

Healthfulness and nutritional composition of Canadian prepackaged foods with and without sugar claims

Jodi T. Bernstein, Beatriz Franco-Arellano, Alyssa Schermel, Marie-Ève Labonté, and Mary R. L'Abbé

Abstract: The objective of this study was to evaluate differences in calories, nutrient content, overall healthfulness, and use of sweetener ingredients between products with and without sugar claims. Consumers assume products with sugar claims are healthier and lower in calories. It is therefore important claims be found on comparatively healthier items. This study is a cross-sectional analysis of the University of Toronto's 2013 Food Label Database. Subcategories where at least 5% of products (and $n \geq 5$) carried a sugar claim were included ($n = 3048$). Differences in median calorie content, nutrient content, and overall healthfulness, using the Food Standards Australia/New Zealand Nutrient Profiling Scoring criterion, between products with and without sugar claims, were determined. Proportion of products with and without claims that had excess free sugar levels ($\geq 10\%$ of calories from free sugar) and that contained sweeteners was also determined. Almost half (48%) of products with sugar claims contained excess free sugar, and a greater proportion contained sweeteners than products without such claims (30% vs 5%, $\chi^2 = 338.6$, $p < 0.0001$). Overall, products with sugar claims were "healthier" and had lower median calorie, free sugar, total sugar, and sodium contents than products without claims. At the subcategory level, reductions in free sugar contents were not always met with similar reductions in calorie contents. This study highlights concerns with regards to the nutritional composition of products bearing sugar claims. Findings can support educational messaging to assist consumer interpretation of sugar claims and can inform changes in nutrition policies, for example, permitting sugar claims only on products with calorie reductions and without excess free sugar.

Key words: sugars, nutrition marketing, food labelling, sugar claims, nutrient composition, free sugar, food policy, sugar claims.

Résumé : Évaluer les différences sur le plan des calories, de la teneur en éléments nutritifs, de la valeur sanitaire globale et de l'utilisation d'édulcorants, et ce, avec ou sans allégations relatives au sucre. Les consommateurs croient que les produits présentant des allégations relatives au sucre sont meilleurs pour la santé et plus faibles en calories. On devrait donc retrouver des allégations sur des produits relativement plus sains. Analyse transversale de la Base de données 2013 de l'étiquetage des aliments de l'Université de Toronto. Les sous-catégories avec au moins 5 % des produits (et $n \geq 5$) présentant une allégation relative au sucre sont incluses ($n = 3048$). Au moyen des critères de notation des profils nutritionnels basés sur les normes alimentaires de l'Australie/Nouvelle-Zélande, on calcule les différences entre les médianes du contenu calorique, de la teneur en éléments nutritifs et de la valeur sanitaire globale des produits avec et sans allégation relative au sucre. On détermine aussi la proportion des produits avec et sans allégation d'une trop haute teneur en sucre libre ($\geq 10\%$ des calories provenant du sucre libre) et contenant des édulcorants. Environ la moitié (48 %) des produits avec des allégations relatives au sucre contient du sucre libre en trop et une plus grande proportion contient des édulcorants comparativement aux produits sans de telles allégations (30 % vs 5 %, $\chi^2 = 338,6$, $p < 0,0001$). Globalement, les produits présentant des allégations relatives au sucre sont « plus sains » et présentent une plus faible médiane de calories, de sucre libre, de sucre total et de sodium comparativement aux produits sans allégations. Au niveau de la sous-catégorie, la diminution de la teneur en sucre libre ne suit pas toujours la même diminution du contenu calorique. Cette étude souligne les préoccupations relatives à la valeur nutritive des produits présentant des allégations relatives au sucre. Les observations peuvent confirmer les messages éducatifs pour éclairer le consommateur au sujet des allégations relatives au sucre; ces observations peuvent guider les modifications des politiques en matière de nutrition, par exemple, en autorisant les allégations relatives au sucre seulement pour les produits présentant des diminutions du contenu calorique et sans de sucre libre en trop. [Traduit par la Rédaction]

Mots-clés : sucres, marketing nutritionnel, étiquetage des aliments, allégations relatives au sucre, composition nutritionnelle, sucre libre, politique nutritionnel.

Introduction

In 2015, several health organizations released guidelines recommending intakes of free sugar be limited to a maximum of 10% of calories to avoid the increased risk of obesity, cardiovascular disease, diabetes, and dental caries associated with excess consumption (Public Health England 2015; US Department of Health and Human Services and US Department of Agriculture 2015; World

Health Organization (WHO) 2015). In 2013, reducing sugar intakes was 1 of the top 3 improvements Canadians reported making to their diets, with 50% of Tracking Nutrition Trends 2013 respondents making this change; up from 15% in 2008 (Canadian Council of Food and Nutrition 2008; Canadian Foundation for Dietetic Research 2013). However, a nationally representative survey of Canadians in 2010/2011 found that 47% of respondents had diffi-

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J.T. Bernstein, B. Franco-Arellano, A. Schermel, M.-È. Labonté, and M.R. L'Abbé. Department of Nutritional Sciences, Faculty of Medicine, University of Toronto, Toronto, ON M5S 3E2, Canada.

Corresponding author: Mary R. L'Abbé (email: mary.labbe@utoronto.ca).

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Table 1. Examples of foods and beverages included in each subcategory evaluated in this study.

