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Change in total sugars consumption among Canadian children and adults

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Abstract

Background: Free sugars are nutrients of public health concern that have been associated with negative health outcomes, including dental caries in children and excess weight gain. Since national-level free sugars data are not currently available for Canadians, total sugars intake was examined to understand sugars intake in the population. The objective of this analysis was to describe and compare total sugars consumption among Canadians in 2004 and 2015.

Data and methods: Data are from the 2004 and 2015 Canadian Community Health Survey—Nutrition. Separate descriptive analyses of total sugars for children aged 2 to 18 (n=13,919) and adults aged 19 and older (n=31,156) were conducted by year and by misreporting status (under-, plausible and over-reporters), and the top sources of total sugars were identified. Misreporting status was studied to better understand differences in sugars intakes between survey years. T-tests were used to determine significant differences between survey years.

Results: In 2015, the average daily total sugars consumption was 101 grams (24 teaspoons) for children aged 1 to 8, 115 grams (27 teaspoons) for children aged 9 to 18, and 85 grams (20 teaspoons) for adults. Sugary beverages, taken together, were the top source of sugars for all age groups. Total sugars consumption decreased from 2004 to 2015 overall, although not by misreporting status. Total sugars from food alone increased from 2004 to 2015, and total sugars from beverages alone decreased, regardless of age or misreporting status.

Interpretation: The overall decrease in total sugars consumption from 2004 to 2015 may be explained by changes in misreporting. Total sugars from food alone increased, while total sugars from beverages alone decreased. This was true for all age groups and for plausible reporters.

Keywords: Total sugar, Canadian Community Health Survey, food, nutrition, dietary intake

Sugars are a type of carbohydrate found naturally in fruit, vegetables and milk. Sugars are also added to food to improve taste or for preservation, such as in the case of jams or jellies. Sugars confer several functional characteristics to foods, including viscosity, texture and browning.[1] Total sugars include all monosaccharides and disaccharides other than polyols, regardless of their source. Added sugars are all sugars added to foods and beverages. Free sugars refer to monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups and fruit juices.[2]

The latest evidence on diet and health indicates that intakes of added sugars, in particular from sugar-sweetened beverages, are associated with the risk of excess body weight and obesity in children and adults.[3,4] The consumption of sugary beverages is also associated with the risk of dental caries and poor oral health in children.[5] In both adults and children, the World Health Organization recommends reducing the intake of free sugars to less than 10% of total energy intake.[2] In 2013, free sugars accounted for 62% of total sugars in Canadian prepackaged foods, although this ranged from 100% in soft drinks and fruit juices to 11% in nuts and seeds.[6]

Since national-level free sugars data are not currently available for Canadians, total sugars intakes were examined to understand sugars intakes in the population. National-level survey data on total sugars intakes for Canadians were previously collected in the 2004 Canadian Community Health Survey (CCHS)—Nutrition. In 2004, Canadians aged 1 year and older consumed a daily average of 110 grams (26 teaspoons) of total sugars, approximately 20% of their total energy intake.[7] While over 30% of total sugars came from the vegetables and fruit category of Canada's Food Guide, 35% of total sugars came from the "other" food category, which includes foods to limit, such as soft drinks and candy.

More recent comprehensive national-level nutrition data were collected in the 2015 CCHS—Nutrition. In the absence of free sugars intake data, the objectives of these analyses were to describe the Canadian population's dietary intakes of total sugars in 2015, and compare these results with estimates from 2004. In light of recent findings[8] that misreporting changed between 2004 and 2015, intakes were examined by misreporting status.

Data and methods

The 2015 CCHS—Nutrition was a cross-sectional survey conducted by Statistics Canada, with data collected from January to December 2015. The target population was Canadian household residents aged 1 year and older living in the 10 provinces. The survey excluded full-time members of the Canadian Forces, people living on reserves or other Aboriginal settlements, residents of the three territories and people living in institutions.

The Automated Multiple Pass Method (AMPM)[9] was used to collect the dietary intake data. The AMPM is a questionnaire that guides the interviewer to maximize respondents' recall of all foods and beverages consumed in the previous 24 hours. The AMPM consists of five steps: (1) respondents report a quick

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What is already known on this subject?

- Sugars are a type of carbohydrate found naturally in fruit, vegetables and milk, and can be added to food to improve taste or for preservation, such as in the case of jams or jellies.
- Free sugars are nutrients of public health concern that have been associated with negative health outcomes, including dental caries in children and excess weight gain.
- Canadian national-level data on total sugars were previously collected in 2004.

What does this study add?

- In 2015, Canadian children consumed up to 25% of their total energy intake per day from total sugars, whereas adults consumed under 20% of their energy from total sugars.
- For all age groups, total sugars consumption from food alone increased over time, whereas total sugars consumption from beverages alone decreased over time.
- Sugary beverages, taken together, were the top source of total sugars for all Canadians.

list of all foods and beverages consumed in the previous 24 hours, in whatever order they wish; (2) the interviewer asks questions about frequently forgotten food categories; (3) the interviewer asks questions about the meal time and occasion (e.g., lunch); (4) the interviewer asks questions regarding more detailed descriptions of the foods and beverages, and quantities consumed; and (5) the interviewer does a final review to collect additional foods that were eaten, but not mentioned earlier.

Sociodemographic and health-related information was collected through a questionnaire. For children younger than 6 years old, information was collected from their parents; for children aged 6 to 11, interviews were conducted with parental help.

