drinks, and sugar-sweetened meal replacement beverages.

For the second component, intakes of two groups of beverages were calculated for use in simulation models: 'sugary drinks' and 'SSBs'. In the scientific literature, sugary drinks are classified using different criteria, particularly with respect to 100% juice. For the tax simulations, 'taxed sugary drinks' were 12 mutually-exclusive categories: regular carbonated soft drinks, regular fruit drinks, regular sports drinks, regular energy drinks, coffee pre-sweetened with sugar, tea pre-sweetened with sugar, hot chocolate

pre-sweetened with sugar, sugar-sweetened milk (e.g., chocolate milk), sugar-sweetened drinkable yogurt, regular flavoured water, smoothies, and 100% juice. 'Taxed SSBs' were the same as sugary drinks, except that 100% juice was omitted (FIGURE 1). Sugar-sweetened protein drinks and sugar-sweetened meal replacement beverages were not included as taxable beverages, though these beverages are sweetened during the manufacturing process. Future tax simulations may include these beverages. Excluded sugar-sweetened beverages were also those prepared at home from scratch (e.g., hot chocolate prepared from unsweetened cocoa and sugar) and sweetened at the table (e.g., coffee with sugar added by the consumer), since these beverages are not sweetened during the manufacturing process and would not be subject to a tax.

FIGURE 1. BEVERAGES TAXED IN SIMULATION MODELS

TAXED SSBs

REGULAR CARBONATED SOFT DRINKS, REGULAR FRUIT DRINKS, REGULAR SPORTS & ENERGY DRINKS, COFFEE, TEA & HOT CHOCOLATE PRE-SWEETENED WITH SUGAR, SUGAR-SWEETENED MILK, SUGAR-SWEETENED DRINKABLE YOGURT, REGULAR FLAVOURED WATER & SMOOTHIES

TAXED SUGARY DRINKS

REGULAR CARBONATED SOFT DRINKS, REGULAR FRUIT DRINKS, REGULAR SPORTS & ENERGY DRINKS, COFFEE, TEA & HOT CHOCOLATE PRE-SWEETENED WITH SUGAR, SUGAR-SWEETENED MILK, SUGAR-SWEETENED DRINKABLE YOGURT, REGULAR FLAVOURED WATER, SMOOTHIES & 100% JUICE

Based on food codes and descriptions in the 2015 CCHS-Nutrition Food Description (FDC) file, a total of 240 unique food codes (variable name: 'FID_CDE') were used to identify non-alcoholic beverages containing free sugars. Some assumptions were made due to limited descriptive and nutrition information. The Food and Ingredient Details (FID) file and the Food Recipe Level (FRL) file report dietary intake using FID_CDE to identify each type of food or beverage consumed by a respondent. After combining the two survey files, FID_CDE used to identify sugary drinks based on the 240 FID_CDE sugary drink codes. Double-counting due to combining these two files was eliminated. Sugary drink intake consisted of only volume consumed as a non-alcoholic beverage, and excluded volume consumed as part of food recipes (e.g., orange juice in a stir fry recipe) or alcoholic beverage recipes (e.g., regular cola in a 'rum and coke'). Accordingly, the analysis underestimated total consumption of non-alcoholic sugary drinks. Survey cases were aggregated to form one case per respondent. For each of 16 beverage categories, volume and energy variables were derived from 'FDC_WTG' (quantity

consumed of a food or beverage, grams) and 'FDC_EKC' (energy per food item, kilocalories). One fruit drink beverage code was missing energy data (FID_CDE 404292 'Juice drink, fruit, without added vitamin C, ready-to drink'). To impute this value, the mean energy density for the fruit drink category was calculated. Then, for consumers of FID_CDE 404292, the fruit drink mean energy density was multiplied by the volume of FID_CDE 404292 consumed to yield an estimate of energy intake from this particular beverage.

To permit the calculation of per capita estimates, non-consumers were assigned zero values for beverage categories that they did not consume. Volume and energy variables were summed to yield three measures of total consumption: 'total sugar-sweetened beverages, 'taxed SSBs', and 'taxed sugary drinks'. Grams were converted to millilitres (ml) based on 1 gram of water equalling 1 ml of water.[44] Energy was reported in kilocalories (kcal). The dietary intake file was merged with the Health Survey (HS) file to examine intake by sex and age sub-groups. Two demographic variables were examined: sex (variable DHH_SEX: male, female), age (DHH_AGE: continuous). Age was recoded into eight age groups (1-3 years, 4-8, 9-13, 14-18, 19-30, 31-50, 51-70, 71+) and, for use in the simulation model, 10-year age groups (1-9, 10-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-79, 80-89, 90+).

ANALYSIS

The first component of the analysis examined sugary drink volume and energy intake among the Alberta population. Using descriptive statistics, per capita daily mean intake and 95% confidence intervals (volume, in ml; energy, in kcal) were calculated for each of the 16 beverage categories and total sugar-sweetened beverages. Estimates were for all respondents, and by sex and age sub-groups. Data was weighted to represent the majority of the 10 provinces.[45] Since weighting methods do not incorporate variance resulting from the multi-stage, clustered nature of the sample design, known as the design effect, a bootstrap resampling method was used for all analysis. The bootstrapped weights prepared by Statistics Canada and Health Canada[43] were applied in the statistical software SAS (version 9.4; SAS Institute Inc., Cary, North Carolina, USA; 2016). The survey file and bootstrap weights file were matched based on the variable SAMPLEID. Proportional samples sizes are reported with results.

The second component of the analysis generated estimates of SSBs and sugary drinks intake for simulation modelling. Using descriptive statistics, per capita daily mean and standard errors (volume, in ml; energy, in kcal) were calculated for 'taxed SSBs' and 'taxed sugary drinks' for 10-year age and sex sub-groups. Proportional survey weights were applied in analysis; bootstrap resampling was not used. Previous use of bootstrap methods for calculating mean beverage consumption produced large standard errors, which translated into standard deviations and confidence intervals that were implausible from a behavioural perspective and would have influenced the simulation modelling results. Proportional weights sum to equal the final sample size, whereas scaled survey weights are the number of people that a respondent represents in the target population. Proportional weights were constructed by first computing a weight constant derive by dividing the sample size (N) by the sum of existing scaled survey weights (i.e., the sum of the weight variable WTS_M). Second, for each

respondent, the weight variable WTS_M was multipled by the weight constant to yield a proportional weight value specific to each respondent. Analysis was conducted with the proportional survey weights applied in statistical software IBM SPSS Statistics (version 24.0; IBM Corp., Armonk, New York, USA; 2016) Since SPSS reports standard errors calculated from the weight variable rather than the sample size, standard errors were recalculated post-analysis from the standard deviation and the unweighted sample size for each 10-year age and sex sub-groups.

HEALTH AND ECONOMIC COSTS MODEL

The Alberta sugary drinks tax simulation model was based on a national sugary drinks tax simulation model. The Alberta model used the same methodology except for three key sets of inputs: 1) beverage consumption was calculated from 2015 CCHS-Nutrition and for residents of Alberta only; 2) for sex and 10-year age sub-groups, mean BMI was calculated from 2015 CCHS-Nutrition and for residents of Alberta only; and 3) population parameters were Alberta's age- and sex-specific 2015 population size. Detail on the national model's study methodology is previously reported and publicly available.[46]

TAX INTERVENTION SPECIFICATION AND PARAMETERS

The modelled tax intervention was an ad valorem excise tax applied in separate simulations to each beverage group: SSBs and sugary drinks. The average pre-tax beverage price was $2.50/litre. Sensitivity analyses examined other pre-tax prices. A minimum 20% tax is recommended by the World Health Organization as best practice.[47] The tax levels were 10%, 20%, and 30% of the pre-tax price. These tax levels were consistent with existing measures in other jurisdictions.[26,48–51]

A pooled own-price elasticity of demand for sugary drinks of -1.20 [95% Confidence Interval (CI): -1.34, -1.06] was used in the model, based on a meta-analysis of studies from the United States, the UK, Mexico, Brazil, France, and India.[52] Given the broad definition of sugary drinks, the model did not incorporate cross-price elasticities or caloric compensation from possible switching to non-taxed beverages and foods. A 100% tax pass-on rate was assumed.

For each tax intervention scenario, tax revenue estimates were calculated based on the entire Alberta population's beverage consumption. Tax revenue calculations did not adjust for secular trends in beverage consumption or changes in population demographics. All monetary values are reported in 2015 Canadian dollars (CAD).[53]

MODEL DESIGN

The Assessing Cost-Effectiveness (ACE) model, a Markov cohort macrosimulation, was adapted to simulate the 2015 Alberta adult population (age 20 and older).[54–56] The population resided in a main life table, with proportions modelled to have each sugary drink-related disease in parallel structures. Disease-specific incidence, remission and case-fatality, and mortality from 'all other causes' of illness, served as annual transition rates that determined cohorts' movements between multiple health states until death or age 95. Disease remission was assumed generally unlikely and set to zero.

The model simulated two physiological pathways using population impact fractions: the effect of energy intake on BMI-mediated diseases (including type 2 diabetes) and the direct non-BMI mediated effect of sugary drink intake on type 2 diabetes. Population impact fractions captured the percentage change in future disease incidence from a risk factor with a given disease relative risk ratio. The modelled BMI-related diseases paralleled those examined in the 2015 Global Burden of Disease (GBD) study (TABLE 1).[57] The study utilized disease definitions specified by the GBD study using International Classification of Diseases codes.

TABLE 1. MODELLED DISEASES ASSOCIATED WITH THE BMI-RELATED AND NON-BMI RELATED HEALTH EFFECTS OF SSB AND SUGARY DRINK CONSUMPTION[a]

Type 2 diabetes[b]
Breast cancer
Colon and rectum cancer
Esophageal cancer
Gallbladder and biliary tract cancer
Kidney cancer
Leukemia
Liver cancer
Ovarian cancer
Pancreatic cancer
Thyroid cancer
Uterine cancer
Ischemic heart disease
Ischemic stroke
Hemorrhagic stroke
Hypertensive heart disease
Chronic kidney disease due to diabetes
Chronic kidney disease due to hypertension
Chronic kidney disease due to glomerulonephritis
Chronic kidney disease due to other causes
Osteoarthritis of the hip
Osteoarthritis of the knee

[a] BMI-related diseases were obtained from the Global Burden of Disease 2015 Study[1]

[b] Model included the BMI-mediated and non-BMI-mediated health effects of sugary drinks on type 2 diabetes[2]

The number of years lived were determined by mortality rates specific to each disease and from all other causes determined. The number of years lived with disability were determined by average morbidity rates ('prevalent years lived with disability', pYLD) for each disease and all other causes. pYLD were calculated using disability weights. Decreased sugary drink consumption lowered disease incidence rates, thereby contributing to improvements in all-cause morbidity and mortality rates.

The model calculated the difference in outcomes between two simultaneous trajectories: a tax intervention scenario, and a counterfactual 'business as usual' scenario with no tax intervention. The primary outcomes were differences in cases of obesity and overweight; disease-specific incidence, prevalence and mortality; deaths; disability-adjusted life years (DALYs). Economic outcomes showed changes in direct health care costs resulting from changes in disease morbidity and mortality, while accounting for additional health costs due to longer lives, and estimated tax revenue. Results are presented by beverage group for a 25-year period (2016-2041).