Food subcategory	Food and beverage examples
Canned fruit	Fruit canned in juice, fruit canned in syrup, fruit canned in water
Dairy beverages and alt.	Drinkable yogurt, milk, plant-based beverages, milkshakes, smoothies
Frozen fruit	Frozen fruit (e.g., berries, mango)
Fruit juice and drinks	Fruit juice, fruit drink, fruit juice-drink combination beverages
Fruit sauces	Fruit sauce, sweetened; fruit sauce, unsweetened (e.g. apple sauce)
Fruit snacks	Apple chips, banana chips, fruit leather/bars, fruit-based gummies
Nut and seed butter	Peanut butter, almond butter/paste, other nut and seed butter/paste
Pie, tart, cobbler	Pie, tart, cobbler, crisp
Puddings and gelatin	Custard, gelatin, mousse, pudding
RTE cereal	Flakes, granola/muesli, high-fibre, puffed, semi-compact/formed, shredded cereals
Salad dressing	Salad dressing, vinegar
Soft drinks	Soft drinks, regular/diet or light; iced tea, regular/diet or light
Sweet condiments	Bread spreads (e.g., chocolate spread), fruit preserves, honey, molasses, syrups
Vegetable drinks	Vegetable juice, tomato juice, tomato-based cocktail
Water	Flavoured water
Yogurt	Yogurt, plain; yogurt, sweetened

Note: alt., alternatives; RTE, ready-to-eat.

culty finding “healthy” processed foods that were lower in added sugar (Schermel et al. 2014). With the emergence of quantitative sugar guidelines from the WHO and other agencies, it is therefore important for public health that information is available to enable consumers to select healthier foods that are lower in sugar.

In Canada, the most commonly consulted source of nutrition information is food product labels (Canadian Foundation for Dietetic Research 2013). One aspect of food labelling is manufacturer voluntary Nutrient Content Claims (NCCs), which highlight the amount of a nutrient in a food based on the information found on the Nutrition Facts table (NfT) (Health Canada 2010; CODEX Alimentarius 2013). In Canada, 36% of consumers always or usually use NCCs to inform their food choice (Canadian Foundation for Dietetic Research 2013). In 2010, 4% of products in the Canadian food supply had sugar-related NCCs (“sugar claims”) (Schermel et al. 2013).

It is well established that the mere presence of an NCC on a label can lead consumers to attribute nutritional benefits to a product beyond that of the nutrient stated in the claim (Roe et al. 1999; Andrews et al. 2000). In regard to sugar claims, research has shown that many consumers assume a product is healthier when a “no added sugar” claim is present (Gorton et al. 2010), and consumers also expect calorie reductions to accompany products with “reduced in sugar” and “no added sugar” claims (Patterson et al. 2012). However, Canadian regulations allow sugar claims to be present on products regardless of their calorie content (Canadian Food Inspection Agency 2014b), as do many other countries and Codex standards (CODEX Alimentarius 2013). This is especially concerning since nutrition marketing is commonly found on foods that are high in calories and other “nutrients to limit” (i.e., sodium, sugar, fat) (Colby et al. 2010; Schermel et al. 2016), and many Canadians rely on NCC alone and do not check the more detailed nutrition information available on the NfT (Reid and Hendricks 1994). Other concerns about products with sugar claims include the replacement of sugar with low- or no-calorie sweeteners (van Raaij et al. 2009), of which the long-term health effects remain inconclusive (Gardner et al. 2012; Mennella 2014; Mwatsama and Landon 2014; Swithers 2015; United States Department of Agriculture 2015).

Sugar claims have the potential to influence food selection and it is important that they are found on products that are healthier and have comparatively better nutritional composition, particularly calories, than similar products without sugar claims, to avoid misleading the consumer (Wansink and Chandon 2006; Wills et al. 2012; Nguyen et al. 2016). The extent to which prepackaged foods and beverages with sugar claims are lower in calories, “nutrients to limit”, or are healthier than those without sugar claims, has not been extensively examined in Canada or elsewhere. The

objectives of this study were to evaluate products with and without sugar claims for differences in terms of (i) the proportion containing excess free sugar contents; (ii) calorie and nutrient contents (i.e., free sugar, total sugar, carbohydrates, total fat, sodium, and protein); (iii) overall healthfulness; and (iv) the use of sweetener ingredients.

Materials and methods

Food Label Information Program (FLIP) Database

This study is a cross-sectional analysis of the University of Toronto’s FLIP 2013 database ($n = 15\ 342$). The database includes information on nutrient contents as declared on the NfT, Ingredient List, Universal Product Code, company, brand, price, container size, and nutrition marketing for private-label and National brand foods. Data were not weighted according to market share. For this study, products were categorized into 17 sugar-focused major food groups, 77 subcategories, and 207 minor subcategories to ensure comparisons of like products (Bernstein et al. 2016). Specific details on the collection, categorization, and validation of FLIP 2013 have been described previously (Bernstein et al. 2016). Excluded from these analyses were meal-replacement beverages ($n = 55$), which are indicated for special dietary use; items with errors in nutrient declarations determined when calorie contents calculated with Atwater values differed by >20% from declared caloric values ($n = 55$); and products with missing sugar declarations ($n = 28$). Only the subcategories where at least 5% of products carried a sugar claim (totalling at least 5 products) were included in this study ($n = 3048$). These categories captured 81% of the 785 products with sugar claims in the database. See Table 1 for examples of foods and beverages in each subcategory included in this study.

Sugar-related claims

A review of product labels was conducted to identify products that had sugar-related nutrient content claims (“sugar claims”). All sugar claims and variations in wording as authorized for use by Health Canada, and outlined in the Canadian Food Inspection Agency’s guide to food labelling and advertising (Canadian Food Inspection Agency 2014b) were considered. Sugar claims found on food packages in FLIP 2013 included “no added sugar”, “reduced in sugar”, “unsweetened”, and “sugar free”. “Unsweetened” claims were grouped with “no added sugar” claims in this study, as both claims can only be present on products without any added sugars, but “unsweetened” claims also require the absence of other sweeteners (Canadian Food Inspection Agency 2014b).