Data from the 2004 CCHS—Nutrition were used for comparison purposes to examine the change in total sugars intakes over time. The target population, collection and methodology were generally similar to the 2015 survey, although there were a few changes within some of the measures used. The physical activity module in 2015 assessed only moderate or vigorous physical activities from the past week, whereas leisure time physical activities over the past three months were assessed in 2004. The food model booklet (used to show respondents pictures of plates, bowls, glasses and mugs to increase accuracy in reporting food and beverage sizes) used pictures in 2015 instead of the drawings used in 2004, and the standard amounts shown in the 2015 pictures were generally smaller than those in the 2004 drawings.[10] Because of these changes, caution must be exercised when comparisons are made between the surveys. More information on the 2004 and 2015 CCHS—Nutrition is available elsewhere.[10,11]

In 2004 and 2015, a total of 35,107 and 20,487 respondents, respectively, completed the initial 24-hour dietary recalls. A subsample of 10,786 and 7,608, respectively, completed a second 24-hour recall 3 to 10 days later to assess day-to-day variations in consumption. The response rates for the 2004 survey were 76.5% for the first recall and 72.8% for the second recall; the corresponding response rates for 2015 were 61.6% and 68.6%, respectively. This study uses data from the first recall only since estimates of means using a single recall approximate the mean usual intake. Second recall data are required to examine the distribution of sugars intakes, which is beyond the scope of this analysis. Null intakes (2004: n=17; 2015: n=4) were removed from both survey years. Invalid recalls (e.g., records with missing or minimal detailed food information; n=49) were removed from the 2004 data only since invalid recalls were already removed from the 2015 data during processing. Because these populations were not appropriate for estimations of misreporting, fasters (kcal=0) (2004: n=21; 2015: n=12), pregnant (2004: n=175; 2015: n=119) and breastfeeding women (2004: n=92; 2015: n=188), and children younger than 2 years old (2004: n=1,088; 2015: n=372) were removed.

Height and weight were measured for a subsample of respondents aged 2 and older—20,739 respondents in 2004 and 13,713 in 2015. The response rates for these subsamples were 62.5% and 70.6%, respectively. To account for the non-response of the measured height and weight component, special survey weights were provided with the data for use in any analyses conducted on this subsample only.

Misreporting

Misreporting (i.e., overestimating or underestimating dietary intake) is a common phenomenon in all nutrition surveys, and previous analysis determined that misreporting changed between the 2004 and 2015 CCHS—Nutrition surveys.[8] To account for potential misreporting in comparisons of total sugars intakes between the two surveys, respondents were classified by survey year as under-reporters, plausible reporters or over-reporters, based on a comparison of their total predicted energy expenditure and their reported energy intake, consistent with the methodology of Garriguet.[8,12] Briefly, total energy expenditure (TEE) was predicted for each respondent based on age, sex, physical activity level and body mass index (BMI) category. BMI was calculated using measured height and weight for the subsample of respondents who had valid measurements, and a correction factor was applied to the adults (19 years of age and older) with self-reported height and weight[13] to more closely approximate measured values, and to include as many respondents as possible. BMI categories for adults were defined according to Health Canada's guidelines.[14] The categories defined by Cole et al. were used for children aged 17 or younger since the TEE equations were derived before the World Health Organization's classification for BMI in children was developed.[15,16] Underweight respondents (18 years of age and older with a BMI of < 18.5kg/m^2) were excluded (2004: n=380; 2015: n=268) since there were no energy expenditure equations for this population. Because the measure of physical activity changed between the two surveys, a fixed level of physical activity was assigned for the entire population: children younger than 14 years of age were assumed to be low active, and individuals 14 years of age and older were considered sedentary.[8] These levels were selected based on directly measured estimates of physical activity in children[17] and adults[18] from 2007 to 2015.

The ratio of reported energy intake to predicted energy expenditure was calculated, and a range was assigned in the form of [exp-(SD); exp(SD)], where SD represents the standard deviation—taking into account the within-individual variation of energy intake, the number of recall days, the error in predicted energy requirements, day-to-day variation, and the measurement error for TEE.[8,12] For both surveys, the standard deviation was set at 35%, resulting in a range of 0.70 to 1.42. Therefore, individuals whose reported energy intake was less than 70% of their predicted energy expenditure were classified as under-reporters. Those who reported energy intakes between 70% and 142% of their predicted energy expenditure were classified as plausible reporters, and those who reported energy intakes above 142% of their predicted energy expenditure were classified as over-reporters.

Total sugars

Daily total sugars intakes represent the sugars in all foods and beverages reported during the 24-hour dietary recall. The Canadian Nutrient File (CNF) was used to estimate average energy and nutrient values, including total sugars, for each item reported during the recalls. A mean from the first 24-hour recall was considered appropriate to estimate the mean intake of a population—not the distribution—where the sample was representative.[19] The CNF 2001b was used for the 2004 CCHS-Nutrition[20] (, and the CNF 2015 was used for the 2015 CCHS-Nutrition.[21] These versions of the CNF reflected the nutritional composition of the food available at the time of the survey. Approximately 4% of the food and recipe items in the CNF 2001b and 3% in the CNF 2015 were missing sugar information, which corresponded to a small number of foods consumed—0.32% in 2004 and 0.15% in 2015. In those cases, Statistics Canada set the sugar values for those foods to zero in the microdata to ensure that the data were used the same way by all data users.