BODY WEIGHT, DISEASE, AND POPULATION SPECIFICATION AND PARAMETERS

Population estimates of BMI were calculated using 2015 CCHS-Nutrition variables for measured BMI found in the Health Survey file (N=20,487).[43] Approximately 70% of respondents permitted the collection of physical measures.[43] The current analysis included only residents of the province of Alberta and excluded participants who reported being pregnant or had unreported BMI, for a final sample size of N=1,644. The data set included special survey weights for use with variables pertaining to measured height and weight to account for lower response rates. Mean measured BMI (kg/m^2) and standard deviation were calculated for sex-specific 10-year age groups with proportional weights applied. Bootstrap resampling was not used, though this approach incorporates variance resulting from the multi-stage, clustered nature of the sample design, known as the design effect that. Regular survey weights do not account for the design effect. Previous use of bootstrap methods for calculating mean BMI produced large standard errors, which translated into standard deviations and confidence intervals that were implausible from a behavioural perspective and would have influenced the simulation modelling results. Proportional weights were calculated from the scaled weight variable for measured height and weight (variable name WTS_MHW) using the same methods applied with the beverage intake analysis. SWO-RDC provided access to the data.

The model incorporated predicted BMI trends[58] derived from serial cross-sectional surveys to account for existing secular changes in BMI.[59–65] Within the model, BMI was modelled as lognormally distributed and results exponentiated for display and reporting. The effect of energy intake on weight was modelled using an energy balance equation.[66,67] This formula provides empirically-derived values for the daily intake of energy [measured in kilojoules (kJ)] required for a weight change of 1 kilogram (kg): 94 kJ per kg per day (95% CI: 88.2, 99.8). Physical activity levels were assumed stable.

Epidemiological data were obtained on disease incidence, prevalence, and case fatality.[68–75] Epidemiologically- and mathematically-coherent parameters for each condition were estimated with DisMod II software (EpiGear, Version 1.05, Brisbane, Australia) and inputted into the model. Canada-specific disability weights were calculated using GBD data and DisMod output.[68] BMI-related relative risks were from the 2015 GBD Study.[57] The relative risk of type 2 diabetes incidence was 1.13 (95% CI: 1.06, 1.21) per serving (250ml/day) of beverage.[2] Data limitations necessitated that some disease outcomes be reported by incident cases or prevalent cases only. For example, prevalent cases of

hypertensive heart disease are reportable, but not incident cases. To avoid double counting mortality among other modelled diseases (e.g., strokes and ischemic heart disease), type 2 diabetes mortality was not included in the life table and, accordingly, cannot be reported. Population parameters were Alberta's age- and sex-specific 2015 population size,[76] 2012 all-cause mortality rates,[76,77] and 2015 all cause pYLD.[68]

HEALTH CARE COSTS

Direct health care costs 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),[78–80] and used incidence and prevalence data.[68–70] Direct costs consisted of hospital care, physician care, drugs, other professionals, public health and other health spending, and were inflated to 2015 Canadian dollars.[53] All costs are reported in 2015 Canadian dollars (CAD). Two types of direct health care costs were assigned: age- and sex-specific cost of having one of the modelled diseases, and age- and sex-specific annual cost for any other health care incurred by all those alive. Indirect costs were not included. EBIC costs data does not account for co-morbidities.

MODEL ANALYSIS

Analyses were conducted using Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA) and two add-ins: Risk Factor (EpiGearXL 5.0) calculated potential impact fractions and Ersatz (Version 1.34) performed a Monte Carlo simulation with bootstrapping (2000 iterations) while incorporating probabilistic uncertainty from model inputs. Uncertainty intervals (i.e., 95% uncertainty intervals) were calculated, reflecting parameter uncertainties. Software (excluding Excel) is from Epigear.com (Brisbane, Australia). Ethics approval was not required for this analysis.

FINDINGS

SUGARY DRINK INTAKE IN ALBERTA

Per capita average daily sugary drink consumption (volume and energy) for the population of Alberta is reported for all respondents and by children (males, females) and adults (males, females) in TABLE 2. 'Total sugar-sweetened beverages' is the sum of 15 beverages categories; 100% juice is reported separately. Tables 3-6 report consumption according to sex and narrower age categories.

TABLE 2. PER CAPITA AVERAGE DAILY SUGARY DRINK CONSUMPTION FOR THE POPULATION OF ALBERTA

	All	**Children** 1-18 yrs		**Adults** 19+ yrs	
		Males	**Females**	**Males**	**Females**
	Volume, ml mean (95% CI) **Energy**, kcal mean (95% CI)	**Volume**, ml mean (95% CI) **Energy**, kcal mean (95% CI)	**Volume**, ml mean (95% CI) **Energy**, kcal mean (95% CI)	**Volume**, ml mean (95% CI) **Energy**, kcal mean (95% CI)	**Volume**, ml mean (95% CI) **Energy**, kcal mean (95% CI)
Sample size	N=2,353	n=253	n=272	n=953	n=875
100% juice					
Volume, ml	**54.9 (45.4-64.5)**	**85.0 (64.5-105.6)**	**102.8 (68.0-137.5)**	**52.0 (36.2-67.7)**	**34.6 (22.1-47.0)**
Energy, kcal	**24.7 (20.4-28.9)**	**39.4 (30.0-48.8)**	**48.4 (32.0-64.9)**	**22.3 (15.7-28.9)**	**15.6 (10.0-21.3)**
Total sugar-sweetened beverages					
Volume, ml	**246.6 (219.6-273.6)**	**316.4 (252.8-380.0)**	**221.0 (189.3-252.6)**	**258.8 (213.2-304.5)**	**221.0 (162.0-280.0)**
Energy, kcal	**123.0 (106.1-139.9)**	**159.8 (128.8-190.8)**	**113.6 (96.5-130.7)**	**128.4 (92.7-164.1)**	**109.4 (76.3-142.5)**
Regular carbonated soft drinks					
Volume, ml	82.0 (64.7-99.4)	101.3 (69.1-133.5)	48.1 (32.5-63.7)	107.5 (75.1-139.8)	59.3 (33.2-85.5)
Energy, kcal	33.8 (26.6-41.1)	41.1 (28.1-54.2)	19.7 (13.3-26.2)	44.6 (31.2-58.1)	24.4 (13.7-35.1)
Tea pre-sweetened with sugar					
Volume, ml	41.0 (26.3-55.8)	38.2 (19.7-56.8)	27.7 (14.1-41.3)	36.6 (15.6-57.7)	50.8 (18.3-83.3)
Energy, kcal	14.0 (8.8-19.3)	13.3 (6.7-19.9)	9.8 (5.0-14.6)	12.9 (5.4-20.4)	16.8 (5.4-28.2)
Sugar-sweetened milk					
Volume, ml	24.3 (16.8-31.7)	40.1 (23.6-56.5)	42.2 (27.1-57.2)	16.5 (5.0-28.0)	22.6 (8.9-36.2)
Energy, kcal	19.6 (12.2-27.1)	31.0 (18.2-43.9)	30.4 (19.1-41.7)	14.0 (4.5-23.5)	19.1 (2.6-35.6)
Regular fruit drinks					
Volume, ml	24.1 (18.7-29.5)	40.5 (17.5-63.6)	63.4 (43.0-83.7)	18.2 (9.2-27.1)	13.7 (7.5-20.0)
Energy, kcal	10.8 (8.5-13.2)	18.5 (8.7-28.4)	26.9 (18.4-35.4)	8.4 (4.5-12.3)	6.3 (3.5-9.2)
Smoothies					
Volume, ml	21.9 (11.0-32.8)	20.2 (8.9-31.5)	14.3 (7.0-21.6)	15.1 (-0.4-30.6)	32.2 (9.0-55.5)
Energy, kcal	13.0 (6.1-19.9)	11.0 (5.4-16.6)	9.5 (4.6-14.3)	10.1 (-1.3-21.5)	17.9 (4.7-31.0)
Regular protein & meal replacement drinks					
Volume, ml	16.7 (8.0-25.4)	6.0 (-0.9-12.9)	2.0 (-1.8-5.7)	26.2 (5.7-46.7)	14.0 (5.4-22.6)
Energy, kcal	15.4 (3.2-27.6)	5.9 (-1.1-12.9)	2.4 (-2.2-7.0)	26.4 (-3.6-56.4)	10.2 (3.8-16.6)
Coffee pre-sweetened with sugar					

Volume, ml	16.5 (7.7-25.2)	12.1 (1.9-22.2)	3.4 (-1.1-8.0)	20.0 (1.0-39.0)	18.0 (8.6-27.5)
Energy, kcal	7.0 (4.1-10.0)	10.3 (0.9-19.7)	2.3 (-0.6-5.2)	5.5 (1.7-9.3)	9.2 (3.0-15.5)
Regular sports drinks					
Volume, ml	7.2 (3.4-11.0)	33.0 (6.2-59.9)	3.5 (-2.1-9.0)	4.7 (1.3-8.1)	3.6 (-2.8-10.1)
Energy, kcal	2.0 (0.9-3.0)	9.2 (1.7-16.7)	0.9 (-0.5-2.4)	1.3 (0.4-2.2)	0.9 (-0.7-2.6)
Regular flavoured water					
Volume, ml	3.2 (-0.2-6.7)	-	0.9 (-0.9-2.6)	6.6 (-1.8-15.0)	1.2 (-0.7-3.2)
Energy, kcal	0.7 (-0.1-1.5)	-	0.2 (-0.2-0.6)	1.5 (-0.4-3.4)	0.3 (-0.2-0.7)
Regular energy drinks					
Volume, ml	2.8 (0.4-5.3)	2.7 (-1.3-6.8)	0.6 (-0.8-2.0)	5.3 (-0.5-11)	0.9 (-0.4-2.2)
Energy, kcal	1.3 (0.2-2.4)	1.3 (-0.6-3.2)	0.2 (-0.3-0.7)	2.4 (-0.3-5.1)	0.4 (-0.2-1.0)
Hot chocolate pre-sweetened with sugar					
Volume, ml	2.7 (1.3-4.1)	10.4 (2.9-17.9)	4.5 (1.0-8.1)	1.6 (-0.5-3.7)	1.2 (-0.2-2.7)
Energy, kcal	2.6 (0.9-4.3)	9.2 (2.1-16.4)	3.7 (0.5-6.8)	0.9 (-0.3-2.1)	2.2 (-1.4-5.7)
Flavoured drinkable yogurt					
Volume, ml	1.8 (0.9-2.8)	4.0 (1.4-6.6)	10.4 (3.5-17.3)	0.3 (-0.3-0.8)	0.3 (-0.2-0.7)
Energy, kcal	1.3 (0.6-2.0)	3.0 (1.0-4.9)	7.6 (2.6-12.6)	0.2 (-0.2-0.6)	0.2 (-0.1-0.5)
Coffee sugar-sweetened at the table					
Volume, ml	1.1 (-0.7-2.9)	-	-	-	3.0 (-1.9-7.8)
Energy, kcal	0.5 (-0.4-1.4)	-	-	-	1.4 (-1.0-3.7)
Hot chocolate prepared from scratch					
Volume, ml	1.0 (-0.5-2.6)	7.8 (-6.4-22.0)	-	0.4 (-0.5-1.3)	0.06 (-0.04-0.16)
Energy, kcal	0.7 (-0.4-1.8)	5.9 (-4.8-16.6)	-	0.1 (-0.1-0.3)	0.04 (-0.03-0.10)

Note: Negative values in 95% confidence intervals are a result of the bootstrap resampling method and not an indication of 'negative' consumption.

