AJCN. First published ahead of print October 25, 2017 as doi: 10.3945/ajcn.117.161356.

Comparison of global nutrient profiling systems for restricting the commercial marketing of foods and beverages of low nutritional quality to children in Canada

Marie-Ève Labonté, Theresa Poon, Christine Mulligan, Jodi T Bernstein, Beatriz Franco-Arellano, and Mary R L'Abbé

Department of Nutritional Sciences, Faculty of Medicine, University of Toronto, Toronto, Ontario, Canada

ABSTRACT

Background: The Canadian government recently committed to introduce legislation to restrict the commercial marketing of unhealthy foods and beverages to children.

Objective: We compared the degree of strictness and agreement between nutrient profile (NP) models relevant to marketing restrictions by applying them in the Canadian context.

Design: With the use of data from the University of Toronto 2013 Food Label Information Program (n = 15,342 prepackaged foods), 4 NP models were evaluated: the Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion (FSANZ-NPSC), the WHO Regional Office for Europe (EURO) model, the Pan American Health Organization (PAHO) model, and a modified version of the PAHO model (Modified-PAHO), which did not consider the extent of food processing because the application of this characteristic was prone to ambiguity. The number and proportion of foods that would be eligible for marketing to children was calculated with the use of each model, overall and by food category.

Results: The Modified-PAHO and PAHO models would permit only 9.8% (95% CI: 9.4%, 10.3%) and 15.8% (95% CI: 15.3%, 16.4%) of foods, respectively, followed by the EURO model [29.8% (95% CI: 29.0%, 30.5%)]. In contrast, the FSANZ-NPSC would consider almost half of prepackaged foods as eligible for marketing to children [49.0% (95% CI: 48.2%, 49.8%)]. Cross-classification analyses showed that only 8.1% of foods would be eligible based on all models (e.g., most pastas without sauce). Subanalyses showed that each model would be more stringent when evaluating food items that specifically target children on their package (n = 747; from 1.9% of foods eligible under Modified-PAHO to 24.2% under FSANZ-NPSC).

Conclusions: The degree of strictness and agreement vary greatly between NP models applicable to marketing restrictions. The discrepancies between models highlight the importance for policy makers to carefully evaluate the characteristics underlying such models when trying to identify a suitable model to underpin regulations restricting the marketing of unhealthy foods to children. *Am J Clin Nutr* doi: https://doi.org/10.3945/ajcn.117.161356.

Keywords: food processing, healthfulness, marketing restrictions, children, nutrition policy

INTRODUCTION

Recent trends show that the prevalence of obesity in Canadian children and adolescents has reached a plateau of ∼13% over the last decade (1). Although the leveling off is promising, those rates are still 3 times higher than those observed in the early 1980s (2). The prevalence of both overweight and obesity in Canadian children and adolescents, estimated at 27.0%, also remains relatively high at the present time (1).

A strong evidence base now supports the role of unhealthy food and beverage marketing as one of the key drivers of the global childhood obesity epidemic (3). Food promotion has indeed been associated with increased food intakes in children (4–6). Marketing practices are also known to shape children's preferences toward low–nutrient-dense food products high in fat, sugar, and salt (6, 7). Additionally, "less healthy" products, as defined by various nutritional criteria, represent the ones that are most heavily marketed to young individuals in Canada and in several other countries (8–10).

In 2016, the WHO Commission on Ending Childhood Obesity established a set of recommended actions for its Member States to effectively combat childhood obesity (11). One of them is to

Supported by Canadian Institutes of Health Research (CIHR) Postdoctoral Fellowship MFE-140953 (M-ÈL); Burroughs Wellcome Fund, Innovation in Regulatory Science (TP, CM, MRL; 1014187); a CIHR Strategic Training Grant in Population Intervention for Chronic Disease Prevention (JTB; TGF-53893); the CIHR Collaborative Training Program in Public Health Policy (JTB); a Graduate Student Fellowship of the Department of Nutritional Sciences, University of Toronto (BF-A); a CIHR Strategic Operating Grant (MRL; 201103SOK−118150); Canadian Stroke Network (MRL; 201103SOK−01194-000); and an Earle W McHenry Research Chair unrestricted research grant from the University of Toronto (MRL).