Calorie, nutrient composition, and excess free sugar levels

For products with and without sugar claims, median calories (kcal/100 g or 100 mL), total sugar, free sugar, carbohydrate, total

Table 2. Method used to calculate fruit, vegetable, nut, and legume (FVNL) points using the Ingredients List in order to calculate the overall nutritional quality using the Food Standards Australia New Zealand Nutrient Profiling Scoring Criterion.

Type	Points ^a	%FVNL	Method used to estimate %FVNL ^b based on Ingredient List
Concentrated ^c	0	<25%	FVNL is not 1 of the first 3 ingredients
	1	≥25%	FVNL is the third ingredient (third ingredient can account for at most 33% of the product weight)
	2	≥43%	FVNL is the first or second ingredient but non-FVNL ingredients (e.g. sugar, water, oil) appear to contribute <i>substantially</i> to product weight (second ingredient can account for at most 50% of the product weight)
	5	≥67%	FVNL is first ingredient and non-FVNL ingredients appear to contribute <i>minimally</i> to product weight
	8	100%	FVNL are only ingredients to contribute to product weight
Nonconcentrated ^d	0	≤40%	FVNL is not 1 of the first 2 ingredients
	1	>40%	FVNL is the second ingredient (second ingredient can account for at most 50% of the product weight)
	2	>60%	FVNL is the first ingredient but non-FVNL ingredients appear to contribute <i>substantially</i> to product weight
	5	>80%	FVNL is the first ingredient and non-FVNL ingredients appear to contribute <i>minimally</i> to product weight
	8	100%	FVNL are the only ingredients contributing to product weight

Note: %FVNL, percentage of fruits, vegetables, nuts, and legumes that contribute to the weight of the product.

^aPoints and associated %FVNL (%FVNL contributes to weight of the product) is presented as stated in FSANZ Standard 1.2.7 (Food Standards Australia New Zealand 2014).

^bCriteria to estimate %FVNL was developed by a team of researchers in lieu of quantitative ingredient declarations on food labels in Canada.

^cConcentrated refers to a product that contains any FVNL in a concentrated form (dried, evaporated, paste).

^dNonconcentrated refers to a product that contains FVNL, none of which are concentrated. If an ingredient is further broken down into components within brackets, the first listed component needs to be an FVNL for the ingredient to be considered an FVNL.

fat, protein (g/100 g or 100 mL), and sodium (mg/100 g or 100 mL) were determined for each subcategory. The majority of products were analyzed on a weight basis, except for beverages and desserts, which were analyzed by volume. Calorie, total sugar, carbohydrate, total fat, protein, and sodium contents as per manufacturer-stated serving size (MSSS) were obtained from the NfT then converted to standardized units (per 100 g or 100 mL) using the MSSS. Free sugar content, as defined by the WHO, was calculated using the University of Toronto decision algorithm, described elsewhere (Bernstein et al. 2016). Percent differences in medians were calculated by subtracting the median for items without a sugar claim from those with and dividing by the median of items without a sugar claim.

According to the Pan American Health Organization’s Nutrient Profiling model, products with ≥10% of calories coming from free sugars, contain an “excess” amount of free sugar (Pan American Health Organization 2016). This cut-off is also in line with dietary guidelines from the WHO that recommend intakes of free sugar should not exceed 10% of calories, as consumption of products with “excess” nutrient contents increases the likelihood dietary intakes will be in excess of the recommendations (WHO 2015; Pan American Health Organization 2016). Free sugar as a percent of energy was calculated by multiplying free sugar content (g per 100 g or per 100 mL) by the Atwater factor for carbohydrates (4 kcal/g) and dividing by the caloric content per 100 g or per 100 mL. This method enables the identification of foods and beverages that would contribute a greater proportion of calories from free sugar than the recommended 10%. Moreover, free sugar contents of each product are placed within the context of the calories contributed by the same product and can therefore be applicable to diets of varying energy intakes. The difference in the proportion of products with excess free sugar contents was compared between those with and without sugar claims, overall and by subcategory.

Healthfulness

Overall healthfulness was determined using a summary score. For each unique product in FLIP 2013 (n = 15 342) a score was calculated using the Food Standards Australia New Zealand – Nutrient Profiling Scoring Criterion (NPSC), designed to determine a foods’ eligibility to carry a health claim (Food Standards Australia New Zealand 2014). The NPSC system assigns points for “nutrients to limit” (calories, saturated fat, sodium, and total sugar) and deducts points for “nutrients and components to encourage” (dietary fibre; protein; and fruit, vegetable, nut, and legume (FVNL) content) (Food Standards Australia New Zealand 2014). To calcu-

late NPSC scores, nutrient contents were obtained from the NfT and converted to either 100 g or 100 mL (food or beverage, respectively). Possible scores calculated using the NPSC system range from -18 to +81, and a lower score is indicative of a higher nutritional quality (“healthier” product) (Food Standards Australia New Zealand 2014).