TABLE 3. CHILDREN'S PER CAPITA AVERAGE DAILY SUGARY DRINK CONSUMPTION, MALES BY AGE GROUP

	MALES			
	1-3 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**4-8 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**9-13 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**14-18 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Sample size	n=48	n=64	n=70	n=71
100% juice				
Volume, ml	**115.7 (65.7-165.8)**	**119.2 (62.4-176.0)**	**70.5 (36.0-105.0)**	**47.7 (15.1-80.2)**
Energy, kcal	**52 (29.1-74.9)**	**56.7 (30.3-83.2)**	**32.1 (16.8-47.3)**	**22.5 (7.4-37.5)**
Total sugar-sweetened beverages				
Volume, ml	**65.8 (26.9-104.7)**	**254.3 (164.4-344.2)**	**248.0 (176.4-319.6)**	**611.0 (406.7-815.4)**
Energy, kcal	**43.6 (17.6-69.7)**	**146.1 (97.4-194.9)**	**124.5 (84.4-164.6)**	**286.4 (193.9-378.8)**
Regular carbonated soft drinks				
Volume, ml	1.2 (-1.0-3.4)	39.6 (-4.2-83.4)	111.8 (70.2-153.4)	214.7 (113.3-316.1)
Energy, kcal	0.5 (-0.4-1.4)	15.7 (-1.4-32.7)	45.5 (28.5-62.5)	87.5 (45.9-129.1)
Tea pre-sweetened with sugar				
Volume, ml	5.3 (-2.6-13.2)	42.1 (-11.4-95.6)	38.6 (11.2-65.9)	56.9 (14.9-99.0)
Energy, kcal	1.7 (-0.8-4.3)	13.7 (-5.2-32.6)	13.9 (4.0-23.7)	20.3 (5.2-35.4)
Sugar-sweetened milk				
Volume, ml	25.8 (4.3-47.3)	65.7 (28.6-102.8)	39.0 (5.8-72.2)	27.9 (3.9-52.0)
Energy, kcal	20.9 (2.2-39.5)	48.3 (20.2-76.5)	31.4 (5.6-57.2)	22.1 (3.7-40.6)
Regular fruit drinks				
Volume, ml	17.8 (-1.7-37.3)	52.5 (11.5-93.4)	23.2 (5.8-40.6)	62.5 (-3.8-128.9)
Energy, kcal	8.0 (-0.7-16.8)	28.5 (5.5-51.4)	9.8 (2.7-16.9)	25.3 (0.2-50.5)
Smoothies				
Volume, ml	1.8 (-1.4-5.1)	23.4 (-6.2-53.0)	12.2 (0.3-24.0)	37.8 (7.4-68.1)
Energy, kcal	1.3 (-1.0-3.6)	10.0 (-1.6-21.6)	7.8 (0.3-15.4)	21.6 (5.0-38.1)
Regular protein & meal replacement drinks				
Volume, ml	4.7 (-3.8-13.1)	3.2 (-3.8-10.1)	1.6 (-1.6-4.7)	13.7 (-8.6-36.0)
Energy, kcal	4.6 (-3.8-1.0)	3.1 (-3.8-10.0)	1.4 (-1.4-4.3)	13.7 (-9.0-36.4)
Coffee pre-sweetened with sugar				
Volume, ml	-	-	7.2 (-6.9-21.2)	36.0 (1.6-70.4)
Energy, kcal	-	-	4.3 (-4.1-12.7)	32.5 (-0.5-65.5)
Regular sports drinks				
Volume, ml	0.6 (-1.1-2.3)	-	1.6 (-1.0-4.3)	115.8 (20.5-211.2)
Energy, kcal	0.2 (-0.3-0.6)	-	0.4 (-0.3-1.1)	32.3 (5.7-59.0)
Regular flavoured water				
Volume, ml	-	-	-	-
Energy, kcal	-	-	-	-
Regular energy drinks				
Volume, ml	-	-	-	9.8 (-4.4-24.0)
Energy, kcal	-	-	-	4.6 (-2.1-11.3)
Hot chocolate pre-sweetened with sugar				
Volume, ml	-	27.8 (0.1-55.5)	4.4 (-2.0-10.7)	8.0 (-0.6-16.6)
Energy, kcal	-	26.9 (0.1-53.6)	3.6 (-1.8-9.1)	5.2 (-0.8-11.2)
Flavoured drinkable yogurt				

	MALES			
	1-3 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**4-8 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**9-13 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**14-18 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Volume, ml	8.5 (0.9-16.1)	0.03 (-0.04-0.10)	8.5 (1.1-15.9)	-
Energy, kcal	6.4 (0.7-12.1)	0.02 (-0.02-0.07)	6.3 (0.8-11.9)	-
Coffee sugar-sweetened at the table				
Volume, ml	-	-	-	-
Energy, kcal	-	-	-	-
Hot chocolate prepared from scratch				
Volume, ml	-	-	-	27.9 (-21.9-77.8)
Energy, kcal	-	-	-	21.0 (-16.5-58.6)

Note: Negative values in 95% confidence intervals are a result of the bootstrap resampling method and not an indication of 'negative' consumption.

TABLE 4. CHILDREN'S PER CAPITA AVERAGE DAILY SUGARY DRINK CONSUMPTION, FEMALES BY AGE GROUP

	FEMALES			
	1-3 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**4-8 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**9-13 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**14-18 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Sample size	n=49	n=90	n=67	n=66
100% juice				
Volume, ml	**104.7 (69.9-139.5)**	**120.6 (57.9-183.3)**	**129.1 (23.8-234.4)**	**50.7 (16.0-85.4)**
Energy, kcal	**48.7 (32.5-64.8)**	**56.6 (27-86.2)**	**61.6 (11.1-112.0)**	**24.0 (7.9-40.1)**
Total sugar-sweetened beverages				
Volume, ml	**148.7 (92.1-205.2)**	**156.2 (103.8-208.6)**	**250.9 (186.3-315.6)**	**331.8 (248.8-414.8)**
Energy, kcal	**82.4 (52.7-112.0)**	**82.9 (53.5-112.2)**	**125.1 (95.4-154.7)**	**166.7 (121.9-211.5)**
Regular carbonated soft drinks				
Volume, ml	7.5 (-2.0-17.1)	37.7 (6.8-68.5)	69.4 (31.8-107.0)	70.6 (36.0-105.3)
Energy, kcal	2.7 (-0.6-6.0)	15.1 (2.7-27.6)	29.2 (13.2-45.2)	29.0 (14.8-43.2)
Tea pre-sweetened with sugar				
Volume, ml	6.4 (-3.2-15.9)	3.2 (-0.8-7.2)	38.5 (11.0-65.9)	65.8 (23.1-108.6)
Energy, kcal	2.1 (-1.2-5.5)	1.2 (-0.3-2.6)	13.3 (3.7-22.9)	23.7 (8.4-39.1)
Sugar-sweetened milk				
Volume, ml	33.3 (10.4-56.2)	37.9 (10.2-65.6)	34.7 (14.5-54.9)	61.8 (29.5-94.2)
Energy, kcal	20.3 (5.0-35.6)	28.0 (7.6-48.5)	25 (10.0-40.1)	46.4 (20.9-71.9)
Regular fruit drinks				
Volume, ml	51.1 (9.9-92.3)	53.5 (22.4-84.5)	51.7 (22.8-80.6)	97.5 (35.1-159.9)
Energy, kcal	21.0 (4.7-37.3)	22.5 (9.8-35.2)	24.1 (10.3-37.9)	40.1 (14.9-65.2)
Smoothies				
Volume, ml	17.4 (-1.1-35.9)	9.3 (-1.0-19.5)	23.7 (3.1-44.3)	9.5 (-0.2-19.1)

	FEMALES			
	1-3 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**4-8 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**9-13 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**14-18 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Energy, kcal	11.8 (-0.9-24.4)	6.0 (-0.8-12.7)	15.6 (2.2-29.0)	6.4 (-0.2-12.9)
Regular protein & meal replacement drinks				
Volume, ml	0.3 (-0.4-1.1)	-	-	7.8 (-7.6-23.2)
Energy, kcal	0.3 (-0.4-13.0)	-	-	9.7 (-9.3-28.6)
Coffee pre-sweetened with sugar				
Volume, ml	-	-	0.9 (-1.0-2.8)	13.1 (-5.3-31.6)
Energy, kcal	-	-	0.6 (-0.6-1.7)	8.8 (-3.0-20.6)
Regular sports drinks				
Volume, ml	0.3 (-0.4-1.1)	-	11.2 (-10.8-33.2)	2.8 (-3.1-8.6)
Energy, kcal	0.1 (-0.1-0.4)	-	2.9 (-2.8-8.6)	0.7 (-0.8-2.2)
Regular flavoured water				
Volume, ml	-	-	3.6 (-3.5-10.6)	-
Energy, kcal	-	-	0.8 (-0.8-2.4)	-
Regular energy drinks				
Volume, ml	-	-	2.6 (-3.1-8.3)	-
Energy, kcal	-	-	0.8 (-1.0-2.7)	-
Hot chocolate pre-sweetened with sugar				
Volume, ml	0.1 (-0.1-0.2)	3.8 (-2.1-9.6)	11.8 (-0.3-23.9)	1.6 (-1.0-4.1)
Energy, kcal	0.03 (-0.04-0.10)	2.4 (-1.1-5.8)	10.6 (-1.4-22.7)	1.1 (-0.7-2.8)
Flavoured drinkable yogurt				
Volume, ml	32.3 (5.2-59.5)	10.9 (-2.6-24.3)	2.9 (-2.1-8.0)	1.2 (-0.6-3.0)
Energy, kcal	23.9 (3.6-44.2)	7.7 (-1.8-17.3)	2.1 (-1.6-5.9)	0.9 (-0.5-2.3)
Coffee sugar-sweetened at the table				
Volume, ml	-	-	-	-
Energy, kcal	-	-	-	-
Hot chocolate prepared from scratch				
Volume, ml	-	-	-	-
Energy, kcal	-	-	-	-

Note: Negative values in 95% confidence intervals are a result of the bootstrap resampling method and not an indication of 'negative' consumption.