Supplemental Figure 1 and Supplemental Table 1 are available from the "Online Supporting Material" link in the online posting of the article and from the same link in the online table of contents at http://ajcn.nutrition.org.

Present address for M-ÈL: Institute of Nutrition and Functional Foods, Laval University, Quebec City, Québec, Canada.

Address correspondence to MRL (e-mail: mary.labbe@utoronto.ca).

Abbreviations used: EURO, WHO Regional Office for Europe; FLIP, Food Label Information Program; FSANZ-NPSC, Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion; FVNL, fruit, vegetable, nut, and legume; Modified-PAHO, modified version of the Pan American Health Organization model; NFt, Nutrition Facts table; NP, nutrient profile; PAHO, Pan American Health Organization.

Received May 25, 2017. Accepted for publication October 2, 2017.
doi: https://doi.org/10.3945/ajcn.117.161356.

implement the WHO 2010 recommendations to reduce the exposure to, and the power of, the marketing of foods and beverages high in SFAs, *trans* fatty acids, free sugars, or salt to children and adolescents (11, 12). Another recommended action is to develop nutrient profile (NP) models, which are based on objective, transparent, and reproducible nutritional criteria, to determine whether a food product is eligible or not eligible to be marketed to children (11). A number of countries, including Chile, Denmark, Ireland, Mexico, New Zealand, Norway, Singapore, South Korea, and the United Kingdom have already taken steps in that direction and use NP models to regulate different forms of marketing to children (13, 14). Other countries, such as Finland and Sweden, instead have implemented a total ban on the marketing of food products to children, therefore not requiring the adoption of an NP model (13, 14).

In October 2016, Health Canada committed to introducing restrictions on the marketing of foods and beverages to children as part of its Healthy Eating Strategy (15). In the event that the complete ban advocated for by various stakeholders in the country is not implemented (16–18), an NP model will need to underpin the proposed restrictions. The main objective of the present study was therefore to compare, in the Canadian context, the degree of strictness and agreement between NP models developed by authoritative organizations for application in restricting marketing to children. A secondary objective was to perform these comparisons on the subset of food products currently carrying on-package marketing to children. Based on previous studies that compared classifications made by NP models meant for a variety of purposes (9, 10, 19–23), we hypothesized that the degree of strictness and agreement would vary substantially between the studied models.

METHODS

Study design

This was a cross-sectional analysis of the Canadian prepackaged food supply with the use of the University of Toronto Food Label Information Program (FLIP) 2013 database, described in detail elsewhere (24). Briefly, FLIP 2013 contains nutritional information on 15,342 unique food products with a Nutrition Facts table (NFt) from the 4 largest grocery chains in Canada (Loblaws, Metro, Sobeys, and Safeway), representing 75.4% of the grocery retail market share (25). Data were collected between May and September 2013 by systematically scanning grocery store shelves with the use of a smartphone application. The information collected includes product information (e.g., company, brand, Universal Product Code), container size, price, NFt information, ingredient list, package marketing (e.g., nutrient content claims, front-of-package labeling, and marketing to children), and photos of all sides of the packages. Only 1 package size/food was captured, but all flavors and varieties were collected. Nutritional information was recorded for products in their "as sold" form and, if necessary (e.g., condensed soup), values for the "as consumed" form were calculated according to package instructions with the use of ESHA Food Processor software (version 10.13.1; ESHA Research) and food composition data from the Canadian Nutrient File, version 2010b (26).

Foods in FLIP 2013 were classified into 22 distinct food categories and 153 subcategories as defined in Schedule M of the Food and Drug Regulations (version in force between 15 March 2012 and 13 December 2016) (27). Specific types of products not classified in any Schedule M category were excluded from the present analyses as follows: meal replacements ($n = 55$), instant or dry yeast ($n = 4$), and a natural health product ($n = 1$). A total of 55 products were further excluded because of errors in nutrient declarations in the NFt, as determined by Atwater calculations that were >20% from the declared caloric values. Thus, 15,227 products were included in the analyses.

Selected NP systems

Table 1 summarizes the key characteristics of each NP model selected for the present study, consisting of 2 international systems recently developed by regional offices of the WHO [Europe (28) and the Americas (29)] and an NP system from the Australia and New Zealand governments (30). These NP models built by authoritative sources were specifically retained for their potential wide applicability, meaning that they have been developed or tested for use in several countries. Further details on each model and their application to the FLIP 2013 database follow.

Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion

Although primarily designed to assess the eligibility of a food product to carry a health claim, the Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion (FSANZ-NPSC) (30) was retained because it represents a modified version of the well-established Ofcom model used for marketing restrictions in the United Kingdom (31). The potential effectiveness of the FSANZ-NPSC as an NP model to restrict marketing to children has also previously been investigated (10, 32). Additionally, the original Ofcom model is currently undergoing revision (33).

Briefly, foods were first classified into 1 of 3 possible categories as follows: *1*) beverages, *2*) any food item not in category 1 or 3, and *3*) cheese with a high calcium content (>320 mg Ca/100 g) and fats (e.g., oil and butter). The third category represents the main difference between the FSANZ-NPSC and the Ofcom model, which includes only 2 categories. That third category takes into account the higher fat and sodium content that can be found in fats and cheese products as compared with other food items that fall into category 2. A summary score was then calculated for each food product based on points for both nutrients to limit (energy, saturated fat, total sugars, and sodium) and nutrients or food components to encourage [protein, fiber, and percent composition of fruits, vegetables, nuts, and legumes (FVNLs) in a product]. Points for each nutrient to limit and each nutrient to encourage were assigned based on nutrient values per 100 g/mL. Because of the absence of quantitative ingredient declarations in Canada, a method was established by our group, based on the presence and position of FVNL ingredients within the ingredient list, to estimate FVNL points for each food product. The method is detailed elsewhere (34). Predefined cutoff scores, which vary depending on the FSANZ-NPSC category, were used to classify food products either as eligible or not

TABLE 1
Summary of the 4 governmental or intergovernmental nutrient profile models evaluated[1]

Model and application(s)	Food categories, *n*	Nutrients											
		n	Energy	Total fat	Saturated fat	*trans* Fat	Total sugars	Free/added sugars	Sweeteners	Sodium/salt	Protein	Fiber	FVNL
FSANZ-NPSC													
Nutrition content and health claims[2]	3[3]	7	✓		✓		✓			✓	✓	✓	✓
PAHO													
Marketing of foods to children	5[4]	7	✓[5]	✓	✓	✓		✓ (free)	✓	✓			
School food environments													
FOP labeling													
Taxation policies													
Agricultural subsidies													
Food provision guidelines for social programs													
Modified-PAHO													
Same as PAHO	1[6]	7	✓[5]	✓	✓	✓		✓ (free)	✓	✓			
EURO													
Marketing of foods to children	17[7]	8[8]	✓	✓	✓	✓	✓	✓ (added)[9]	✓	✓			

[1] EURO, WHO Regional Office for Europe; FOP, front-of-package; FSANZ-NPSC, Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion; FVNL, fruits, vegetables, nuts, and legumes; Modified-PAHO, modified version of Pan American Health Organization model; PAHO, Pan American Health Organization.

[2] The FSANZ-NPSC was retained because it consists of an updated version of the Ofcom model used for marketing restrictions in the United Kingdom.

[3] The 3 food categories are as follows: *1*) beverages, *2*) any food item not in category 1 or 3, and *3*) cheese with a calcium content >320 mg/100 g, edible oil spreads, margarine, and butter.

[4] The 5 food categories are as follows: *1*) processed products, *2*) ultra-processed products, *3*) unprocessed or minimally processed products, *4*) culinary ingredients, and *5*) freshly prepared dishes. The same nutrient criteria are applied only to processed and ultra-processed products. Nutrient criteria are not applied to unprocessed or minimally processed products, culinary ingredients, and freshly prepared dishes; that is, the PAHO model considers that these categories are always eligible to be marketed to children.

[5] Total energy provided by the food is not a criterion; however, the criteria for the other nutrients are presented on a per-total-energy basis (e.g., the threshold to indicate an excess of total fat is ≥30% of total energy).

[6] All foods are evaluated with the use of the nutrient profile criteria, irrespective of the extent of food processing.