In the absence of quantitative ingredient declarations in Canada, the model was adapted to estimate points related to the percentage of FVNL in each product. FVNL points were assigned based on the presence and position of these ingredients within the Ingredient List, which places components in descending order based on relative weight contribution (Table 2) (Canadian Food Inspection Agency 2016a). For Ingredient Lists that provided a breakdown of the ingredients into a second generation (provided in brackets), the first 2 components listed within the brackets were considered followed by the next first generation ingredient listed (out of brackets). For example, for an Ingredient List that contains “milk, strawberry preparation (sugar, strawberries, water), guar gum...”, sugar and strawberries would be considered part of the second ingredient, and guar gum the third. For products with multiple Ingredient Lists (e.g., tuna kit with crackers), an average of FVNL points from each component was used, rounding down to the nearest whole point (e.g., (5 + 1)/2 = 3, since there is no 3-point level, it is rounded down to 2 FVNL points). Products with missing Ingredient Lists (<2%) were not assigned FVNL points unless it was evident FVNL contributed to the majority of weight based on the product name or type. Due to missing nutrient declarations on a products’ NfT, 5 products were excluded from analyses that used the NPSC scores in this study. FVNL points were independently determined twice for each product by blinded researchers. A third researcher assessed agreement between both assignments and a group consensus was reached for any discrepancies. Final NPSC scores in the “as purchased” and “as consumed” forms were calculated. This study used the NPSC scores for products in the “as purchased” form. Median NPSC scores of products without a sugar claim were subtracted from those with a sugar claim to determine the difference in medians and direction of change, overall and by subcategory.

Sweetener use

The Canadian Food Inspection Agency describes sweeteners as a food additive that is used to give products a sweet taste and can include sugar alcohols (e.g., malitol, xylitol, sorbitol), non-nutritive sweeteners (e.g., aspartame, sucralose, acesulfame-potassium), cyclamate sweeteners, or saccharin sweeteners (Canadian Food

Table 3. Number and proportion (%) of products with sugar claims, by type of sugar claim and by subcategory^a (n = 3048).

Food subcategory	“No added sugar” claim ^b (%)	“Sugar free” claim (%)	“Reduced in sugar” claim (%)	Any sugar claim (%)
Canned fruit ^c	14 (9)	0 (0)	2 (1.3)	15 (9.7)
Dairy beverages and alt. ^c	31 (12.8)	0 (0)	3 (1.2)	33 (13.6)
Frozen fruit	37 (60.7)	0 (0)	0 (0)	37 (60.7)
Fruit drinks	234 (36)	0 (0)	14 (2.2)	248 (38)
Fruit sauces ^c	38 (61.3)	0 (0)	3 (4.8)	38 (61.3)
Fruit snacks	21 (52.5)	0 (0)	0 (0)	21 (52.5)
Nut and seed butter	16 (20.5)	0 (0)	0 (0)	16 (20.5)
Pies and tarts	7 (7)	0 (0)	0 (0)	7 (7)
Puddings and gelatin	26 (13.3)	1 (0.5)	3 (1.5)	30 (15.4)
RTE cereal ^c	10 (4)	3 (1.2)	3 (1.2)	14 (5.6)
Salad dressing	13 (4.2)	6 (1.9)	0 (0)	19 (6.2)
Soft drinks	4 (1.5)	53 (19.5)	5 (1.8)	62 (22.8)
Sweet condiments	16 (5.4)	0 (0)	13 (4.4)	29 (9.7)
Vegetable drinks	10 (23.3)	0 (0)	0 (0)	10 (23.3)
Water	0 (0)	8 (14.6)	0 (0)	8 (14.6)
Yogurt	48 (20.4)	0 (0)	0 (0)	48 (20.4)
Overall	525 (17.2)	71 (2.3)	46 (1.5)	635 (20.8)

Note: alt., alternatives; RTE, ready-to-eat.

^aOnly includes predetermined subcategories with ≥5% and ≥5 products with sugar claims (any type of sugar claim or a combination).

^b“No added sugar” claims also captured products that carried “unsweetened” claims.

^cThe addition of the number of products with each type of claim exceeds the number of products with any sugar claim because some products carried more than 1 type of claim.

Inspection Agency 2015). Presence of sweeteners in FLIP 2013 were identified by searching the Ingredient List of each product for permitted sweeteners as outlined by Health Canada (2016b). The prevalence of sweeteners in products with and without sugar claims was determined.

Statistical analyses

Categorical variables (e.g., presence sugar claims, proportion of products with excess sugar contents) were presented as counts and frequencies (percentages). χ^2 test was used to compare the proportion of products with excess free sugar contents and with sweetener ingredients among products with and without sugar claims (Fisher’s exact test was used when cell counts were less than 5). Wilcoxon Mann–Whitney *U* test was used to determine if calorie content, nutrient content, and NPSC scores were statistically different ($p < 0.05$) between items with and without sugar claims. All statistical analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, N.C., USA).

Nutritional significance

Nutritional significance in this study refers to differences in median calorie and nutrient contents ≥25%. This is the required minimum difference for a product to carry comparative nutrient content claims such as “reduced in sugar” or “lower in sugar” claims (Canadian Food Inspection Agency 2014b). It is also in excess of the tolerance limit for nutrient declarations on the NFT, which must be within 20% of actual analyzed values (Canadian Food Inspection Agency 2014a). Results that are both statistically significant and nutritionally significant are presented when examining differences in calorie and nutrient contents.

Results

Twenty-one percent (n = 635) of products evaluated carried at least 1 sugar claim. The most prevalent type was “no added sugar” claims (n = 525), followed by “sugar free” claims (n = 71), and “reduced in sugar” claims (n = 46) (Table 3). For the following

sections on calorie and nutrient contents, “significance” refers to both statistical and nutritional significance.