TABLE 5. ADULTS' PER CAPITA AVERAGE DAILY SUGARY DRINK CONSUMPTION, MALES BY AGE GROUP

	MALES			
	19-30 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**31-50 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**51-70 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**71+ yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Sample size	n=203	n=399	n=278	n=72
100% juice				
Volume, ml	**68.7 (22.0-115.4)**	**57.6 (30.9-84.4)**	**35.4 (18.3-52.5)**	**37.5 (17.3-57.7)**
Energy, kcal	**31.4 (9.5-53.3)**	**23.4 (13.1-33.7)**	**15.2 (8.1-22.3)**	**17.8 (7.6-28.0)**
Total sugar-sweetened beverages				
Volume, ml	**403.9 (251.0-556.8)**	**259.2 (189.8-328.5)**	**193.5 (140.0-246.9)**	**100.0 (56.8-143.2)**
Energy, kcal	**260.8 (105.9-415.8)**	**103.0 (78.2-127.8)**	**88.1 (64.2-112.0)**	**50.6 (27.7-73.4)**
Regular carbonated soft drinks				
Volume, ml	163.1 (64.3-262.0)	95.2 (56.6-133.8)	99.6 (54.7-144.5)	48.8 (18.0-79.6)
Energy, kcal	68.2 (27.3-109.1)	38.8 (23.0-54.6)	42.2 (23.1-61.3)	19.5 (7.1-31.9)
Tea pre-sweetened with sugar				
Volume, ml	34.5 (-2.6-71.7)	50.1 (5.9-94.4)	27.3 (5.3-49.3)	3.6 (-3.4-10.5)
Energy, kcal	12.1 (-1.1-25.2)	17.6 (1.8-33.5)	9.8 (1.9-17.7)	1.1 (-1.1-3.4)
Sugar-sweetened milk				
Volume, ml	49.3 (-2.2-100.7)	6.8 (-2.9-16.5)	7.9 (1.5-14.4)	11.0 (-1.9-23.9)
Energy, kcal	41.9 (1.5-82.4)	6.8 (-4.1-17.6)	5.1 (0.5-9.8)	9.6 (-2.5-21.8)
Regular fruit drinks				
Volume, ml	32.5 (3.0-61.9)	11.8 (-0.8-24.4)	17.2 (5.9-28.6)	16.4 (1.2-31.6)
Energy, kcal	13.6 (1.6-25.6)	5.5 (-0.1-11.1)	8.7 (2.8-14.6)	8.2 (0.4-16.1)
Smoothies				
Volume, ml	36.5 (-33.0-105.9)	13.0 (1.6-24.3)	5.9 (-0.3-12.1)	2.0 (-1.6-5.5)
Energy, kcal	27.1 (-25.0-79.1)	7.7 (0.8-14.6)	3.5 (-0.2-7.2)	1.0 (-0.9-3.0)
Regular protein & meal replacement drinks				
Volume, ml	46.1 (-21.6-113.8)	32.8 (-3.1-68.7)	8.8 (-3.9-21.5)	1.0 (-0.7-2.7)
Energy, kcal	83.4 (-54.1-220.9)	14.5 (1.0-28.0)	8.4 (-3.7-20.4)	1.2 (-0.7-3.0)
Coffee pre-sweetened with sugar				
Volume, ml	5.1 (-3.0-13.2)	33.0 (-10.9-76.9)	17.3 (5.6-29.1)	-
Energy, kcal	0.9 (-0.5-2.3)	7.6 (-0.4-15.6)	7.4 (1.8-13.0)	-
Regular sports drinks				
Volume, ml	3.3 (-3.9-10.5)	5.6 (-0.2-11.3)	5.8 (-0.6-12.2)	-
Energy, kcal	0.9 (-1.0-2.7)	1.49 (-0.03-3.01)	1.6 (-0.1-3.2)	-
Regular flavoured water				
Volume, ml	12.8 (-9.9-35.6)	8.9 (-7.5-25.2)	0.5 (-0.7-1.6)	-
Energy, kcal	3.0 (-2.3-8.2)	2.0 (-1.7-5.8)	0.1 (-0.2-0.4)	-
Regular energy drinks				
Volume, ml	20.8 (-4.5-46.0)	1.6 (-1.6-4.9)	0.5 (-0.5-1.5)	-
Energy, kcal	9.8 (-2.1-21.6)	0.7 (-0.8-2.2)	0.2 (-0.2-0.5)	-
Hot chocolate pre-sweetened with sugar				
Volume, ml	-	0.5 (-0.4-1.3)	0.4 (-0.4-1.1)	17.2 (-10.2-44.6)
Energy, kcal	-	0.2 (-0.2-0.7)	0.2 (-0.2-0.6)	9.9 (-5.2-25.0)
Flavoured drinkable yogurt				

	MALES			
	19-30 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**31-50 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**51-70 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**71+ yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Volume, ml	-	-	0.9 (-1.1-2.9)	-
Energy, kcal	-	-	0.7 (-0.8-2.2)	-
Coffee sugar-sweetened at the table				
Volume, ml	-	-	-	-
Energy, kcal	-	-	-	-
Hot chocolate prepared from scratch				
Volume, ml	-	-	1.3 (-1.7-4.4)	-
Energy, kcal	-	-	0.3 (-0.4-1.1)	-

Note: Negative values in 95% confidence intervals are a result of the bootstrap resampling method and not an indication of 'negative' consumption.

TABLE 6. ADULTS' PER CAPITA AVERAGE DAILY SUGARY DRINK CONSUMPTION, FEMALES BY AGE GROUP

	FEMALES			
	19-30 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**31-50 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**51-70 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**71+ yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Sample size	n=172	n=345	n=269	n=89
100% juice				
Volume, ml	**16.7 (0.8-32.7)**	**50.0 (23.0-77.0)**	**22.6 (8.0-37.1)**	**45.4 (19.6-71.3)**
Energy, kcal	**8.0 (0.1-16.0)**	**22.8 (10.2-35.3)**	**9.7 (3.2-16.3)**	**20.4 (10.1-30.7)**
Total sugar-sweetened beverages				
Volume, ml	**381.2 (232.6-529.9)**	**181.9 (100.8-263.1)**	**202.5 (80.5-324.6)**	**119.6 (67.1-172.2)**
Energy, kcal	**170.5 (105.6-235.4)**	**90.7 (48.2-133.2)**	**110.7 (27.6-193.8)**	**60.1 (34.0-86.2)**
Regular carbonated soft drinks				
Volume, ml	75.8 (30.4-121.3)	53.8 (22.5-85.1)	65.3 (-4.5-135.2)	30.8 (3.9-57.8)
Energy, kcal	31.6 (12.8-50.3)	22.0 (9.2-34.8)	26.7 (-1.9-55.4)	12.9 (1.6-24.2)
Tea pre-sweetened with sugar				
Volume, ml	130.1 (-10.4-270.6)	38.4 (8.6-68.2)	27.2 (2.9-51.5)	17.2 (-1.1-35.5)
Energy, kcal	46.2 (-4.3-96.6)	13.7 (3.0-24.4)	5.7 (1.5-9.8)	5.9 (-0.7-12.5)
Sugar-sweetened milk				
Volume, ml	5.0 (-0.2-10.1)	7.4 (0.4-14.4)	54.2 (10.9-97.4)	20.1 (1.9-38.3)
Energy, kcal	2.73 (-0.05-5.50)	3.52 (-0.04-7.08)	51.6 (-1.6-104.9)	13.2 (0.6-25.8)
Regular fruit drinks				
Volume, ml	16.1 (0.3-31.8)	8.7 (1.6-15.8)	19.2 (3.0-35.5)	12.4 (1.1-23.7)
Energy, kcal	7.31 (-0.02-14.64)	4.1 (0.8-7.3)	8.5 (1.4-15.7)	6.6 (0.6-12.7)
Smoothies				
Volume, ml	58.2 (6.2-110.3)	41.7 (-11.7-95.1)	8.3 (1.0-15.5)	17.8 (-3.8-39.4)

	FEMALES			
	19-30 yrs **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**31-50 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**51-70 yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)	**71+ yrs** **Volume** (ml) mean (95% CI) **Energy** (kcal) mean (95% CI)
Energy, kcal	25.6 (2.3-48.9)	25.4 (-6.1-56.9)	5.5 (0.6-10.4)	10.8 (-2.7-24.3)
Regular protein & meal replacement drinks				
Volume, ml	15.4 (-2.7-33.6)	15.7 (1.0-30.3)	13.9 (-1.6-29.4)	4.9 (-2.7-12.4)
Energy, kcal	12.7 (-3.6-29.0)	11.0 (0.5-21.4)	9.4 (-2.0-20.7)	4.6 (-2.5-11.8)
Coffee pre-sweetened with sugar				
Volume, ml	55.9 (17.0-94.7)	8.2 (0.5-15.8)	8.7 (-0.2-17.5)	11.6 (-0.4-23.6)
Energy, kcal	36.7 (8.2-65.2)	3.6 (-0.1-7.2)	1.45 (-0.03-2.93)	2.02 (-0.02-4.06)
Regular sports drinks				
Volume, ml	18.3 (-14-50.6)	0.1 (-0.2-0.4)	-	-
Energy, kcal	4.8 (-3.6-13.1)	0.04 (-0.04-0.11)	-	-
Regular flavoured water				
Volume, ml	1.2 (-1.1-3.5)	-	3.0 (-3.2-9.2)	0.8 (-0.8-2.5)
Energy, kcal	0.3 (-0.3-0.8)	-	0.7 (-0.7-2.1)	0.2 (-0.2-0.6)
Regular energy drinks				
Volume, ml	4.7 (-2.2-11.7)	-	-	-
Energy, kcal	2.2 (-1.0-5.5)	-	-	-
Hot chocolate pre-sweetened with sugar				
Volume, ml	0.5 (-0.7-1.7)	1.7 (-1.3-4.7)	0.04 (-0.05-0.12)	4.1 (-1.8-10.0)
Energy, kcal	0.5 (-0.6-1.6)	4.3 (-4.6-13.1)	0.03 (-0.04-0.10)	3.8 (-1.8-9.5)
Flavoured drinkable yogurt				
Volume, ml	-	0.5 (-0.6-1.6)	0.3 (-0.2-0.8)	-
Energy, kcal	-	0.3 (-0.4-1.0)	0.2 (-0.2-0.6)	-
Coffee sugar-sweetened at the table				
Volume, ml	-	5.6 (-6.2-17.5)	2.4 (-2.7-7.6)	-
Energy, kcal	-	2.7 (-3.0-8.5)	0.9 (-1.0-2.8)	-
Hot chocolate prepared from scratch				
Volume, ml	-	0.1 (-0.1-0.3)	0.1 (-0.1-0.2)	-
Energy, kcal	-	0.1 (-0.1-0.2)	0.02 (-0.03-0.07)	-

Note: Negative values in 95% confidence intervals are a result of the bootstrap resampling method and not an indication of 'negative' consumption.

HEALTH AND ECONOMIC BENEFITS FROM A TAX ON SUGARY DRINKS IN ALBERTA

A 20% tax on SSBs or sugary drinks had an impact on health and economic outcomes modelled for the adult population of Alberta. Overall, a 20% tax on SSBs was estimated to postpone 1,201 deaths, avert 46,162 DALYS, and prevent 61,324 cases of overweight and obesity among the Alberta adult population over a 25-year period. Prevented new disease cases include 21,661 cases of type 2 diabetes, 5,700 cases of ischemic heart disease, 2,099 cancer cases, and 752 stroke cases. The simulated tax produced almost $1.1 billion in health care savings and $3.5 billion in tax revenue, for a total of $4.6 billion in economic savings over 25 years.

A simulated 20% tax on sugary drinks, which had an even greater positive health impact than the SSB tax, was estimated to postpone 1,457 deaths, avert 55,201 DALYS, and prevent 73,687 cases of overweight and obesity among the Alberta adult population over a 25-year period. Prevented new disease cases include 25,576 cases of type 2 diabetes, 6,941 cases of ischemic heart disease, 2,546 cancer cases, and 925 stroke cases. The simulated tax produced $1.3 billion in health care savings and nearly $4.4 billion in tax revenue, for a total of almost $5.7 billion in economic savings over 25 years.

BODY MASS INDEX

Over the next 25 years, a 20% tax on SSBs was projected to decrease the per capita daily energy intake among Canadian males and females aged 20 and older by 21 kcal (95% uncertainty intervals [UI]: 18, 24) and 19 kcal (16, 22), respectively. The overall effect on BMI would be a mean reduction in BMI of 0.29 (0.25, 0.34) for males and 0.33 (0.28, 0.38) for females. A 20% tax on sugary drinks was projected to decrease the per capita daily energy intake of males and females by 25 kcal (22, 28) and 22 kcal (19, 26), respectively. The lower energy intake would produce a mean reduction in BMI of 0.36 (0.31, 0.41) for males and 0.38 (0.32, 0.44) for females. The largest changes in energy intake and BMI occurred among the highest beverage consumers. The taxes prevented cases of overweight and obesity within the simulated population (Table 7).