Top sources of total sugars

To estimate the top sources of sugars, foods were categorized according to the Bureau of Nutritional Sciences classification used in both CCHS—Nutrition surveys. Foods were placed into each food group based on the proportion of each ingredient, according to the Nutrition Survey System food and recipe database. For example, when a recipe was composed of one main ingredient, it was placed into the food group of its main ingredient (e.g., a blueberry muffin would be placed in "grains") for contribution to the total sugars intake calculation. If a recipe was composed of many ingredients, each ingredient was placed into its own food group (e.g., shepherd's pie—potato [vegetable], ground beef [meat and alternatives], corn [vegetable]), and the total sugars were calculated for each ingredient. Then, certain foods were flagged by a nutritionist, depending on the presence or absence of free sugars. The final food categories are listed in Appendix A.

Statistical analysis

This analysis was based on 13,919 children aged 2 to 18 (2004: n=9,196; 2015: n=4,723) and 31,156 adults aged 19 and older (2004: n=18,578; 2015: n=12,578). Descriptive statistics were used to examine average daily sugars intakes in grams, and the percentage of energy by age group (2 to 8 years compared with 9 to 18 years) for children and by sex for adults.

Table 1
Respondent counts and distribution of misreporting status, by population and survey cycle, household population aged 2 and older, Canada excluding territories, 2004 vs. 2015

	All	Under-reporters			Plausible reporters			Over-reporters		
			95% confidence interval			95% confidence interval			95% confidence interval	
	n	%	from	to	%	from	to	%	from	to
Aged 2 to 8 years										
2004†	2,885	6.7	5.3	8.4	65.7	62.5	68.7	27.6	24.8	30.7
2015	1,511	14.1*	11.1	17.8	67.9	63.8	71.7	18.0*	15.1	21.2
Aged 9 to 18 years										
2004†	6,311	16.5	15.0	18.1	61.5	59.5	63.6	22.0	20.4	23.7
2015	3,212	26.3*	23.9	28.9	60.9	58.1	63.7	12.8*	11.0	14.8
Aged 19 years and older										
Both sexes										
2004†	18,578	28.2	27.0	29.4	58.2	56.8	59.6	13.6	12.6	14.6
2015	12,578	34.5*	32.8	36.2	58.1	56.4	59.8	7.4*	6.6	8.3
Males										
2004†	8,563	28.6	26.7	30.5	57.3	55.3	59.3	14.1	12.8	15.6
2015	6,160	34.2*	31.9	36.6	58.1	55.7	60.5	7.7*	6.5	9.0
Females										
2004†	10,015	27.8	26.2	29.5	59.2	57.2	61.1	13.0	11.6	14.5
2015	6,418	34.8*	32.5	37.1	58.1	55.7	60.4	7.1*	6.2	8.2

* significantly different from reference category ($p < 0.05$)
† reference category
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

The top 10 sources of sugars consumption were examined using proc ratio in SUDAAN, and calculated based on the percentage of total sugars intake. T-tests were used to determine significant differences between survey cycles by misreporting status for each sex and age group. Significance levels were set at $p < 0.05$, and a Bonferroni adjustment was applied in cases of multiple comparisons.

All analyses were performed using SAS-callable SUDAAN v.11.0.1. Survey sampling weights were applied so that estimates were representative of the Canadian population. Analyses were conducted separately for children and adults. Adults aged 19 and older with measured height and weight were included, as were adults who had a corrected self-reported height or weight value. For children aged 2 to 18, only those with measured heights and weights were included; there were no correction factors for this age group. The full sample weight was used for adults. For children, a special sampling weight was used that accounted for the non-response bias of measured height and weight data. The bootstrap weights provided with the data were used to calculate coefficients of variation and confidence intervals, to account for the complex sampling design of the CCHS. It must be noted that, because the child and adult populations were examined using two different survey sampling weights, the intake estimates for each group cannot be combined to provide an intake estimate for the total population.

Results

Misreporting

Table 1 shows the distribution of misreporting status by population and survey year. Regardless of age or sex, the number of under-reporters was significantly higher in 2015 compared with 2004. In the youngest age group, the increase was more than double (6.7% vs. 14.1%; $p < 0.05$). However, the number of over-reporters decreased significantly. The prevalence of plausible reporters was unchanged at approximately 60%.

Average daily total sugars intake

In 2015, the average daily total sugars intake from food and beverages among all children aged 2 to 8 was 101 grams (24 teaspoons). Among the plausible respondents, 98 grams (23 teaspoons) were consumed (Table 2). For children aged 9 to 18, these numbers were 115 grams (27 teaspoons) and 116 grams (28 teaspoons), respectively. For children in both age groups, over one-third of the total sugars came from beverages, both those that did and those that did not contain free sugars.

Among children aged 2 to 8, average daily total sugars intakes (in grams) from food and beverages did not change from 2004 to 2015 overall or by misreporting status (Table 2). For children aged 9 to 18, overall daily total sugars intake was significantly lower in 2015, but there was no difference when misreporting status was taken into account. Average daily total sugars intakes from food alone increased overall and for all misreporting groups among children, regardless of age group, whereas average total sugars from beverages decreased for both age groups overall and for plausible reporters.