Difference in calorie and sugar contents

Of the products with a sugar claim, nearly half (48%) contained excess free sugar levels (≥10% of calories), compared with 78% of comparable products without sugar claims ($\chi^2 = 227.6, p < 0.0001$) (Fig. 1). Forty-two percent of products with “no added sugar” claims and 85% of products with “reduced in sugar” claims contained excess free sugar levels (data not shown). For nearly all subcategories, fewer products with sugar claims had excess free sugar levels compared with those without, with fruit drinks being the exception (100% of products with sugar claims had excess free sugar levels compared with 98% without, $p = 0.027$, Fisher’s exact test) (Fig. 1). The proportion of products with excess free sugar levels was similar between products with and without a sugar claim in fruit snacks, nut and seed butter, and sweet condiments.

Overall, median caloric density (kcal/100 g or 100 mL), free sugar, and total sugar contents were significantly lower among products with a sugar claim compared with those without (–53%, –100%, and –37%, respectively, $p < 0.0001$) (Table 4). At the subcategory level, products with sugar claims had lower or similar amounts of calories, free sugar, and total sugar than products without sugar claims, with 1 exception; total sugar was 25% higher among fruit snacks with sugar claims compared with those without ($p = 0.0124$). For dairy beverages and alternatives, pies and tarts, puddings and gelatin, ready-to-eat cereal, and salad dressing, the reduction in calories was less than the reduction seen in total sugar levels.

Difference in other nutrients

Overall, there was no significant difference in total fat or carbohydrate content between products with and without sugar claims but sodium and protein were lower among products with sugar claims (–64%, $p < 0.0001$ and –37%, $p < 0.0001$, respectively) (Table 4). At the subcategory level, only salad dressing with sugar claims had a higher median fat and protein content than without claims, with a difference of 72% ($p = 0.0035$) and 198% ($p < 0.0001$), respectively. Nine subcategories (canned fruit, dairy beverages and alternatives, fruit sauces, pies and tarts, puddings and gelatin, salad dressing, soft drinks, sweet condiments, and yogurt) had lower median carbohydrate contents among products with sugar claims and 2 subcategories (ready-to-eat cereal and nut and seed butter) had lower median sodium contents than those without sugar claims.

Difference in overall healthfulness

Median NPSC scores were significantly lower (“healthier”), among products with sugar claims overall and for most subcategories except frozen fruit, salad dressing, vegetable drinks, and water (Fig. 2). More specifically, vegetable drinks was the only subcategory where the median healthfulness score was higher (less healthy) among products with sugar claims than those without (0 vs. –1, $p = 0.0220$). Differences in median NPSC scores ranged from zero in dairy beverages and alternatives ($p = 0.0136$) to 13 in nut and seed butter and in puddings and gelatin ($p = 0.0001$ and $p < 0.0001$, respectively).

Use of sweetener ingredients

Sweetener use was more prevalent among products with sugar claims (30%) compared with products without sugar claims (5%, $\chi^2 = 338.57, p < 0.0001$) (Fig. 3). This trend was also observed in 6 subcategories (canned fruit, pies and tarts, puddings and gelatin, soft drinks, sweet condiments, and yogurt), with 100% of the products with claims in puddings and gelatin and pies and tarts containing sweeteners (Fig. 3). More than half of products with sugar claims contained sweeteners in 7 out of the 10 subcategories that contained sweeteners.

Fig. 1. Proportion of products with and without sugar claims that contained an “excess” amount of free sugar ($\geq 10\%$ of calories), overall and by subcategory ($n = 3048$). Analysis only includes subcategories with $\geq 5\%$ and ≥ 5 products with sugar claims. Only subcategories with products that contained “excess” free sugar contents are shown; frozen fruit and water are not shown. Asterisk (*) denotes a statistically significant difference (*, $p < 0.05$; **, $p < 0.01$; ****, $p < 0.0001$). (a) Denotes subcategories where a Fishers exact test was used (cell counts < 5); the remaining underwent analysis using χ^2 tests. Alt., alternatives; RTE, ready-to-eat.

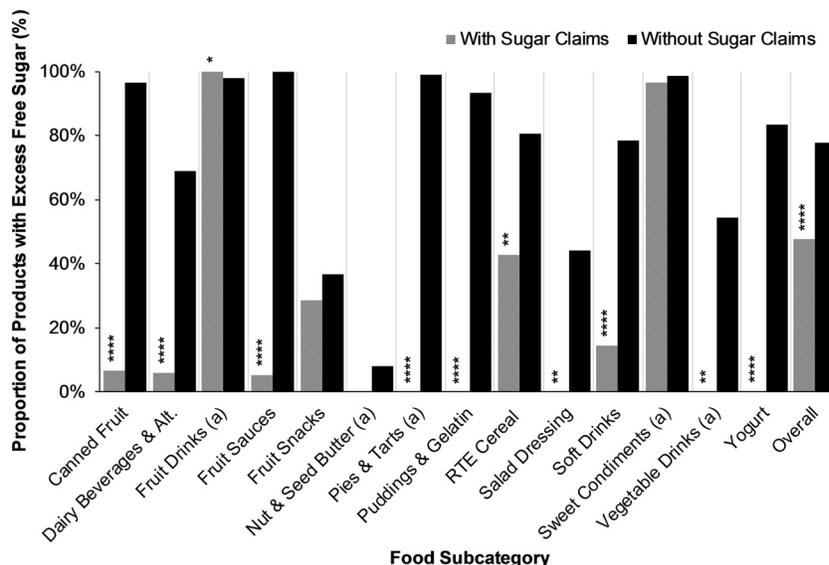


Table 4. Amount and percent (%) difference^a in median calorie, free sugar, total sugar, carbohydrate, total fat, sodium, and protein content per 100 g or 100 mL between products without and with sugar claims by subcategory and overall^b ($n = 3048$).