TABLE 7. PREVENTED CASES OF OVERWEIGHT AND OBESITY DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Overweight		
Males*	-1,410 (-94, -2,681)	-1,848 (-3,187, -442)
Females	3,245 (4,107, 2,449)	4,118 (3,238, 5,138)
Total	1,835 (3,478, 397)	2,270 (674, 4,017)
Obesity		
Males	35,344 (40,830, 30,339)	42,919 (37,172, 49,206)
Females	24,145 (28,394, 20,365)	28,499 (24,398, 33,291)
Total	59,489 (68,218, 51,420)	71,417 (62,004, 81,291)

*The negative values for overweight males is interpreted as an increase in cases of overweight for males. However, this is still a beneficial outcome. Due to the tax intervention, some males with obesity had a decrease in BMI and shifted to having overweight. Movement of males from overweight to normal weight occurred, but was not sufficiently large to offset the movement of males from obesity to overweight.

DISEASES

The modelled SSB and sugary drinks taxes prevented cases of type 2 diabetes (Tables 8 & 9), cancers (Tables 10 & 11), cardiovascular disease (Tables 12-14), chronic kidney disease (Tables 15 & 16), osteoarthritis (Table 17), and low back pain (Table 18).

TYPE 2 DIABETES

TABLE 8. PREVENTED INCIDENT CASES OF TYPE 2 DIABETES DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Type 2 diabetes mellitus		
Males	10,986 (8,244, 13,863)	13,273 (10,230, 16,715)
Females	10,675 (8,226, 13,211)	12,302 (9,570, 15,159)
Total	21,661 (17,005, 26,349)	25,576 (20,734, 30,969)

TABLE 9. PREVENTED PREVALENT CASES OF TYPE 2 DIABETES DUE TO 20% BEVERAGE TAXES, 2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Type 2 diabetes mellitus		
Males	9,299 (6,983, 11,730)	11,201 (8,607, 14,128)
Females	9,393 (7,214, 11,643)	10,836 (8,411, 13,369)
Total	18,692 (14,679, 22,791)	22,037 (17,832, 26,703)

CANCERS

TABLE 10. PREVENTED INCIDENT CASES OF CANCER DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Esophageal cancer		
Males	66 (13, 129)	83 (17, 162)
Females	20 (1, 42)	25 (2, 53)
Total	86 (29, 152)	108 (37, 189)
Colon and rectum cancer		
Males	226 (175, 279)	289 (227, 361)
Females	58 (28, 93)	76 (37, 117)
Total	285 (224, 350)	365 (287, 455)
Liver cancer		
Males	66 (24, 110)	82 (29, 140)
Females	19 (2, 37)	24 (4, 46)
Total	85 (40, 132)	106 (50, 173)
Gallbladder and biliary track cancer		
Males	14 (3, 27)	17 (3, 34)
Females	38 (23, 54)	49 (31, 70)

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Total	51 (33, 72)	67 (43, 92)
Pancreatic cancer		
Males	17 (-4, 40)	22 (-4, 52)
Females	22 (8, 36)	29 (10, 49)
Total	39 (14, 67)	52 (19, 88)
Breast cancer		
Males		
Females	793 (271, 1,376)	932 (320, 1,658)
Total	793 (271, 1,376)	932 (320, 1,658)
Uterine cancer		
Males		
Females	415 (343, 490)	489 (411, 574)
Total	415 (343, 490)	489 (411, 574)
Ovarian cancer		
Males		
Females	10 (-3, 24)	13 (-3, 30)
Total	10 (-3, 24)	13 (-3, 30)
Kidney cancer		
Males	92 (62, 123)	116 (79, 153)
Females	76 (58, 98)	93 (69, 118)
Total	169 (131, 207)	209 (162, 261)
Thyroid cancer		
Males	36 (11, 63)	45 (14, 80)
Females	72 (48, 100)	86 (58, 117)
Total	108 (73, 149)	131 (89, 179)
Leukemia		
Males	28 (15, 41)	35 (19, 51)
Females	30 (12, 49)	39 (15, 63)
Total	58 (37, 82)	74 (47, 103)

Note: The negative values are due to random variability in inputs throughout the model and the limited degree of certainty in inputs.

TABLE 11. PREVENTED CANCER DEATHS DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Esophageal cancer		
Males	56 (11, 110)	71 (14, 138)
Females	16 (1, 34)	20 (1, 43)
Total	72 (24, 128)	91 (31, 160)
Colon and rectum cancer		
Males	71 (54, 87)	90 (70, 113)
Females	15 (6, 25)	19 (8, 31)
Total	86 (67, 106)	109 (85, 137)
Liver cancer		
Males	32 (11, 53)	39 (14, 68)
Females	10 (1, 20)	13 (2, 25)
Total	42 (20, 66)	52 (24, 86)
Gallbladder and biliary track cancer		
Males	3 (1, 5)	3 (0, 7)
Females	8 (5, 11)	10 (6, 14)

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Total	10 (7, 15)	13 (8, 18)
Pancreatic cancer		
Males	12 (-3, 28)	15 (-4, 36)
Females	17 (6, 28)	23 (7, 38)
Total	29 (10, 49)	38 (13, 64)
Breast cancer		
Males		
Females	104 (33, 182)	119 (38, 216)
Total	104 (33, 182)	119 (38, 216)
Uterine cancer		
Males		
Females	47 (39, 56)	55 (46, 64)
Total	47 (39, 56)	55 (46, 64)
Ovarian cancer		
Males		
Females	3 (-2, 9)	4 (-2, 11)
Total	3 (-2, 9)	4 (-2, 11)
Kidney cancer		
Males	20 (13, 26)	24 (17, 32)
Females	13 (10, 17)	16 (12, 20)
Total	33 (25, 41)	40 (31, 51)
Thyroid cancer		
Males	1 (0, 2)	1 (0, 2)
Females	0 (0, 0)	0 (0, 0)
Total	1 (0, 2)	2 (1, 3)
Leukemia		
Males	7 (3, 11)	9 (4, 14)
Females	10 (4, 17)	13 (5, 22)
Total	17 (10, 26)	22 (13, 32)

Note: The negative values are due to random variability in inputs throughout the model and the limited degree of certainty in inputs.

CARDIOVASCULAR DISEASE

TABLE 12. PREVENTED INCIDENT CASES OF CARDIOVASCULAR DISEASE DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Ischemic heart disease		
Males	3,236 (2,428, 4,164)	4,001 (2,980, 5,137)
Females	2,464 (1,778, 3,205)	2,939 (2,111, 3,864)
Total	5,700 (4,506, 6,914)	6,941 (5,512, 8,483)
Ischemic stroke		
Males	234 (164, 313)	295 (207, 394)
Females	205 (130, 293)	252 (152, 361)
Total	439 (327, 563)	546 (402, 702)
Hemorrhagic stroke		
Males	150 (95, 215)	185 (117, 267)
Females	163 (97, 243)	194 (113, 288)
Total	313 (219, 423)	379 (267, 509)

TABLE 13. PREVENTED PREVALENT CASES OF CARDIOVASCULAR DISEASE DUE TO 20% BEVERAGE TAXES, 2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Ischemic heart disease		
Males	2,238 (1,666, 2,881)	2,746 (2,033, 3,548)
Females	1,830 (1,322, 2,378)	2,147 (1,544, 2,821)
Total	4,069 (3,220, 4,943)	4,893 (3,877, 5,986)
Ischemic stroke		
Males	126 (91, 166)	157 (113, 206)
Females	121 (84, 164)	144 (98, 196)
Total	248 (191, 309)	300 (231, 377)
Hemorrhagic stroke		
Males	55 (35, 79)	68 (43, 96)
Females	68 (42, 98)	80 (49, 115)
Total	123 (88, 165)	147 (106, 194)
Hypertensive heart disease		
Males	67 (26, 120)	82 (32, 147)
Females	84 (25, 151)	107 (32, 196)
Total	151 (81, 237)	188 (93, 300)

TABLE 14. PREVENTED CARDIOVASCULAR DISEASE DEATHS DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Ischemic heart disease		
Males	414 (306, 536)	514 (374, 667)
Females	210 (147, 276)	258 (175, 348)
Total	624 (483, 767)	773 (601, 959)
Ischemic stroke		
Males	66 (44, 93)	85 (56, 117)
Females	54 (28, 86)	70 (33, 111)
Total	121 (84, 161)	155 (106, 209)
Hemorrhagic stroke		
Males	81 (52, 116)	101 (64, 145)
Females	84 (50, 128)	101 (59, 151)
Total	166 (115, 224)	202 (142, 272)

TABLE 15. PREVENTED PREVALENT CASES OF CHRONIC KIDNEY DISEASE DUE TO 20% BEVERAGE TAXES, 2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Chronic kidney disease due to diabetes mellitus		
Males	1,057 (222, 2162)	1,300 (263, 2,636)
Females	1,757 (249, 3,512)	1,988 (304, 3,995)
Total	2,814 (1,010, 4,886)	3,288 (1,227, 5,712)
Chronic kidney disease due to hypertension		
Males	560 (115, 1,155)	687 (136, 1,349)
Females	1,029 (175, 2,086)	1,155 (176, 2,354)
Total	1,590 (591, 2,791)	1,842 (725, 3,232)
Chronic kidney disease due to glomerulonephritis		
Males	896 (172, 1,921)	1,123 (202, 2,320)
Females	1,519 (197, 3,029)	1,691 (193, 3,489)
Total	2,415 (827, 4,186)	2,814 (1,047, 4,957)
Chronic kidney disease due to other causes		
Males	765 (121, 1,624)	1,004 (209, 2,048)
Females	1,351 (200, 2,685)	1,512 (227, 3,138)
Total	2,116 (765, 3,703)	2,516 (1,021, 4,322)

TABLE 16. PREVENTED CHRONIC KIDNEY DISEASE DEATHS DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Chronic kidney disease due to diabetes mellitus		
Males	47 (10, 97)	59 (12, 121)
Females	26 (3, 52)	30 (4, 60)
Total	73 (27, 129)	90 (33, 159)
Chronic kidney disease due to hypertension		
Males	28 (5, 59)	36 (6, 71)
Females	22 (3, 46)	27 (3, 56)
Total	50 (19, 89)	62 (23, 108)
Chronic kidney disease due to glomerulonephritis		
Males	8 (1, 17)	10 (2, 21)
Females	6 (1, 12)	7 (1, 15)
Total	14 (5, 25)	18 (7, 31)
Chronic kidney disease due to other causes		
Males	1 (0, 1)	1 (0, 2)
Females	1 (0, 1)	1 (0, 2)
Total	1 (0, 2)	2 (1, 3)

OSTEOARTHRITIS

TABLE 17. PREVENTED PREVALENT CASES OF OSTEOARTHRITIS DUE TO 20% BEVERAGE TAXES, 2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Osteoarthritis of the hip		
Males	116 (49, 191)	139 (54, 227)
Females	155 (65, 253)	182 (86, 294)
Total	271 (153, 396)	321 (188, 463)
Osteoarthritis of the knee		
Males	862 (440, 1,329)	1,053 (535, 1,621)
Females	1,390 (659, 2,218)	1,622 (786, 2,571)
Total	2,251 (1,409, 3,271)	2,675 (1,652, 3,778)

LOW BACK PAIN

TABLE 18. PREVENTED PREVALENT CASES OF LOW BACK PAIN DUE TO 20% BEVERAGE TAXES, 2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Low back pain		
Males	164 (89, 243)	198 (104, 294)
Females	122 (56, 197)	165 (81, 258)
Total	286 (181, 398)	363 (231, 506)

DEATHS

Table 21 reports deaths postponed due to the simulated tax interventions.

TABLE 19. POSTPONED DEATHS DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Avoidable deaths		
Males	683 (554, 816)	848 (694, 1,021)
Females	518 (411, 637)	610 (493, 747)
Total	1,201 (1,003, 1,406)	1,457 (1,231, 1,705)

DISABILITY ADJUSTED LIFE YEARS (DALYs)

Table 22 reports DALYS averted due to the simulated tax interventions.