For adults, similar trends were found (Table 3). Overall, Canadians aged 19 and older reported consuming an average of 85 grams (20 teaspoons) of total sugars in 2015, whereas plausible reporters consumed 95 grams (23 teaspoons). Approximately one-third of sugars came from beverages. For the total population, and for male adults and female adults separately, the average daily intake of total sugars from foods and beverages decreased from 2004 to 2015, though this was not evident among the misreporting

Table 2
Mean daily total sugars intake, in grams, by misreporting status and age group, household population aged 2 to 18, Canada excluding territories, 2004 vs. 2015

	Total‡			Under-reporters			Plausible reporters			Over-reporters		
	Mean grams	95% confidence interval from	to	Mean grams	95% confidence interval from	to	Mean grams	95% confidence interval from	to	Mean grams	95% confidence interval from	to
Aged 2 to 8 years												
Food and beverages												
2004†	104	101	108	52	46	57	95	92	99	139	130	147
2015	101	97	105	59	50	68	98	94	102	145	136	155
Food alone												
2004†	53	51	56	23	19	27	48	45	50	74	68	80
2015	65*	62	68	36*	31	42	63*	60	66	93*	83	103
Beverages alone												
2004†	51	49	53	29	24	34	48	45	50	65	59	71
2015	36*	34	39	22	17	28	35*	33	38	52*	47	57
Aged 9 to 18 years												
Food and beverages												
2004†	128	124	131	65	61	69	119	116	122	199	190	209
2015	115*	111	120	70	66	75	116	113	120	204	182	226
Food alone												
2004†	61	59	64	27	25	29	56	53	58	103	95	111
2015	69*	67	72	41*	38	45	70*	67	72	125*	114	137
Beverages alone												
2004†	66	64	69	37	34	41	63	61	66	96	89	103
2015	46*	43	49	29*	26	32	47*	44	50	79	58	100

* significantly different from reference category ($p < 0.05$)
† reference category
‡ respondents with measured height and weight information only
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

groups. Average daily total sugars intakes from food alone were higher in 2015, though not for over-reporters or for female adults overall. Average total sugars intakes from beverages alone were lower in 2015 for all adults, male and female, regardless of misreporting status, although there was no change among female over-reporters.

Figure 1 shows the percentage of energy from total sugars for plausible reporters for both age groups in children, and for male and female adults. In 2015, 25.9% of the average daily calories among children aged 2 to 8 came from total sugars, a significant increase from the 23.7% in 2004. A similar trend was found among 9- to 18-year-olds (21.5% in 2004 compared with 22.4% in 2015). For both younger and older children, the percentage of energy from total sugars in food alone increased from 2004, whereas the percentage of energy from total sugars in beverages alone decreased ($p < 0.05$). For all children, beverages contributed to 9% of the daily calories from total sugars. For adults, the average daily percentage of energy from total sugars did not change from 2004 to 2015—about 17% for males and 18% for females. However, regardless of sex, the percentage of energy from sugars in food alone increased and from beverages alone decreased, similar to what was observed in children. Similar results were seen for children overall (not taking misreporting into account) and for adults overall (data not shown).

Table 3
Mean daily total sugars intake, in grams, by misreporting status and sex, household population aged 19 and older, Canada excluding territories, 2004 vs. 2015

	Total			Under-reporters			Plausible reporters			Over-reporters		
	Mean grams	95% confidence interval from	to	Mean grams	95% confidence interval from	to	Mean grams	95% confidence interval from	to	Mean grams	95% confidence interval from	to
All adults												
Food and beverages												
2004†	93*	91	95	54	52	56	97	95	99	154	148	161
2015	85	83	87	55	53	57	95	93	97	146	136	156
Food alone												
2004†	55*	54	56	33*	32	34	57*	55	58	91	87	96
2015	58	56	59	39	37	40	64	62	66	96	89	104
Beverages alone												
2004†	38*	37	39	21*	20	22	40*	39	42	63*	58	68
2015	27	26	28	16	15	18	31	29	33	49	43	55
Males												
Food and beverages												
2004†	102*‡	100	105	58‡	55	60	109‡	106	112	167‡	158	176
2015	94‡	92	97	60‡	57	62	106‡	103	110	159‡	143	176
Food alone												
2004†	57*‡	55	59	34*	32	36	60*‡	58	63	92	86	98
2015	62‡	60	63	40‡	38	43	69‡	66	71	102	88	115
Beverages alone												
2004†	45*‡	43	47	24*‡	22	25	48*‡	46	51	75*‡	67	83
2015	33‡	31	35	19‡	17	21	38‡	35	41	58‡	49	67
Females												
Food and beverages												
2004†	83*	80	85	50	48	52	85	83	88	139	130	149
2015	75	73	77	50	48	53	83	80	86	131	121	141
Food alone												
2004†	52	50	54	32*	30	33	53*	51	55	90	83	98
2015	53	52	55	36	34	38	59	57	61	91	84	97
Beverages alone												
2004†	31*	29	32	18*	17	20	32*	30	34	49	43	55
2015	21	20	23	14	12	15	24	22	25	40	32	48

* significantly different from reference category ($p < 0.05$)
† reference category
‡ significantly different from females within the same survey year and reporting group ($p < 0.05$)
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