Food subcategory	Calories (kcal)	Free sugar (g)	Total sugar (g)	Carbohydrates (g)	Total fat (g)	Sodium (mg)	Protein (g)
Canned fruit	-31 (-52%)****	-8 (-100%)****	-7 (-56%)****	-7 (-46%)****	0 (.)	-1 (-12%)	0 (-54%)
Dairy beverages and alt.	-28 (-54%)****	-3 (-100%)****	-5 (-92%)****	-5 (-82%)****	0 (-20%)	2 (4%)	-3 (-86%)****
Frozen fruit	0 (0%)	0 (.)	0 (-6%)	0 (0%)	0 (.)	0 (.)	0 (0%)
Fruit drinks	0 (0%)	-1 (-7%)	-1 (-7%)	0 (-3%)	0 (.)	2 (25%)	0 (.)
Fruit sauces	-27 (-38%)****	-6 (-100%)****	-6 (-38%)****	-7 (-37%)****	0 (.)	-3 (-37%)	0 (33%)
Fruit snacks	-24 (-7%)****	0 (.)	15 (26%)*	10 (13%)*	0 (.)	44 (124%)	-1 (-34%)
Nut and seed butter	67 (11%)*	-2 (-100%)****	0 (0%)	-5 (-20%)*	3 (7%)	-188 (-100%)*	1 (4%)*
Pies and tarts	-57 (-18%)*	-17 (-100%)****	-16 (-77%)****	-13 (-32%)*	-1 (-6%)	-29 (-14%)	0 (8%)
Puddings and gelatin	-161 (-73%)****	-20 (-100%)****	-20 (-100%)****	-18 (-96%)****	0 (.)	2 (3%)	0 (9%)
RTE cereal	-33 (-8%)	-17 (-100%)*	-12 (-59%)*	2 (2%)	-1 (-23%)	-308 (-95%)****	2 (17%)
Salad dressing	58 (24%)*	-6 (-100%)****	-7 (-100%)****	-6 (-50%)****	14 (72%)****	-153 (-19%)	1 (198%)****
Soft drinks	-40 (-100%)****	-10 (-100%)****	-10 (-100%)****	-10 (-100%)****	0 (.)	0 (0%)	0 (.)****
Sweet condiments	-110 (-44%)****	-21 (-40%)****	-21 (-40%)****	-30 (-46%)****	0 (.)	25 (.)**	1 (.)****
Vegetable drinks	-5 (-22%)*	-1 (-100%)*	-1 (-18%)*	-1 (-17%)*	0 (.)	-8 (-4%)	0 (-19%)
Water	-111 (-100%)	0 (.)	0 (.)	0 (.)	0 (.)	7 (.)	0 (.)
Yogurt	-50 (-56%)****	-8 (-100%)****	-7 (-64%)****	-8 (-60%)****	-2 (-100%)****	1 (3%)	0 (0%)*
Overall	-53 (-53%)****	-10 (-100%)****	-5 (-37%)****	-3 (-23%)****	0 (.)****	-18 (-64%)****	0 (-37%)****

Note: Asterisk (*) denotes a statistically significant difference (*, $p < 0.05$; **, $p < 0.01$; ****, $p < 0.0001$) determined by Wilcoxon Mann-Whitney U tests. alt., alternatives; RTE, ready-to-eat.

^aNegative values indicate lower levels in foods with sugar claims. (.) Denotes a percent difference was not able to be determined because the divisor was zero.

^bOnly predetermined subcategories with $\geq 5\%$ and ≥ 5 products with sugar claims are included.

Discussion

The present study assessed the differences in calorie contents, nutrient contents, overall healthfulness, and the use of sweeteners in Canadian prepackaged foods and beverages with sugar claims compared with similar products without sugar claims. This research is particularly well-timed given the emergence of dietary guidelines suggesting the need to limit free sugar intakes (Public Health England 2015; US Department of Health and Human Services and US Department of Agriculture 2015; WHO 2015) and the increased interest in reducing sugar consumption among Canadians (Canadian Council of Food and Nutrition 2008; Canadian Foundation for Dietetic Research 2013). Dietary guidelines, to be effective, need to be supported by food labelling regulations that ensure sugar claims aid consumers in their selection of healthier food alternatives and reduce the detrimental effects associated

with excess free sugar consumption (Moynihan and Kelly 2013; Te Morenga et al. 2013; Te Morenga et al. 2014; Yang et al. 2014). In Canada, claims used on products must abide by the specific regulation for that claim and also must not be misleading, untruthful, or create an erroneous impression of a product (Canadian Food Inspection Agency 2016b).

Contrary to consumer perceptions, many products with sugar claims had excess free sugar levels. A study by Food Standards Australia and New Zealand found 28% of respondents incorrectly thought the presence of a “no added sugar” claim meant a product would not contain any sugar (Food Standards Australia and New Zealand 2003). In the present study, approximately half (48%) of the products with sugar claims contained excessive amounts of free sugar. For example, 36% of fruit drinks and 5.4% of sweet condiments had a “no added sugar” claim, yet over 99% of them

Fig. 2. Median NPSC scores between products without and with sugar claims, by subcategory and overall ($n = 3043$), where negative values (on the left) indicate a lower score among products with sugar claims (healthier). Asterisks (*) denotes a statistically significant difference (*, $p < 0.05$; **, $p < 0.01$; ****, $p < 0.0001$). Analysis only includes subcategories with $\geq 5\%$ and ≥ 5 products with sugar claims. Alt., alternatives; NPSC, Food Standards Australia New Zealand Nutrient Profiling Scoring Criterion; RTE, ready-to-eat.