TABLE 20. AVERTED DALYS DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Avoidable DALYs		
Males	23,184 (19,122, 27,651)	28,363 (23,768, 33,556)
Females	22,978 (18,723, 27,445)	26,838 (22,393, 31,975)
Total	46,162 (38,781, 53,544)	55,201 (47,135, 64,227)

HEALTH CARE COSTS SAVINGS

The SSB and sugary drink taxes produced health care cost savings for the simulated Alberta population.

TABLE 21. HEALTH CARE COSTS SAVINGS DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Health care costs		
Males	$583,137,524 ($476,628,239, $699,976,059)	$711,508,294 ($592,885,161, $843,448,840)
Females	$516,342,372 ($425,038,545, $618,767,930)	$599,744,308 ($498,661,411, $717,074,720)
Total	$1,099,479,896 ($920,990,948, $1,283,368,806)	$1,311,252,603 ($1,118,589,201, $1,527,841,228)

*2015 Canadian dollars

TAX REVENUE

TABLE 22. TAX REVENUE DUE TO 20% BEVERAGE TAXES, 2016-2041

	SSBs Mean (95% UI)	Sugary drinks Mean (95% UI)
Tax revenue		
Annual (2016)	$141,190,540 ($132,848,068, $149,909,986)	$174,592,077 ($165,603,193, $183,800,369)
25-year total	$3,529,763,488	$4364,801,918

*2015 Canadian dollars

HEALTH AND ECONOMIC IMPACT OF DIFFERENT TAXATION LEVELS

TABLE 23. SUMMARY OF HEALTH AND ECONOMIC BENEFITS FROM 10% BEVERAGE TAXES, 2016-2041*

	SSBs Mean (95% UI)	**Sugary drinks** Mean (95% UI)
Deaths postponed	665 (554, 788)	810 (681, 954)
DALYs averted	25,823 (21,622, 30,176)	30,840 (26,075, 35,994)
Overweight & obesity cases prevented	33,521 (28,597, 38,658)	40,169 (34,304, 46,189)
Diabetes*	12,185 (9,598, 14,999)	14,326 (11,379, 17,560)
Ischemic heart disease*	3,153 (2,490, 3,866)	3,839 (3,070, 4,733)
Cancer*		
Esophageal	48 (16, 84)	60 (20, 107)
Colon and rectum	157 (123, 197)	202 (159, 250)
Liver	46 (22, 74)	60 (28, 96)
Gallbladder & biliary track	29 (19, 40)	37 (23, 52)
Pancreas	22 (8, 39)	28 (10, 47)
Breast	439 (135, 799)	522 (175, 920)
Uterine	230 (189, 275)	272 (228, 322)
Ovarian	6 (-1, 13)	7 (-2, 16)
Kidney	94 (73, 117)	116 (89, 146)
Thyroid	61 (40, 83)	72 (48, 98)
Leukemia	32 (19, 45)	41 (25, 58)
Stroke*		
Ischemic	246 (186, 317)	303 (225, 390)
Hemorrhagic	174 (122, 235)	212 (145, 289)
Health care costs savings		
Tax revenue (annual)	$78,343,403 ($74,019,026, $82,750,080)	$96,759,378 ($91,938,976, $101,613,374)
Tax revenue	$1,958,585,070	$2,418,984,458

*For disease conditions, refers to incident cases prevented

Note: The negative values are due to random variability in inputs throughout the model and the limited degree of certainty in inputs.

TABLE 24. SUMMARY OF HEALTH AND ECONOMIC BENEFITS FROM 30% BEVERAGE TAXES, 2016-2041*

	SSBs Mean (95% UI)	**Sugary drinks** Mean (95% UI)
Deaths postponed	1,646 (1,384, 1,945)	2,002 (1,693, 2,328)
DALYs averted	62,885 (53,397, 73,224)	74,934 (63,979, 86,767)
Overweight & obesity cases prevented	85,136 (72,529, 98,570)	102,377 (88,151, 117,414)
Diabetes*	29,360 (23,561, 35,583)	34,495 (27,564, 41,814)
Ischemic heart disease*	7,821 (6,266, 9,548)	9,519 (7,547, 11,612)
Cancer*		
Esophageal	117 (38, 207)	153 (55, 264)
Colon and rectum	393 (307, 490)	504 (390, 615)
Liver	116 (51, 185)	146 (71, 234)
Gallbladder & biliary track	71 (45, 100)	91 (59, 126)
Pancreas	55 (20, 93)	71 (27, 119)
Breast	1,092 (360, 1,919)	1275 (425, 2,258)
Uterine	568 (472, 673)	670 (563, 792)
Ovarian	14 (-4, 33)	18 (-4, 41)
Kidney	232 (181, 288)	288 (225, 354)
Thyroid	149 (101, 203)	179 (120, 245)
Leukemia	80 (50, 113)	101 (61, 144)
Stroke*		
Ischemic	607 (460, 777)	749 (555, 960)
Hemorrhagic	427 (299, 571)	520 (359, 692)
Health care costs savings		
Tax revenue (annual)	$237,900,698 ($224,063,576, $251,779,837)	$192,498,799 ($179,763,110, $204,647,687)
Tax revenue	$4,812,469,987	$5,947,517,454

*For disease conditions, refers to incident cases prevented

Note: The negative values are due to random variability in inputs throughout the model and the limited degree of certainty in inputs.

DISCUSSION

The current study reports on consumption of 100% juice and SSBs among the Alberta population, as well as the potential health and economic benefits of a tax on SSBs and sugary drinks. According to 2015 Canadian Community Health Survey – Nutrition data, Albertans consumed an average of 54.9 ml (24.7 kcal) of 100% juice per person per day and 246.6 ml of SSBs (123.0 kcal) per person per day. Compared to national estimates, Alberta's 100% juice consumption is significantly lower and 'total SSB' consumption is significantly higher (data not reported). Albertans are among the highest consumers of SSBs in Canada.

A simulated 20% tax on SSBs was estimated to postpone 1,201 deaths, avert 46,162 DALYS, and prevent 61,324 cases of overweight and obesity among the Alberta adult population over a 25-year period. Prevented new disease cases include 21,661 cases of type 2 diabetes, 5,700 cases of ischemic heart disease, 2,099 cancer cases, and 752 stroke cases. Overall, the simulated tax produced almost $1.1 billion in health care savings and $3.5 billion in tax revenue, for a total of $4.6 billion in economic savings over 25 years.

A simulated 20% tax on sugary drinks, which had an even greater positive health impact than the SSB tax, was estimated to postpone 1,457 deaths, avert 55,201 DALYS, and prevent 73,687 cases of overweight and obesity among the Alberta adult population over a 25-year period. Prevented new disease cases include 25,576 cases of type 2 diabetes, 6,941 cases of ischemic heart disease, 2,546 cancer cases, and 925 stroke cases. Overall, the simulated tax produced $1.3 billion in health care savings and nearly $4.4 billion in tax revenue, for a total of almost $5.7 billion in economic savings over 25 years.

Dietary recall data entails important assumptions and limitations. Group-level analysis of unadjusted means can be assumed to reflect the mean of the population distribution of usual intake, since data was collected throughout the year, and the days of week were evenly represented.[45,81] However, underreporting of food energies is a common limitation of dietary recall data, and no standard adjustment currently exists for correcting underreporting.[82] In addition, dietary recalls are known to underestimate sugary drink consumption, by as much as 30-40% according to some estimates.[83] Therefore, sugary drink intake based on CCHS data may underestimate actual intake levels. It should also be noted that the CCHS sampling frame has poor coverage of certain sub-populations with higher than average SSB consumption, including Indigenous peoples in Canada.[84,85] Smaller sample sizes for younger children may have contributed greater variability to beverage intake estimates.

The study contains some limitations and assumptions. Since the Alberta sugary drink tax model was based on a national model, and due a lack of provincial-level data, numerous parameters are Canada-specific and not Alberta-specific. For example, it was assumed that national disease trends, BMI trends, mortality rates, and health care costs were the same for Alberta. It is unknown how much Alberta's metrics would vary from national values, though it is expected that the overall finding regarding the beneficial nature of a sugary drink tax would not change. A strength is that the current model used data specific to Alberta for three key sets of inputs: 1) beverage consumption was calculated from 2015 CCHS-Nutrition and for residents of Alberta only; 2) for sex and 10-year age sub-groups, mean BMI was calculated from 2015 CCHS-Nutrition and for residents of Alberta only; and 3) population parameters were Alberta's age- and sex-specific 2015 population size. No sensitivity analysis was conducted for the Alberta model. However, extensive sensitivity analysis was conducted for the national model and the conclusions may be applied to the Alberta model.[86]

Limitations and assumptions applicable to the national model also apply to the Alberta sugary drink tax model. Apart from the direct effects of sugary drinks on type 2 diabetes, the model did not account for other non-BMI-mediated health effects. However, the model includes an comprehensive set of BMI-related diseases, as well as type 2 diabetes direct effects. Due to the model design and data limitations, the type of tax modelled was an *ad valorem* excise tax on sugary drinks. However, the type of tax most commonly proposed and implemented in 'real world' settings is a specific excise tax based on beverage volume or sugar content.[22,25–28,48,49,51,87] It was assumed that changes in consumption and weight would occur equally across population sex and age groups. In actuality, not all Canadians consume sugary drinks and, among consumers, some drink significantly less or more than the average.[44,88–90] Based on the simulation framework, high consumers stand to benefit the most as their consumption can decline more in response to a tax intervention.

The inclusion of 100% juice was based on the fact that free sugars contribute to the overall energy density of beverages and are metabolized the same way as 'added' sugars.[21] The model assumed that 100% fruit juice and other sugary drinks had the same BMI-mediated health effects as SSBs; however, it remains unclear whether macronutrients other than sugar in 100% juice may alter the disease-specific risks attributable to SSBs. For this reason, all primary health and economic outcomes were reported separately for SSBs and sugary drinks. In addition, when estimating the non-BMI-mediated effects of SSBs and sugary drinks on type 2 diabetes cases, it was assumed that 100% juice would have the same effects as SSBs. However, a recent meta-analysis suggests that the effect of 100% fruit juice on type 2 diabetes may be slightly lower than for SSBs; therefore, the current analysis may have overestimated the direct of effect of 100% fruit juice on type 2 diabetes.[2] This may have produced a slight overestimation of type 2 diabetes cases for the burden of sugary drinks and the impact of a sugary drink tax.

Given the broad definition of sugary drinks, the model did not incorporate caloric compensation from switching to non-taxed beverages and foods, and assumed no caloric substitution. Sugary drink consumption was assumed to have no secular change. The primary scenarios also used a 100% pass-on rate. If beverage manufacturers and distributors choose to absorb some of the tax, a lower pass-on rate occurs (e.g. 80%), translating to smaller price increases and ultimately a less effective tax intervention as consumers do not reduce their consumption as much. An over-shifting (e.g. 120% pass-on rate) achieves an even greater change in consumer behaviour than the 100% pass through. Evidence from France and Mexico, settings with an excise tax on SSBs, show pass-on rates equal to or almost equal to 100%, with some heterogeneity by product, outlet and region.[34,35] In Berkeley, California, the tax was passed on but not at a 100% rate: 69% for carbonated soft drinks, 47% for fruit-flavoured beverages, and 47% for SSBs overall.[42] However, the pass-on rate may have been affected the localized nature of the tax. In France and Mexico the taxes were applied to all SSBs within the countries, making it more challenging for manufacturers to absorb the cost or shift some of the cost to other non-SSB products.