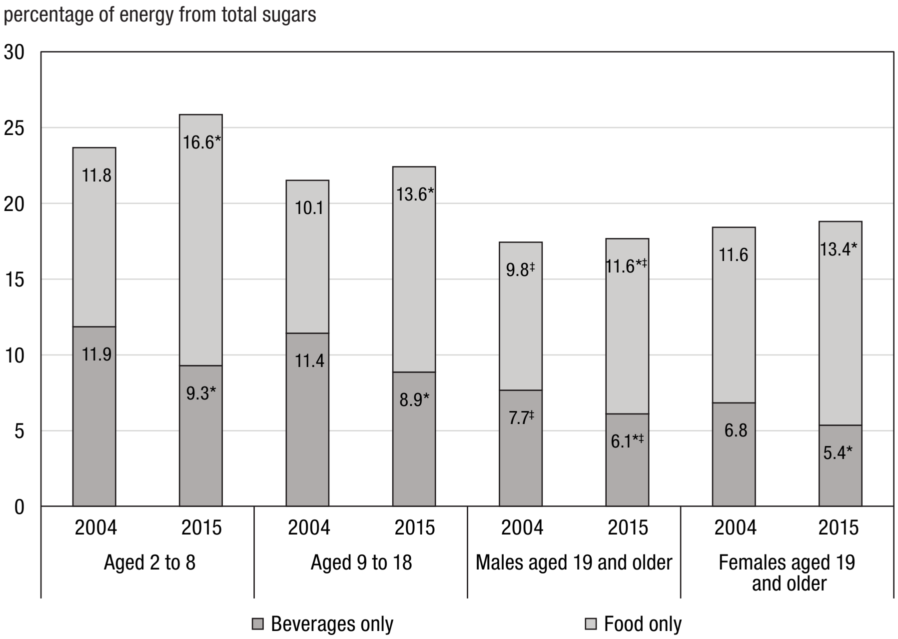
Top sources of total sugars intake

Tables 4, 5 and 6 show the top sources of total sugars from foods and beverages among plausible reporters. For all age groups, fruit was the greatest source of total sugars; all other top sources were similar, but varied in rank. In general, total sugars from the top food sources increased from 2004 to 2015, with the exception of the decline in sugars coming from the "sugars, syrups and confectionary" category. Conversely, total sugars from the top beverages decreased, though there was no change in total sugars coming from milk (containing free sugars). Regular soft drink consumption became a top source among older children and adults, though as a percentage of total sugars, consumption of regular soft drinks decreased by up to half of what was seen in 2004 (15.9% of total sugars in 2004 compared with 7% in 2015 for older children; 14.6% in 2004 compared with 8.9% in 2015 for adults).

In 2015, the top 10 sources of total sugars for children aged 2 to 8 accounted for 83.1% of total sugars, compared with 90.6% in 2004 (Table 4). For children aged 9 to 18 (Table 5), the top 10 sources accounted for 78.6% of total sugars in 2015, compared with 91.7% in 2004. For adults, the top 10 sources accounted for 77.1% of total sugars in 2015, compared with 88.2% in 2004 (Table 6). The top 10 sources were similar for the total population (not taking misreporting into account) across age groups, with the exception of adults 19 years of age and older, where yoghurt was the 9th highest source, fruit drink was the 10th and milk containing free sugars was the 11th (data not shown).

If sugary beverages were combined together into one category—regular soft drinks, milk (containing free sugars), juice, fruit drinks, energy drinks, plant-

Figure 1
Percentage of energy from total sugars, by age group and sex, plausible reporters only, household population aged 2 and older,† Canada excluding territories, 2004 vs. 2015



* significantly different from 2004 estimate ($p < 0.05$)
† direct comparisons between children and adults should not be made
‡ significantly different from females within the same food/beverage group and survey year ($p < 0.05$)
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

Table 4
Top sources of total sugars consumption for foods and beverages, plausible reporters only, household population aged 2 to 8 years, Canada excluding territories, 2004 vs. 2015

		Plausible reporters aged 2 to 8					
		2004†			2015		
			95% confidence interval			95% confidence interval	
Rank‡	Food category	% of total sugars	from	to	% of total sugars	from	to
1	Fruit (not containing free sugars)	16.6	15.2	18.0	17.7	16.2	19.2
2	Milk (not containing free sugars)	16.4	15.2	17.5	13.6*	12.5	14.8
3	Juice (containing free sugars)	16.8	15.3	18.3	11.6*	10.3	12.9
4	Sugars, syrups and confectionary (containing free sugars)	13.0	11.6	14.5	9.4*	8.2	10.5
5	Baked goods and products (containing free sugars)	6.0	5.2	6.9	8.9*	7.6	10.1
6	Frozen desserts (containing free sugars)	4.1	3.2	5.0	6.3	4.5	8.2
7	Yoghurt (containing free sugars)	2.0	1.4	2.6	5.7*	4.9	6.6
8	Milk (containing free sugars)	6.5	5.3	7.8	3.7*	2.7	4.7
9	Fruit drinks (containing free sugars)	6.3	5.2	7.4	3.5*	2.5	4.5
10	Vegetables (not containing free sugars)	2.7	2.5	3.0	2.6	2.3	2.9

* significantly different from reference category ($p < 0.05$)
† reference category
‡ ranked according to top 10 in 2015; items from 2004 are shown for comparison purposes only and are not necessarily the top 10 from 2004
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

based beverages (containing free sugars), and tea and coffee (containing free sugars)—they would be the top source of sugars for all age groups in the Canadian population, for plausible reporters, and the total population (not taking misreporting into account). Among children aged 2 to 8, sugary beverages accounted for 21.8% of average daily total sugars consumption in 2015, significantly lower than the 32.8% in 2004. For children aged 9 to 18, these numbers were 29.8% and 39.2%, respectively. Among adults, 23.6% of total sugars came from sugary beverages in 2015, compared with 30% in 2004. In absolute intakes, on average, young children consumed 5 teaspoons (22.1 grams) of sugars, older children consumed 8 teaspoons (34.4 grams) and adults consumed 5 teaspoons (20.0 grams) of sugars from sugary beverages in 2015. For sugary beverage consumers only, these numbers were 7 teaspoons (31.2 grams), 11 teaspoons (48.0 grams) and 9 teaspoons (38.1 grams), respectively (data not shown).