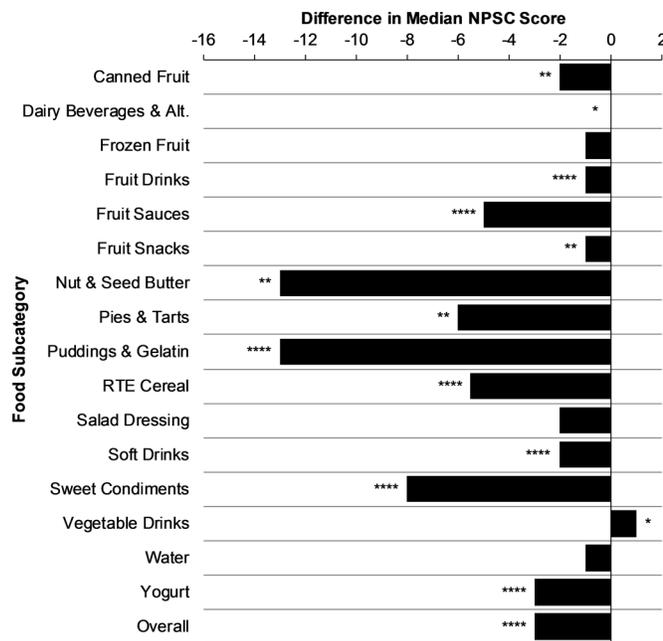
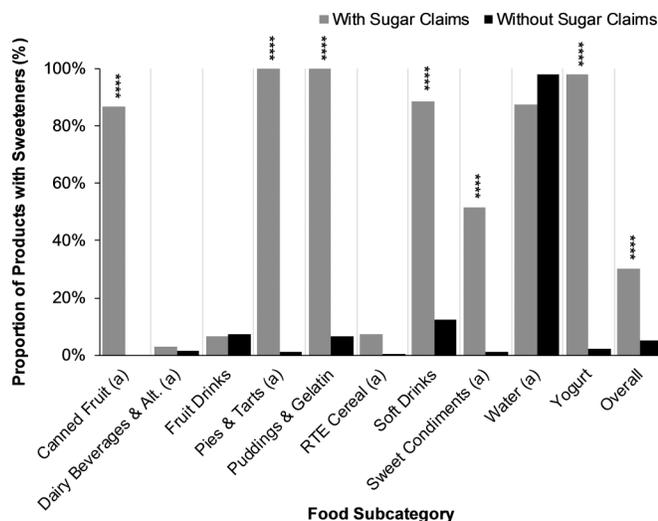


Fig. 3. Proportion of products with and without sugar claims that contained sweeteners, by subcategory and overall ($n = 3048$). Analysis only includes subcategories with $\geq 5\%$ and ≥ 5 products with sugar claims. Asterisk (*) denotes a statistically significant difference (****, $p < 0.0001$). Only subcategories that contained sweeteners are shown; nut and seed butter, frozen fruit, fruit sauces, fruit snacks, salad dressing, and vegetable drinks not shown. “Sweeteners” refers to all non- or low-caloric sweetening agents as defined by the Canadian Food Inspection Agency, including sugar alcohols (e.g., xylitol and sorbitol), and noncaloric or artificial sweeteners (e.g., sucralose and aspartame) (Canadian Food Inspection Agency 2015). (a) Denotes subcategories where a Fishers exact test was used (cell counts < 5); the remaining underwent analysis using χ^2 tests. Abbreviations: Alt., alternatives; RTE, ready-to-eat.



contained excess free sugar. The Canadian regulations do not consider fruit juice a sweetener when it is not concentrated and is used as a fruit ingredient (Canadian Food Inspection Agency 2006). For this reason, sweet condiments (namely, fruit preserves) and fruit juice, although the latter is considered a free sugar, can still bear a “no added sugar” claim. Additionally, a “reduced in sugar” claim can only be present on products in which the sugar content is lowered by at least 25% compared with a similar reference product; yet there is no limitation based on the absolute amount of free sugar in the product and 85% of products with “reduced in sugar” claims contained excess free sugar levels. The presence of sugar claims on products with excess free sugar contents may mislead consumers, detracting from efforts to reduce free sugar intakes and risk of associated negative health outcomes. This is particularly relevant for the 70% of Canadians who consider the amount of sugar in a product at least sometimes when choosing foods (Canadian Foundation for Dietetic Research 2013).

Second, another area of concern from a public health perspective is that most products with sugar claims were lower in free sugar contents, but the reduction was not comparable for calories. Consumer research has shown that consumers expect similar and meaningful calorie reductions in products with sugar claims (Patterson et al. 2012). This finding highlights a misalignment between consumer perceptions and regulatory requirements. Higher levels of other macronutrients used to replace sugar likely contributed to the divergence in calorie and free sugar levels. Protein and fat, for example, were higher among products with sugar claims in most subcategories that were lower in free sugar but not calories, but were not always significantly higher (statistically and/or nutritionally). For low fat claims, consumer research has demonstrated that underestimating calorie contents can actually lead to increasing intake (Wansink and Chandon 2006; Ebneter et al. 2013), whether this also holds true for sugar claims is unknown.

Overall median fat content between products with and without sugar claims was not significantly different. However, many of the subcategories included in this analysis are typically already lower fat or fat-free (e.g., fruits, soft drinks, sweet condiments). These findings are in contrast to research that has shown higher sugar levels among low fat products (Nguyen et al. 2016) and further investigation would be required if sugar claims were to become more prevalent in the future, especially on higher fat foods. To our knowledge, this is the first study to compare the relationship between sugar claims and “nutrients to limit” on a large scale. However, these results align with a similar, small-scale study assessing the incongruence between sugar claims and nutrient contents on cookies, crackers, and breakfast cereals (Wiseman 2013), which found levels of “nutrients to limit” were not significantly higher in products with sugar claims.