APPENDIX: BEVERAGE PARAMETERS FOR MODEL

APPENDIX TABLE 1. SUGARY DRINK CONSUMPTION AND ENERGY DENSITY IN ALBERTA, 2015 CCHS-NUTRITION

	SSBs		Sugary Drinks	
Males Age	**Consumption (SE)** Millilitre/person/day	**Energy density** Kcal/litre	**Consumption (SE)** Millilitre/person/day	**Energy density** Kcal/litre
0-9	158.3 (17.3)	580.6	268 (20.6)	534.2
10-19	445.1 (37.7)	451.6	501.9 (37.9)	452.1
20-29	378.9 (49.6)	492.1	440.3 (52.4)	485.8
30-39	214.6 (28.8)	463.9	293.4 (36)	455.7
40-49	294.6 (40.3)	357.9	342.3 (43.2)	360.2
50-59	151.8 (27.2)	421.9	176.7 (28)	421.7
60-69	177.2 (28.3)	441.8	226 (30.8)	442.6
70-79	125.1 (24.6)	425.3	163.3 (25.2)	438.1
80-89	84.6 (33.7)	599.5	114.4 (37.4)	563.1
90+	84.6 (33.7)	599.5	114.4 (37.4)	563.1
Females Age	**Consumption (SE)** Millilitre/person/day	**Energy density** Kcal/litre	**Consumption (SE)** Millilitre/person/day	**Energy density** Kcal/litre
0-9	163.2 (15.2)	541.7	282.1 (18.7)	511.5
10-19	293.6 (24.8)	500.3	368.9 (30.8)	495.0
20-29	354.6 (49.9)	418.8	366.1 (49.9)	420.2
30-39	232.2 (37.2)	477.7	295.2 (41.5)	475.9
40-49	105.3 (21.1)	452.0	145.8 (23.1)	448.3
50-59	228.1 (48)	609.3	255.6 (48.1)	588.3
60-69	142.4 (29.2)	390.4	149.9 (29.2)	393.5
70-79	94.1 (19)	427.7	137.5 (19)	437.4
80-89	121.5 (30.5)	533.2	182.4 (33.3)	507.4
90+	84.6 (30.5)	533.2	182.4 (33.3)	507.4

REFERENCES

1. GBD 2015 Risk Factors Collaborators. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016 Oct 8;388(10053):1659–724.

2. Imamura F, O'Connor L, Ye Z, Mursu J, Hayashino Y, Bhupathiraju SN, et al. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: systematic review, meta-analysis, and estimation of population attributable fraction. BMJ. 2015;351:h3576.

3. Greenwood DC, Threapleton DE, Evans CEL, Cleghorn CL, Nykjaer C, Woodhead C, et al. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: systematic review and dose-response meta-analysis of prospective studies. Br J Nutr. 2014 Sep 14;112(5):725–34.

4. Kim Y, Je Y. Prospective association of sugar-sweetened and artificially sweetened beverage intake with risk of hypertension. Arch Cardiovasc Dis. 2016 Apr;109(4):242–53.

5. Moynihan PJ, Kelly S. Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines. J Dent Res. 2014 Jan;93(1):8–18.

6. Malik VS, Pan A, Willett WC, Hu FB. Sugar-sweetened beverages and weight gain in children and adults: a systematic review and meta-analysis. Am J Clin Nutr. 2013;98(4):1084–102.

7. Malik VS, Schulze MB, Hu FB. Intake of sugar-sweetened beverages and weight gain: a systematic review. Am J Clin Nutr. 2006 Aug;84(2):274–88.

8. Malik VS, Popkin BM, Bray GA, Després J-P, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. Circulation. 2010 Mar 23;121(11):1356–64.

9. O'Connor L, Imamura F, Lentjes MAH, Khaw K-T, Wareham NJ, Forouhi NG. Prospective associations and population impact of sweet beverage intake and type 2 diabetes, and effects of substitutions with alternative beverages. Diabetologia. 2015 Jul;58(7):1474–83.

10. Malik VS, Popkin BM, Bray GA, Després J-P, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. Diabetes Care. 2010;33(11):2477–83.

11. Xi B, Huang Y, Reilly KH, Li S, Zheng R, Barrio-Lopez MT, et al. Sugar-sweetened beverages and risk of hypertension and CVD: a dose-response meta-analysis. Br J Nutr. 2015 Mar 14;113(5):709–17.

12. Prospective Studies Collaboration. Body-mass index and cause-specific mortality in 900 000 adults: collaborative analyses of 57 prospective studies. Lancet. 2009 Mar 28;373(9669):1083–96.

13. Global BMI Mortality Collaboration, Di Angelantonio E, Bhupathiraju S, Wormser D, Gao P, Kaptoge S, et al. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. Lancet. 2016 20;388(10046):776–86.

14. Lauby-Secretan B, Scoccianti C, Loomis D, Grosse Y, Bianchini F, Straif K. Body fatness and cancer: viewpoint of the IARC Working Group. N Engl J Med. 2016 Aug 25;375(8):794–8.

15. Singh GM, Danaei G, Farzadfar F, Stevens GA, Woodward M, Wormser D, et al. The age-specific quantitative effects of metabolic risk factors on cardiovascular diseases and diabetes: a pooled analysis. PloS One. 2013;8(7):e65174.

16. Kodama S, Horikawa C, Fujihara K, Yoshizawa S, Yachi Y, Tanaka S, et al. Quantitative relationship between body weight gain in adulthood and incident type 2 diabetes: a meta-analysis. Obes Rev. 2014 Mar;15(3):202–14.

17. Global Burden of Metabolic Risk Factors for Chronic Diseases Collaboration (BMI Mediated Effects), Lu Y, Hajifathalian K, Ezzati M, Woodward M, Rimm EB, et al. Metabolic mediators of the effects of body-mass index, overweight, and obesity on coronary heart disease and stroke: a pooled analysis of 97 prospective cohorts with 1·8 million participants. Lancet. 2014 Mar 15;383(9921):970–83.

18. United States Department of Agriculture. What are added sugars? [Internet]. Choose MyPlate. 2016 [cited 2017 Apr 4]. Available from: https://www.choosemyplate.gov/what-are-added-sugars

19. Te Morenga L, Mallard S, Mann J. Dietary sugars and body weight: systematic review and meta-analyses of randomised controlled trials and cohort studies. BMJ. 2013;345(7891):e7492.

20. Te Morenga L, Howatson AJ, Jones RM, Mann J. Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. Am J Clin Nutr. 2014;100(1):65–79.

21. World Health Organization. Guideline: sugars intake for adults and children [Internet]. Geneva: World Health Organization; 2015 [cited 2016 Nov 1]. Available from: http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028_eng.pdf?ua=1

22. Secretaría de Salud. Estrategia Nacional para la Prevención y el Control del Sobrepeso, la Obesidad y la Diabetes [Internet]. Mexico: IEPSA, Entidad Paraestatal del Gobierno Federal; 2013. Available from: http://promocion.salud.gob.mx/dgps/descargas1/estrategia/Estrategia_con_portada.pdf

23. République Française. Code général des impôts, CGI.-Article 1613 ter [Internet]. 2014. Available from: http://www.legifrance.gouv.fr/affichCodeArticle.do?idArticle=LEGIARTI000025051331&cidTexte=LEGITEXT000006069577

24. World Cancer Research Fund International. NOURISHING framework: Use economic tools to address food affordability and purchase incentives [Internet]. London: World Cancer Research Fund International; 2016 Oct [cited 2017 Jan 22]. Available from: http://www.wcrf.org/sites/default/files/Use-Economic-Tools.pdf

25. Philadelphia City Council. Amending Title 19 of The Philadelphia Code, entitled "Finance, Taxes and Collections," by adding a new Chapter 19-4100, entitled "Sugar-Sweetened Beverage Tax," under certain terms and conditions. [Internet]. Bill No. 160176 Jun 16, 2016. Available from: https://phila.legistar.com/LegislationDetail.aspx?ID=2595907&GUID=36060B21-D7EE-4D50-93E7-8D2109D47ED1&FullText=1

26. City of Berkeley. November 4, 2014 - general election results [Internet]. 2015. Available from: http://www.acgov.org/rov/elections/20141104/

27. HM Revenue & Customs. Policy Paper: Soft Drinks Industry Levy [Internet]. 2016. Available from: https://www.gov.uk/government/publications/soft-drinks-industry-levy/soft-drinks-industry-levy

28. Department of Finance. Financial Statement of the Minister of Finance, Mr. Michael Noonan, T.D., 11 October 2016 [Internet]. Budget.gov.ie. 2016 [cited 2017 Jan 22]. Available from: http://www.budget.gov.ie/Budgets/2017/FinancialStatement.aspx

29. Economics Tax Analysis Chief Directorate. Taxation of Sugar Sweetened Beverages: Policy Paper [Internet]. Department of National Treasury, Republic of South Africa; 2016 Jul. Available from: http://www.treasury.gov.za/public%20comments/Sugar%20sweetened%20beverages/POLICY%20PAPER%20AND%20PROPOSALS%20ON%20THE%20TAXATION%20OF%20SUGAR%20SWEETENED%20BEVERAGES-8%20JULY%202016.pdf

30. Seattle City Council. Tax on engaging in the business of distributing sweetened beverages [Internet]. Ord 125324 Jun 6, 2017. Available from: http://seattle.legistar.com/LegislationDetail.aspx?ID=3034243&GUID=E03CE985-3AC8-4A3F-81AF-B6E43CEE6C90

31. Falbe J, Rojas N, Grummon AH, Madsen KA. Higher retail prices of sugar-sweetened beverages 3 months after implementation of an excise tax in Berkeley, California. Am J Public Health. 2015 Nov;105(11):2194–201.

32. Silver LD, Ng SW, Ryan-Ibarra S, Taillie LS, Induni M, Miles DR, et al. Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. PLOS Med. 2017 Apr 18;14(4):e1002283.

33. Colchero MA, Zavala JA, Batis C, Shamah-Levy T, Rivera-Dommarco JA. [Changes in prices of taxed sugar-sweetened beverages and nonessential energy dense food in rural and semi-rural areas in Mexico]. Salud Publica Mex. 2017 Apr;59(2):137–46.

34. Berardi N, Sevestre P, Tépaut M, Vigneron A. The impact of a 'soda tax' on prices: evidence from French micro data. Appl Econ. 2016;48(41):3976–94.

35. Colchero MA, Salgado JC, Unar-Munguía M, Molina M, Ng S, Rivera-Dommarco JA. Changes in prices after an excise tax to sweetened sugar beverages was implemented in Mexico: evidence from urban areas. PloS One. 2015;10(12):e0144408.

36. Alvarado M, Kostova D, Suhrcke M, Hambleton I, Hassell T, Samuels TA, et al. Trends in beverage prices following the introduction of a tax on sugar-sweetened beverages in Barbados. Prev Med [Internet]. 2017 Jul 15 [cited 2017 Aug 13]; Available from: http://www.sciencedirect.com/science/article/pii/S0091743517302608

37. Cawley J, Willage B, Frisvold D. Pass-Through of a Tax on Sugar-Sweetened Beverages at the Philadelphia International Airport. JAMA [Internet]. 2017 Oct 25 [cited 2017 Nov 21]; Available from: https://jamanetwork.com/journals/jama/fullarticle/2660167

38. Colchero MA, Guerrero-López CM, Molina M, Rivera JA. Beverages sales in Mexico before and after implementation of a sugar sweetened beverage tax. PloS One. 2016;11(9):e0163463.

39. Colchero MA, Popkin BM, Rivera JA, Ng SW. Beverage purchases from stores in Mexico under the excise tax on sugar sweetened beverages: observational study. BMJ. 2016 Jan 6;352:h6704.