[7] There are 17 food categories, but the beverages food category contains 4 subcategories. These categories are as follows: *1*) chocolate and sugar confectionery, energy bars, and sweet toppings and desserts; *2*) cakes, sweet biscuits, pastries, other sweet bakery wares, and dry mixes for making such; *3*) savory snacks; *4*) beverages: *a*) juices, *b*) milk drinks, *c*) energy drinks, and *d*) other beverages; *5*) edible ices; *6*) breakfast cereals; *7*) yogurts, sour milk, cream, and other similar foods; *8*) cheese; *9*) ready-made and convenience foods and composite dishes; *10*) butter and other fats and oils; *11*) bread, bread products, and crisp breads; *12*) fresh or dried pasta, rice, and grains; *13*) fresh and frozen meat, poultry, fish, and similar; *14*) processed meat, poultry, fish, and similar; *15*) fresh and frozen fruit, vegetables, and legumes; *16*) processed fruit, vegetables, and legumes; and *17*) sauces, dips, and dressings.

[8] The number and types of nutrients or food components considered varies depending on the category, except for *trans* fat. Indeed, according to the WHO, "marketing is prohibited if the product contains >1 g per 100 g total fat in the form of industrially-produced *trans* fatty acids," irrespective of the food category. Because the exact contribution of ruminant compared with industrially produced *trans* fat is not known for products from the Food Label Information Program, this criterion was evaluated based on the presence of hydrogenated oils or partially hydrogenated oils in the ingredient list of a product and the amount of total *trans* fat per 100 g total fat; refer to the Methods section for further details.

[9] According to the WHO, added sugars are used as a criterion in the EURO model because available data in food composition tables refer to added sugars. In the current analyses, data on free sugars were used instead.

eligible to be marketed to children. The version of the FSANZ-NPSC in force in Australia and New Zealand before 1 March 2016 was used in the present analyses (30).

Pan American Health Organization NP model

The Pan American Health Organization (PAHO), representing the WHO Regional Office for the Americas, published an NP model in 2016 designed for applications in a wide range of nutrition policies, including, among others, restrictions on the marketing of unhealthy food and beverages to children, the regulation of school food environments, the establishment of front-of-package warning labels, and the establishment of taxation policies (29).

The application of the PAHO NP model first required food items to be classified into 1 of 5 possible categories, based on their extent of processing: *1*) ultra-processed products, *2*) processed products, *3*) unprocessed or minimally processed products, *4*) culinary ingredients, or *5*) freshly prepared products. As FLIP is a database of packaged foods, no product in FLIP 2013 was a freshly prepared product. Processed or ultra-processed products were thereafter classified as containing "excessive" or "not excessive" amounts of critical nutrients (sodium, free sugars, other sweeteners, total fat, saturated fat, and *trans* fat), based on predetermined thresholds in the model. Other sweeteners were specifically evaluated based on their presence (yes or no) in the ingredient list and sodium was evaluated on a

per-kilocalorie basis, whereas all other nutrients were evaluated as a percentage of energy. The free sugar content of products in FLIP 2013 was calculated with the use of the University of Toronto's free sugar algorithm, which is based on the WHO definitions, as described by Bernstein et al. (24). Food products that exceeded ≥1 of the predetermined thresholds for critical nutrients were considered not eligible to be marketed to children, whereas food products that did not exceed any threshold were considered eligible. Unprocessed or minimally processed products and culinary ingredients were not subject to the application of the thresholds and therefore were all considered eligible in the present study. The PAHO model specifies that these types of products usually form part of a healthy diet or, in the case of culinary ingredients (e.g., olive oil), are used in conjunction with unprocessed or minimally processed foods for producing freshly prepared dishes.

Modified-PAHO NP model

It was decided to test a modified version of the PAHO NP model (Modified-PAHO), which took into account 2 modifications. First, an across-the-board approach was used, in which all foods in FLIP 2013 (i.e., not only processed or ultra-processed products, but also the minimally processed and unprocessed foods) were evaluated against the thresholds and classified as excessive or not in critical nutrients. This decision was made to simplify the application of the PAHO NP model by not taking into account the extent of food processing, because the delimitation between processed or ultra-processed products as compared with unprocessed products, minimally processed products, or culinary ingredients was ambiguous for certain food items. An across-the-board approach therefore eliminated any possible subjectivity in the initial categorization of foods.