On a positive side, these results support earlier research that showed consumers believe products with “no added sugar” claims are healthier (Gorton et al. 2010). In this study, products with sugar claims had more favourable NPSC scores overall, and the difference was significant in most categories. On the other hand, four subcategories — dairy beverages and alternatives, frozen fruit, salad dressings, and water — had healthfulness scores for claim products that were not statistically different from their counterparts without claims and may not direct consumers towards a product that is any healthier. However, median sodium levels were also lower in products with sugar claims.

Finally, a greater proportion of products with sugar claims contained sweeteners (30%) than those without sugar claims (5%). These findings are largely in line with consumer perceptions that sweeteners would be used to replace sugar in products with sugar claims (Patterson et al. 2012). Sweetener use may also explain the lower proportion of products with sugar claims that had excess free sugar levels. The 5 subcategories with the greatest proportion

of sweetener use among products with sugar claims were among the categories with at least 50% fewer products with excess free sugar levels (i.e., canned fruit, pudding and gelatin, pies and tarts, soft drinks, and yogurt). The use of sweeteners may be a worthwhile method of reformulation to achieve caloric and sugar reductions in some subcategories, but the potential for sweeteners to encourage energy and sugar compensation at subsequent meals needs to be considered (Mennella 2014; Mwatsama and Landon 2014; Swithers 2015), along with the unknown long-term health effects of higher intakes and acceptability of increased sweetener use by consumers. In a 2013 study, 54% of Canadian consumers reported that the use of sweeteners influenced their food choices (Canadian Foundation for Dietetic Research 2013).

Some of the variation in nutritional composition between products with and without sugar claims may be because the types of products with sugar claims in a subcategory differed from those without. For example, the products with sugar claims in dairy beverages and alternatives were mainly limited to dairy alternatives such as soy, almond, or rice milk, whereas those without sugar claims included both dairy beverages and alternatives. Similarly, sugar claims in the fruit juice and drinks category were mostly found on fruit juices, as opposed to fruit drinks or combination beverages. In pies and tarts, sugar claims were limited to fruit-filled pies and were not found on butter/sugar or custard pies and tarts. Most items in salad dressings with sugar claims were creamy-type dressings; and finally, 100% of the yogurts with sugar claims were fat-free, and only 1 was plain, the rest were flavoured. This is similar to findings from an earlier study from our group evaluating “low fat” claims on Canadian prepackaged foods, which found the claims were more often on alternatives in the same food category rather than on the same product with less fat (Schermel et al. 2016).

Limitations of this study included the use of nutrient values as declared on the NfT, rather than actual analyzed values. However, the cut-off for nutritional significance was set at 25%, which exceeds the 20% variation permitted from analyzed values for labelling compliance (Canadian Food Inspection Agency 2014a). This cut-off, although subjectively determined, also meets the minimum reduction (25%) in nutrient content required to make a “reduced” claim (Canadian Food Inspection Agency 2014b). There are currently no direct analytical methods available to determine free sugar contents, but calculations were based on an algorithm used to estimate added sugar levels that has been shown to have high inter-researcher repeatability (Louie et al. 2014). Additionally, the categories analyzed are those in which ≥5% of products (totalling at least 5 products) carried sugar claims and therefore the overall results presented are reflective of those categories. Finally, FLIP 2013 does not reflect the entire Canadian prepackaged food supply but is estimated to represent approximately 75% of the Canadian food retail market share (Canadian Grocer 2012).

In summary, this study found that in general, food products bearing sugar claims are “healthier” and are lower in free sugar and calories than similar products without sugar claims. However, when comparing products within a subcategory, those with sugar claims were lower in free sugar but this was not usually accompanied by similar reductions in calorie contents. Perhaps most concerning are the many products with sugar claims (nearly half) that also contained excessive amounts of free sugar. These results identify several shortcomings in the current regulations that govern the use of sugar-related nutrient content claims, such as no requirement for calorie reductions, or reductions based on absolute levels of free sugar. Further, current regulations provide exceptions for when fruit juice is considered an added sugar and when it is considered a fruit ingredient, and to date there are no requirements that a product with a nutrient content claim needs to be any healthier than one without or meet a “healthy” criterion. The recently proposed *Healthy Eating Strategy* for Canadians suggests that “no added sugars” and “unsweetened” claims should

not be used on fruit juices that meet the proposed “high in sugar” threshold of ≥15% of a daily value for total sugar (based on 100 g/day) (Health Canada 2016a). This proposal may address at least some of the concerns identified in this study. Findings from this study can be used to inform needed changes in nutrient content regulations and can be used to support educational messaging to assist consumer interpretation and use of sugar claims on foods. For example, permitting sugar claims only on products with calorie reductions and without excessive free sugar content would support national healthy eating guideline objectives. Sugar claims have the potential to influence food selection, and with more Canadians trying to reduce their sugar intake, it is now even more essential that sugar claims are found on healthier products to both avoid misleading the consumer and to support free sugar intake guidelines. Unfortunately, findings from this study present several areas of concern with regards to the nutritional composition of foods and beverages bearing sugar claims, which are not dealt with under current regulations.

Conflict of interest statement

Before this study, Beatriz Franco-Arellano was a PepsiCo employee (2009 – Aug 2015). The company had no connection with the research. The rest of the authors have no conflicts of interest associated with this manuscript.

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