Discussion

This study used two large, nationally representative samples to estimate the change in total sugars consumption from 2004 to 2015. Given that the samples were from two different survey populations, the breakdown of respondents by misreporting status provided the ability to compare within groups, which allowed for better comparability between survey years. Although the results of this analysis mainly focused on plausible reporters, many of the estimates for the other reporting groups—and for the population overall—were presented and generally followed the same trends, although they were not always statistically significant. In the absence of free or added sugars data, top sources of total sugars offer some insight into the changes in eating habits of the population. In general, soft drinks—essentially added sugars—contributed less to sugar

Table 5
Top sources of total sugars consumption for foods and beverages, plausible reporters only, household population aged 9 to 18 years, Canada excluding territories, 2004 vs. 2015

		Plausible reporters aged 9 to 18					
		2004†			2015		
			95% confidence interval			95% confidence interval	
Rank‡	Food category	% of total sugars	from	to	% of total sugars	from	to
1	Fruit (not containing free sugars)	11.7	10.7	12.8	13.8*	12.8	14.9
2	Sugars, syrups and confectionary (containing free sugars)	13.8	12.7	15.0	11.1*	9.9	12.3
3	Milk (not containing free sugars)	12.8	12.0	13.6	10.3*	9.6	11.0
4	Juice (containing free sugars)	11.5	10.5	12.5	9.7	8.5	10.9
5	Baked goods and products (containing free sugars)	6.0	5.4	6.6	8.0*	7.3	8.8
6	Regular soft drinks (containing free sugars)	15.9	14.6	17.1	7.0*	5.8	8.2
7	Frozen desserts (containing free sugars)	4.9	4.0	5.8	6.4	5.1	7.6
8	Milk (containing free sugars)	4.9	4.1	5.7	5.3	4.3	6.3
9	Fruit drinks (containing free sugars)	7.1	6.1	8.0	3.9*	3.1	4.7
10	Vegetables (not containing free sugars)	3.1	2.9	3.3	3.0	2.7	3.3

* significantly different from reference category ($p < 0.05$)
† reference category
‡ ranked according to top 10 in 2015; items from 2004 are shown for comparison purposes only and are not necessarily the top 10 from 2004
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

Table 6
Top sources of total sugars consumption for foods and beverages, plausible reporters only, household population aged 19 years and older, Canada excluding territories, 2004 vs. 2015

		Plausible reporters adults					
		2004†			2015		
			95% confidence interval			95% confidence interval	
Rank‡	Food category	% of total sugars	from	to	% of total sugars	from	to
1	Fruit (not containing free sugars)	17.8	17.0	18.6	17.2	16.2	18.1
2	Sugars, syrups and confectionary (containing free sugars)	16.3	15.4	17.3	13.6*	12.6	14.7
3	Regular soft drinks (containing free sugars)	14.6	13.5	15.7	8.9*	7.9	9.9
4	Baked goods and products (containing free sugars)	8.0	7.3	8.6	8.8	8.1	9.4
5	Milk (not containing free sugars)	10.4	9.9	10.9	7.9*	7.4	8.4
6	Juice (containing free sugars)	9.4	8.6	10.3	6.9*	6.0	7.8
7	Vegetables (not containing free sugars)	5.8	5.6	6.1	5.0*	4.7	5.3
8	Frozen desserts (containing free sugars)	1.5	1.2	1.7	3.8*	3.3	4.4
9	Milk (containing free sugars)	2.3	1.9	2.7	2.6	1.6	3.5
10	Yoghurt (containing free sugars)	2.0	1.8	2.3	2.5	2.1	2.8

* significantly different from reference category ($p < 0.05$)
† reference category
‡ ranked according to top 10 in 2015; items from 2004 are shown for comparison purposes only and are not necessarily the top 10 from 2004
Sources: Statistics Canada, 2004 Canadian Community Health Survey—Nutrition (cycle 2.2), and 2015 Canadian Community Health Survey—Nutrition.

in 2015 than in 2004. In children, fruit—naturally occurring sugars—contributed more. Although not perfect, this shows a trend of decreasing free sugars from 2004 to 2015.

Results from this study show that, among Canadian children and adults overall, average daily total sugars consumption from food and beverages decreased from 2004 to 2015. However, an examination of plausible reporters showed no change in total sugars consumption between the two survey years, for either children or adults. It is likely that the overall decrease is explained by a combination of factors, such as the change in the food model booklet and the prevalence of misreporting, mainly the increase in under-reporting in the 2015 CCHS—Nutrition. Improved quality control measures were added to the AMPM in 2015, which greatly decreased the number of outliers and sizing errors. The same observation was made in Australia, where, between 1995 and 2011/2012, national declines in total energy and sugars intakes were attributed to under-reporting.[22] In the United States, a reduction in estimated mean daily intakes of added sugars was observed across age groups between 2003 to 2004 and 2011 to 2012 in the National Health and Nutrition Examination Survey.[23]