Second, an adjustment to the PAHO sodium criterion was applied to beverages with a zero- or low-calorie content. Some beverages with a very low sodium content (e.g., 5 mg Na/serving), but also a very low energy content (e.g., 0 calories), were initially classified as being in excess for sodium (i.e., sodium was well above the threshold of ≥1 mg Na/kcal), however, those beverages were clearly not a significant source of that nutrient. Based on the Food and Drug Regulations (35), the "low in sodium" nutrient content claim cutoff of ≤140 mg Na per reference amount and per serving of stated size was used as the threshold in these cases [beverages with both a sodium content ≤140 mg/serving and an energy content ≤140 kcal/serving were considered to have <1 mg Na/kcal (i.e., "not in excess")]. A total of 134 beverages were affected by this change. The "low in sodium" cutoff was chosen considering that most of the non–calorie-reduced versions of the beverages had an energy content close to or <140 kcal/serving, therefore allowing for a 1:1 ratio. Also, beverages with an energy content ≤140 kcal, but a sodium content >140 mg/serving were considered as having a ratio >1 (i.e., in excess).

WHO Regional Office for Europe NP model

The WHO Regional Office for Europe (EURO) model, introduced in 2015, was specifically designed for restricting the marketing of unhealthy foods and beverages to children (28). It was built based primarily on the government-developed and government-endorsed models from Norway and Denmark.

Foods from FLIP 2013 were first classified into 1 of 17 possible categories, among which the beverages category was further divided into 4 subcategories (juices, milk drinks, energy drinks, and other beverages). As specified by the model, foods classified in 7 of the food categories had no nutritional criteria and were automatically considered either not eligible to be marketed to children [categories 1, 2, 4a, 4c, and 5 (e.g., juices)] or always eligible [categories 13 and 15 (e.g., frozen fruits)]. Foods in other categories were evaluated against predetermined thresholds per 100 g/mL for the following nutrients or foods components, which varied depending on the category: total fat, saturated fat, total sugar, added sugar, nonsugar sweetener, salt, and energy (e.g., category 6, breakfast cereals, included limits for total fat, total sugar, and salt). The source document for the model provides additional details on the nutrients considered in each category and on how their thresholds were determined (28). Where applicable, free sugars were taken into account instead of added sugars because their amounts could be calculated for foods in FLIP 2013 (see the PAHO NP model), and they are the type of sugars specifically considered as part of the current WHO guidelines on sugars (36). Additionally, the model specifies that "marketing is prohibited if the product contains >1 g per 100 g total fat in the form of industrially-produced *trans* fatty acids" (28), irrespective of the food category. A total of 55 products from different categories, which were initially classified as eligible to be marketed to children based on the criteria for the above nutrients or food components, were reclassified as not eligible because hydrogenated or partially hydrogenated oils were present in their ingredient list, and their total *trans* fatty acids content was >1 g/100 g of total fat. The total *trans* fatty acid content was used because the exact proportion of industrially produced *trans* fatty acids in a product could not be determined. Thus, the use of total *trans* fatty acids represented a more conservative approach.

Considerations for all selected models

Under each NP model, food products from FLIP 2013 were first classified into their appropriate category independently by 2 authors (M-ÈL and TP), and any discrepancy was resolved by consensus. The classification of FLIP products into each model's categories was completed with the use of a combination of information from Schedule M categories and subcategories (described above), sugar-focused categories detailed in Bernstein et al. (24), and the ingredient list. For consistency, and because the FSANZ-NPSC and EURO models specify that food products should be evaluated with the use of nutritional composition data in the "as consumed" form (if necessary), this type of data was used for all models. Nevertheless, the "as sold" data correspond to the "as consumed" data for ≥92.0% of products (n = 14,115/15,342) in the database.

On-package marketing to children

For the purpose of the subanalyses, the presence of on-package marketing to children was determined with the use of the elements previously established and tested in our group (37), based on information from Colby et al. (38) and Elliot (39) as follows: *1*) children's product lines, *2*) child-focused lettering or graphics, *3*) allusions to fun or play, *4*) unconventional flavors, colors, or shapes, *5*) toys, coupons, prizes, or contests, *6*) games, and *7*)

characters appealing to children. A product had to meet ≥1 of the previous criteria to be considered as marketed to children. The classification of all products in FLIP 2013 as having on-package marketing to children or not was performed by one of the authors (CM) and verified by a team member not involved in the present project. Any uncertainty was resolved by consensus with the other authors.