40. Cochero MA, Rivera-Dommarco J, Popkin BM, Ng SW. In Mexico, evidence of sustained consumer response two years after implementing a sugar-sweetened beverage tax. Health Aff (Millwood). 2017 Feb 22;10.1377/hlthaff.2016.1231.

41. Colchero MA, Molina M, Guerrero-López CM. After Mexico implemented a tax, purchases of sugar-sweetened beverages decreased and of water increased: difference by place of residence, household composition, and income level. J Nutr. 2017 Jun 14;

42. Falbe J, Thompson HR, Becker CM, Rojas N, McCulloch CE, Madsen KA. Impact of the Berkeley excise tax on sugar-sweetened beverage consumption. Am J Public Health. 2016 Oct;106(10):1865–71.

43. Statistics Canada. 2015 Canadian Community Health Survey (CCHS) - Nutrition: User Guide. Ottawa: Statistics Canada; 2017 Aug.

44. Garriguet D. Beverage consumption of Canadian adults. Health Rep. 2008;19(4):23–9.

45. Statistics Canada. Canadian Community Health Survey Cycle 2.2 User Guide [Internet]. Ottawa: Statistics Canada; 2008 Apr [cited 2016 Jun 1]. Available from: http://www23.statcan.gc.ca/imdb-bmdi/document/5049_D24_T9_V1-eng.pdf

46. Jones AC, Veerman JL, Hammond D. The health and economic impact of a tax on sugary drinks in Canada: technical report [Internet]. Waterloo, Ontario, Canada: University of Waterloo; 2017. Available from: http://davidhammond.ca/sugary-drink-tax-study-technical-report/

47. WHO. Fiscal policies for diet and the prevention of noncommunicable diseases: technical meeting report, 5-6 May 2015 [Internet]. Geneva: World Health Organization; 2016 [cited 2017 Jan 22]. Available from: http://www.who.int/dietphysicalactivity/publications/fiscal-policies-diet-prevention/en/

48. City of Oakland. November 8, 2016 Official Election Results [Internet]. 2016. Available from: https://acgov.org/rov/current_election/230/

49. City and County of San Francisco Department of Elections. November 8, 2016 Official Election Results [Internet]. 2016. Available from: http://www.sfelections.org/results/20161108/

50. Cook County Board of Commissioners. Chapter 74 - Taxation, Article XXII. Sweetened Beverage Tax, Sections 74-850 to 74-859 of the Cook County Code [Internet]. Nov 10, 2016. Available from: https://www.cookcountyil.gov/sites/default/files/service/final-sweetened-beverage-ordinance-approved-amendments.pdf

51. City of Boulder. 2016 General Election November 8, 2016 - Official Results [Internet]. 2016 [cited 2017 Jan 13]. Available from: http://clerk.boco.solutions/ElectionResults2016G

52. Veerman J, Barendregt J, Higashi H, Cobiac L, Das L, Hogue E. Sugar-sweetened beverage taxes in the World Bank East Asia Pacific Region: leveraging fiscal policy for the prevention and mitigation of obesity and diet-related NCDs. Australia: University of Queensland; 2016 Feb. Report No.: Final report for the World Bank.

53. Statistics Canada. CANSIM Table 326-0021 - Consumer Price Index [Internet]. 2016 [cited 2016 Nov 13]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=3260021

54. Carter R, Moodie M, Markwick A, Magnus A, Vos T, Swinburn B, et al. Assessing cost-effectiveness in obesity (ACE-obesity): an overview of the ACE approach, economic methods and cost results. BMC Public Health. 2009;9:419.

55. Forster M, Veerman JL, Barendregt JJ, Vos T. Cost-effectiveness of diet and exercise interventions to reduce overweight and obesity. Int J Obes 2005. 2011 Aug;35(8):1071–8.

56. Veerman JL, Sacks G, Antonopoulos N, Martin J. The impact of a tax on sugar-sweetened beverages on health and health care costs: a modelling study. PLoS ONE [Internet]. 2016 Apr 13 [cited 2016 May 20];11(4). Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4830445/

57. GBD 2013 Risk Factors Collaborators, Forouzanfar MH, Alexander L, Anderson HR, Bachman VF, Biryukov S, et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks in 188 countries, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet Lond Engl. 2015 Dec 5;386(10010):2287–323.

58. Lau PW, Barendregt JJ, Veerman JL. Projecting the burden of the increasing body mass index trend in Canada over the next 25 Years. Can J Diabetes. 2013 Apr 1;37:S244.

59. Statistics Canada. 2000-2001 (Cycle 1.1) Canadian Community Health Survey (CCHS) [Internet]. 2007 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=3359

60. Statistics Canada. 2003 (Cycle 2.1) Canadian Community Health Survey (CCHS) [Internet]. 2007 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=4995

61. Statistics Canada. 2005 (Cycle 3.1) Canadian Community Health Survey (CCHS) [Internet]. 2007 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=22642

62. Statistics Canada. 2007 (Cycle 4.1) Canadian Community Health Survey - Annual Component (CCHS) [Internet]. 2007 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=29539

63. Statistics Canada. 2008 Canadian Community Health Survey - Annual Component (CCHS) [Internet]. 2009 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=56918

64. Statistics Canada. 2009 Canadian Community Health Survey - Annual Component (CCHS) [Internet]. 2010 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=67251

65. Statistics Canada. 2010 Canadian Community Health Survey - Annual Component (CCHS) [Internet]. 2010 [cited 2017 Jan 12]. Available from: http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvey&Id=81424

66. Swinburn BA, Sacks G, Lo SK, Westerterp KR, Rush EC, Rosenbaum M, et al. Estimating the changes in energy flux that characterize the rise in obesity prevalence. Am J Clin Nutr. 2009 Jun;89(6):1723–8.

67. Swinburn B, Sacks G, Ravussin E. Reply to KD Hall and CC Chow. Am J Clin Nutr. 2010 Mar 1;91(3):817.

68. Institute for Health Metrics and Evaluation. GBD Results Tool [Internet]. Global Burden of Disease Study 2015. 2016 [cited 2016 Oct 13]. Available from: http://ghdx.healthdata.org/gbd-results-tool

69. Public Health Agency of Canada. Canadian Chronic Disease Surveillance System [Internet]. Open Government Portal. 2016 [cited 2016 Nov 11]. Available from: http://open.canada.ca/data/en/dataset/9525c8c0-554a-461b-a763-f1657acb9c9d

70. Statistics Canada. CANSIM Table 103-0550 - New cases of primary cancer (based on the August 2015 CCR tabulation file), by cancer type, age group and sex, Canada, provinces and territories [Internet]. 2016 [cited 2016 Nov 11]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1030550

71. Statistics Canada. CANSIM Table 102-0522 - Deaths, by cause, Chapter II: Neoplasms (C00 to D48), age group and sex, Canada [Internet]. 2016 [cited 2016 Nov 11]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020522

72. Statistics Canada. CANSIM Table 102-0529 - Deaths, by cause, Chapter IX: Diseases of the circulatory system (I00 to I99), age group and sex, Canada [Internet]. 2016 [cited 2016 Nov 11]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020529

73. Statistics Canada. CANSIM Table 102-0524 - Deaths, by cause, Chapter IV: Endocrine, nutritional and metabolic diseases (E00 to E90), age group and sex, Canada [Internet]. 2015 [cited 2016 Oct 18]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020524

74. Statistics Canada. CANSIM Table 102-0536 - Deaths, by cause, Chapter XVI: Certain conditions originating in the perinatal period (P00 to P96), age group and sex, Canada [Internet]. 2016 [cited 2016 Nov 14]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020536

75. Statistics Canada. CANSIM Table 102-0538 - Deaths, by cause, Chapter XVIII: Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00 to R99), age group and sex, Canada [Internet]. 2016 [cited 2016 Nov 14]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020538

76. Statistics Canada. CANSIM Table 051-0001 - Estimates of population, by age group and sex for July 1, Canada, provinces and territories, annual (persons) [Internet]. 2017 [cited 2017 Feb 22]. Available from: http://www5.statcan.gc.ca/cansim/a26?id=510001

77. Statistics Canada. CANSIM Table 102-0503 - Deaths, by age and sex, Canada, province and territories, annual (number) [Internet]. 2015 [cited 2016 Oct 18]. Available from: http://www5.statcan.gc.ca/cansim/a26?lang=eng&id=1020503

78. Public Health Agency of Canada. Economic burden of illness in Canada [Internet]. 2010 [cited 2016 Sep 21]. Available from: http://www.phac-aspc.gc.ca/ebic-femc/index-eng.php

79. Canadian Institute for Health Information. National health expenditure trends [Internet]. 2015 [cited 2016 Sep 21]. Available from: https://www.cihi.ca/en/spending-and-health-workforce/spending/national-health-expenditure-trends

80. Public Health Agency of Canada. Economic burden of illness in Canada, 2005-2008 [Internet]. Ottawa: Public Health Agency of Canada : Canadian Institute for Health Information; 2014 [cited 2016 Sep 14]. Available from: http://epe.lac-bac.gc.ca/100/201/301/weekly_checklist/2014/internet/w14-44-U-E.html/collections/collection_2014/aspc-phac/HP50-1-2013-eng.pdf

81. Centers for Disease Control and Prevention. Key Concepts about Identifying Analytic Implications of Different Types of Data [Internet]. NHNAES Dietary Web Tutorial. 2013 [cited 2016 Nov 11]. Available from: https://www.cdc.gov/nchs/tutorials/Dietary/Basic/StatisticalConsiderations/Info4.htm

82. Centers for Disease Control and Prevention. Key Concepts about Understanding Measurement Error [Internet]. NHNAES Dietary Web Tutorial. 2013 [cited 2016 Nov 11]. Available from: https://www.cdc.gov/nchs/tutorials/Dietary/Basic/StatisticalConsiderations/Info2.htm

83. Davy BM, Jahren AH, Hedrick VE, Comber DL. Association of δ13C in Fingerstick Blood with Added Sugars and Sugar-sweetened Beverage Intake. J Am Diet Assoc. 2011 Jun;111(6):874–8.

84. Downs SM, Marshall D, Ng C, Willows ND. Central adiposity and associated lifestyle factors in Cree children. Appl Physiol Nutr Metab Physiol Appliquée Nutr Métabolisme. 2008 Jun;33(3):476–82.

85. Tomlin D, Naylor PJ, McKay H, Zorzi A, Mitchell M, Panagiotopoulos C. The impact of Action Schools! BC on the health of Aboriginal children and youth living in rural and remote communities in British Columbia. Int J Circumpolar Health. 2012 Mar 19;71:17999.

86. Jones AC, Veerman JL, Hammond D. The health and economic impact of a tax on sugary drinks in Canada [Internet]. Waterloo, ON: University of Waterloo; 2017 Mar. Available from: https://www.heartandstroke.ca/-/media/pdf-files/canada/media-centre/health-economic-impact-sugary-drink-tax-in-canada-en.ashx?la=en&hash=B3DFB8DEA34A2454D3A01EDB1482FB3D27C22DB7

87. City of Albany. November 8, 2016 Official Election Results [Internet]. 2016. Available from: https://acgov.org/rov/current_election/230/

88. Garriguet D. Beverage consumption of children and teens. Health Rep. 2008;19(4):17–22.

89. Danyliw AD, Vatanparast H, Nikpartow N, Whiting SJ. Beverage intake patterns of Canadian children and adolescents. Public Health Nutr. 2011;14(11):1961–9.

90. Nikpartow N, Danyliw AD, Whiting SJ, Lim HJ, Vatanparast H. Beverage consumption patterns of Canadian adults aged 19 to 65 years. Public Health Nutr. 2012;15(12):2175–84.