For the overall population, and by misreporting groups, trends in total sugars intakes from food alone compared with beverages alone were consistent: total sugars from food increased over time, while total sugars from beverages decreased over time. No other study was found that examined total sugars from food compared with beverages; therefore, it is difficult to make comparisons with other populations. Nevertheless, differences in food sources may help to explain these findings. From 2004 to 2015, the consumption of baked goods and products, as a percentage of total sugars, increased by up to 50% among children. Large increases were also seen in the consumption of frozen desserts, particularly among adults, and in the consumption of types of yoghurt that contain free sugars. Conversely, the consumption of total sugars from the “sugars, syrups and confectionary” category decreased among all populations. In Australia, estimates from 1995 to 2011/2012 showed that intakes of confectionary increased by around 45% among adults, although sugars from the category “syrups, jams and dishes other than confectionary” decreased by 20% to 30%.[22]

Top beverage sources may also help to explain the consistent decrease in total sugars consumption from beverages alone for all age groups in absolute values and as a percentage of energy from total sugars. The percentage of total sugars consumption from juice decreased by almost 50% in younger children and adults (17% for older children). For regular soft drinks, the percentage of total sugars consumption decreased by more than 50% among older children and by 64% among adults. Among Australians, sugars from soft drinks (as a proportion of total sugars) decreased, by 14%, on average, from 2005 to 2011/2012 among adults, by 16% among boys, and by 27% among girls.[22]

Because they have been associated with weight gain and obesity in children and adults, sugary beverages have been researched intensively in recent years.[3,4] The present study found that, as a whole, sugary beverages were the top source of total sugars consumption among all populations, accounting for 22% of total sugars for younger children, 30% for older children and 24% for adults. Despite the high proportions found in this study, percentages of sugary beverages consumed in 2015 were significantly lower than in 2004, which suggests a decrease in consumption across age groups. This is consistent with reports from Australia.[22]

Strengths of this study include the two large, nationally representative samples of Canadians over two different survey years, with similar methodology and sampling plans. The surveys used the validated 24-hour dietary recall method to collect food and nutrient information. All analyses were adjusted for misreporting status. To identify differences over time, changes in total sugars consumption were examined for all foods and beverages combined, and further by foods or beverages alone.

There were a number of limitations in this study. Two days of sugars data were available in the CCHS—Nutrition surveys, but only data from the first recall were included in these analyses since the objective was to examine average intakes and compare them over time. Adjustment for day-to-day variation in consumption would require an estimation of usual intake, which is necessary in examinations of intakes across distributions. Sugars intakes were self-reported and could be prone to recall bias or potential under-reporting because of social desirability.[24]

The sample was categorized by misreporting status to ensure greater comparability between the two survey years. Still, some factors influence the misreporting categories. Therefore, plausible reporters should be interpreted as reporters who gave the most reasonable responses on the interview day, based on their energy intake/TEE ratio, and not as the most accurate reporters. For example, physical activity was assumed to be the same for all respondents and for both survey years, given there was no comparable measure across surveys. Respondents who under- or over-consumed on the single recall day may have been misclassified as an under- or over-reporter. Further, it was determined that the misreporting classification methodology uses one standard deviation (SD=1), which provides an energy intake/TEE ratio that is close to 1. However, this led to approximately 40% of respondents being classified as over- or under-reporters. Before using this approach to categorize respondents by misreporting status, researchers should consider the relevance of this classification method to their study objectives to ensure that important information is not being excluded from their analyses.

Changes made to the food booklet models between the 2004 and 2015 CCHS—Nutrition have contributed to observed differences in total sugars since the quantities presented in the medium and large beverage models were smaller in 2015 than in 2004. Further, the CNF database changed between surveys because of the evolution of food products in the marketplace, and may have provided different nutrient profiles for certain food or beverage items. This may have led to small differences in total sugars estimations. Garriguet[8] reported in a preliminary analysis that the differences in the CNF food databases between the two survey years did not contribute significantly (20 kcal) to the observed changes in estimated energy intake.

Conclusion

Canadian children and adults consume up to 25% of their total daily energy intakes from total sugars. Compared with 2004, the percentage of total energy intakes among children from total sugars increased in 2015. Although an overall decrease in total sugars intakes in grams was seen when 2004 was compared with 2015, that decline can be explained in part by a combination of elements, such as changes to the food model booklet and the prevalence of misreporting between the surveys. Total sugars intakes from food have increased over time, whereas total sugars intakes from beverages have decreased. These trends were true for all age groups overall and for plausible reporters. ■

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Appendix

Table A
List of Bureau of Nutritional Sciences (BNS) food codes included in main food categories