Statistical analyses

The degree of strictness was determined by the number and proportion (percentage with accompanying 95% CIs) of food products considered eligible to be marketed to children in FLIP 2013 and was reported overall and by Schedule M category for each of the selected NP models. Agreement between the various models was determined by cross-classification analysis (i.e., number and proportion of food products classified similarly or differently between any 2 models). Cohen's κ statistic was also used, and agreement was interpreted as follows: slight, 0.01–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; and almost perfect, 0.81–0.99 (40). The number and proportion of foods classified as eligible by all models or not eligible by any model was also determined. Subanalyses consisted of repeating the above analyses with the use of only the subset of foods with on-package marketing to children. All statistical analyses were carried out in SAS (version 9.4; SAS Institute Inc.).

RESULTS

The degree of strictness, as shown by the proportion of Canadian prepackaged foods classified as eligible to be marketed to children, varied considerably between the different NP models (**Table 2**). The Modified-PAHO and PAHO models were the strictest overall by allowing only 9.8% (95% CI: 9.4%, 10.3%) and 15.8% (95% CI: 15.3%, 16.4%) of foods, respectively, followed by the EURO model [29.8% (95% CI: 29.0%, 30.5%)]. In contrast, almost half of the Canadian prepackaged food products [49.0% (95% CI: 48.2%, 49.8%)] were considered as

TABLE 2
Number and proportion (%) of Canadian prepackaged foods that would be eligible to be marketed to children according to 4 nutrient profile models, overall and by food category (n = 15,227)[1]

		Foods eligible to be marketed to children							
		FSANZ-NPSC		PAHO		Modified-PAHO		EURO	
Schedule M category number and description[2]	Foods analyzed, n	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
All	15,227	7455[3]	49.0 (48.2, 49.8)	2413[3]	15.8 (15.3, 16.4)	1497[3]	9.8 (9.4, 10.3)	4534[3]	29.8 (29.0, 30.5)
1. Bakery products	2084	575[3]	27.6 (25.7, 29.5)	69[3]	3.3 (2.5, 4.1)	69[3]	3.3 (2.5, 4.1)	307	14.7 (13.2, 16.3)
2. Beverages	482	264	54.8 (50.3, 59.2)	46	9.5 (6.9, 12.2)	59[3]	12.2 (9.3, 15.2)	55[3]	11.4 (8.6, 14.3)
3. Cereals, other grain products	988	801[4]	81.1 (78.6, 83.5)	675[3]	68.3 (65.4, 71.2)	662[5]	67.0 (64.1, 69.9)	707	71.6 (68.7, 74.4)
4. Dairy products and substitutes	1240	676[3]	54.5 (51.7, 57.3)	105	8.5 (6.9, 10.0)	24	1.9 (1.2, 2.7)	265	21.4 (19.1, 23.7)
5. Desserts	827	272	32.9 (29.7, 36.1)	1	0.1 (0, 0.4)	1	0.1 (0, 0.4)	0	0 (0, 0)
6. Dessert toppings, fillings	116	13[4]	11.2 (5.4, 17.0)	2	1.7 (0, 4.1)	2	1.7 (0, 4.1)	0	0 (0, 0)
7. Eggs and substitutes	56	53	94.6 (88.6, 100)	46	82.1 (71.8, 92.5)	0	0 (0, 0)	56	100 (100, 100)
8. Fats, oils	535	191	35.7 (31.6, 39.8)	148	27.7 (23.9, 31.5)	2	0.4 (0, 0.9)	153	28.6 (24.8, 32.4)
9. Marine, fresh water animals	440	340	77.3 (73.3, 81.2)	65	14.8 (11.4, 18.1)	17	3.9 (2.1, 5.7)	374	85.0 (81.7, 88.3)
10. Fruit, fruit juices	1089	773[3]	71.0 (68.3, 73.7)	456[3]	41.9 (38.9, 44.8)	208[3]	19.1 (16.8, 21.4)	106	9.7 (8.0, 11.5)
11. Legumes	180	179	99.4 (98.3, 100)	99	55.0 (47.7, 62.3)	93	51.7 (44.3, 59.0)	153	85.0 (79.7, 90.3)
12. Meat, poultry, their products, substitutes	895	249	27.8 (24.9, 30.8)	12	1.3 (0.6, 2.1)	1	0.1 (0, 0.3)	378	42.2 (39.0, 45.5)
13. Miscellaneous	446	100[3]	22.4 (18.5, 26.3)	60	13.5 (10.3, 16.6)	43	9.6 (6.9, 12.4)	35	7.8 (5.3, 10.4)
14. Combination dishes	1357	981[4]	72.3 (69.9, 74.7)	27	2.0 (1.2, 2.7)	27	2.0 (1.2, 2.7)	708	52.2 (49.5, 54.8)
15. Nuts, seeds	220	167	75.9 (70.2, 81.6)	165	75.0 (69.2, 80.8)	1	0.5 (0, 1.4)	118	53.6 (47.0, 60.3)
16. Potatoes, sweet potatoes, yams	140	134	95.7 (92.3, 99.1)	18	12.9 (7.2, 18.5)	18	12.9 (7.2, 18.5)	55	39.3 (31.1, 47.5)
17. Salads	70	57	81.4 (72.1, 90.8)	0	0 (0, 0)	0	0 (0, 0)	30	42.9 (31.0, 54.7)
18. Sauces, dips, gravies, condiments	1229	385[3]	31.3 (28.7, 33.9)	52	4.2 (3.1, 5.4)	49[3]	4.0 (2.9, 5.1)	144	11.7 (9.9, 13.5)
19. Snacks	794	224	28.2 (25.1, 31.3)	32	4.0 (2.7, 5.4)	30	3.8 (2.4, 5.1)	56	7.1 (5.3, 8.8)
20. Soups	456	408	89.5 (86.6, 92.3)	6	1.3 (0.3, 2.4)	6	1.3 (0.3, 2.4)	425	93.2 (90.9, 95.5)
21. Sugars, sweets	749	27[5]	3.6 (2.3, 4.9)	65[5]	8.7 (6.7, 10.7)	0[5]	0 (0, 0)	4	0.5 (0, 1.1)
22. Vegetables	834	586[4]	70.3 (67.2, 73.4)	264[3]	31.7 (28.5, 34.8)	185[3]	22.2 (19.4, 25.0)	405	48.6 (45.2, 52.0)