Main food category	BNS groups included
Sugars, syrups and confectionary	41A sugars (white and brown); 41B jams, jellies and marmalade; 41C other sugars (syrups, molasses, honey, etc.); 43A candies, gums, etc; 43C jello, dessert toppings and pudding mixes, commercial; 44A chocolate bar; 160B grain dishes (tapioca, rice pudding); 205 milk desserts (custards, blancmange); 229 sweet snacks, sugar, candies, etc. (recipes)
Pasta	1A pasta; 130A spaghetti; 130B macaroni; 130C lasagna; 130D noodles (egg noodles); 130E other types of pasta (ravioli, manicotti, gnocchi, knish, perogies, etc.)
Rice	1B rice; 130F rice (recipe sub-group)
White bread	2A white bread; 140A white; 170A english muffins
Whole wheat grain bread	3A whole wheat breads; 3B other whole grain breads; 140B whole grain and whole wheat
Other bread products	4A rolls, bagels, pita bread, croutons, dumplings, matzo, tortilla; 4B crackers and crsipbreads; 140C other breads, crackers, rolls, dumplings, bannocks, bagels, english muffins
Baked products	4C muffins and english muffins; 4E croissants, pie crusts and phyllo dough; 7A cookies, commercial; 7B biscuits, commercial; 8A pies, commercial (pop tarts); 8B cakes, commercial (frozen cake); 8C danishes, doughnuts and other pastries, commercial; 140D biscuits; 140F croissants; 150A cakes, cheesecakes, shortcakes and brownies; 150 sweet baked goods; 170B biscuits (baking powder); 170C croissant
Frozen desserts	9A ice cream; 9B ice milk; 9C frozen yoghurt; 43B popsicle, sherbet; 202 frozen dairy product (recipes)
Pancakes and waffles	4D pancakes and waffles; 140E pancakes and waffles; 170D pancakes and french toast
Higher fibre breakfast cereals†	5A whole grain, oats and high-fibre breakfast cereals
Breakfast cereals†	6A breakfast cereal (other)
Granola bars	7C granola bar
Toppings	13A whipping cream; 13D sour cream
Cream	13B table cream; 13C half and half; 201A cream (recipe sub-group)
Cheese	14 cheeses; 204 cheese (recipes)
Yoghurt†	15A yoghurts, less than 2% b.f.; 15B yoghurts, more than 2.1% b.f.; 203 yoghurt (recipes)
Egg	16A egg; 16B frozen egg substitutes; 218 egg dishes
Butter / hard margarine	17A butter; 20A block margarine; 21B animal fats; 21C shortening
Margarine and oil	18A regular tub margarine; 18B calorie-reduced tub margarine; 21A vegetable oils
Red meat	22 beef; 23 veal; 24 lamb; 25A pork, fresh, lean only; 25B pork, fresh, lean and fat (including ground pork); 28 liver and liver patés; 29 offals (excluding liver); 31 game meats; 210 meat dishes (excluding frozen dinners)
Processed meat	25C bacon, 25D ham, cured, lean only; 25E ham, cured, lean and fat; 30A sausage; 32A luncheon meat; 213 sausage, cured and luncheon meats
Poultry	27 chicken and turkey (poultry); 211 poultry dishes
Nuts and seeds†	33A nuts; 33B seeds; 226 nuts and seeds (recipes)
Nut butters†	33C peanut butter and other nut spreads
Fish and seafood	34 fish; 35 seafood; 212 fish and shellfish dishes
Vegetables†	36A beans; 36B broccoli; 36C cabbage and kale; 36D cauliflower; 36E carrots; 36F celery; 36G corn; 36H lettuces and leafy greens (spinach, mustard greens, etc.); 36I mushrooms; 36J onion, green onions, leeks, garlic; 36K peas and snow peas; 36L peppers, red and green; 36M squashes; 36N tomatoes; 36P other vegetables (cucumber, immature beans, brussel sprouts, beets, turnips); 50A soups with vegetables; 220C salads; 220D leafy greens; 220E other vegetables (boiled, baked); 220F vegetables (mixed with other stuff)
Legumes and vegetable proteins	37 legumes; 217 legume (recipes)
Savory snacks	38A potato chips; 42A popcorn, plain and pretzels; 42B salty and high-fat snacks (including tortilla chips)
Fried potato	38B fried or roasted potatoes; 220B french fries and hash brown potatoes
Potato	39 potatoes, raw and cooked (excluding fried); 220A potatoes (boiled, mashed, baked, etc.)
Fruit†	40 fruits, raw, cooked, frozen and canned; 225 fruit dish
Soup	50B soups without vegetables
Condiments and gravies	50C gravies; 50D sauces (white, bearnaise, soya, tartar, ketchup, etc.); 50E salad dressings (with or without oil); 50F seasonings (salt, pepper, vinegar, etc.); 227B sauces and gravies (recipe sub-group); 227C salad dressing (recipe sub-group)
Beverages	
Milk†	10A milk, whole; 10B milk, 2%; 10C milk, 1%; 10D milk, skim; 10E milk, evaporated, whole; 10F milk, evaporated, 2%; 10G milk, evaporated, skim; 10K goat and sheep milk; 200A reconstituted from powder
Milk (sweetened)	46D other beverages (malted milk, instant breakfast); 231 milk-based beverage (milkshakes, malted milk, hot cocoa, instant breakfast, etc)
Plant-based beverages†	10J plant-based beverage (soy, almond, coconut)
Tea or coffee (sweetened)	sugar > 0 AND: 51A tea (including iced tea); 51B coffee; 231B tea (recipe sub-group); 231C coffee (recipe sub-group)
Tea and iced tea (unsweetened)	sugar ≤ 0 AND: 51A tea (including iced tea)
Coffee (unsweetened)	sugar ≤ 0 AND: 51B coffee
Water†	51C water (well and mineral); 231A water (tap and mineral)
Regular soft drinks	46A soft drinks—regular
Soft drinks with sugar substitutes	46B soft drinks—aspartame
Fruit drinks	46C fruit drinks
Energy sports drinks and vitamin water	46E energy drink; 46F vitamin water; 46G sports drink
Alcohol	47 spirits and liqueurs; 48 wines; 49 beers and coolers; 231G alcoholic beverages
Juice	36O juices, tomato and vegetable; 45 fruit juices; 231E fruit juices (recipe sub-group)

† unsweetened unless free sugars were present and flagged
Note: Few exceptions were applied and are available on request.
Source: Canadian Nutrient File 2015.