[1] EURO, WHO Regional Office for Europe; FSANZ-NPSC, Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion; Modified-PAHO, modified version of Pan American Health Organization model; PAHO, Pan American Health Organization.

[2] Schedule M categories are defined in the Canadian Food and Drug Regulations (27). Detailed descriptions for each category and subcategory can also be found in Supplemental Table 1.

[3] Missing data for <0.5% of food items.

[4] Missing data for 0.5% to <1.0% of food items.

[5] Missing data for 1.0% to <1.5% of food items.

eligible to be marketed to children according to the FSANZ-NPSC model. Differences in the overall strictness of the various NP models were also observed quite consistently across different food categories, with the Modified-PAHO model being the strictest model and the FSANZ-NPSC being the most permissive model in the majority of categories (Table 2).

The Modified-PAHO model eliminated large proportions of some core foods that contained high amounts of a negative nutrient. For example, only ≤0.5% of nuts and seeds and eggs and egg substitutes were allowed by the Modified-PAHO model, whereas >53% of foods in those categories were allowed under the other models (Table 2). Products in both food categories were essentially eliminated because of their high content in total fat and saturated fat (**Supplemental Figure 1**).

In contrast, substantial proportions of food products not consistent with dietary guidelines were classified as eligible for marketing to children under the FSANZ-NPSC model, whereas those same products were permitted in very low proportions (≤8%) or not permitted at all under the other models (i.e., carbonated and noncarbonated beverages; most types of frozen desserts; custard, gelatin, and pudding; hors d'oeuvres; sauces for dipping; legume- or dairy-based dips; minor main entree sauces, such as gravy; and snacks, such as chips and pretzels; **Supplemental Table 1**).

Cross-classification analyses showed that about half of the foods identified as not eligible under the FSANZ-NPSC model were also not eligible under the other models, whereas this proportion was >65% for the comparison between the EURO model and each of the PAHO models and at 84% between the original PAHO model and its modified version (**Table 3**). These results are consistent with the observed degrees of agreement between the NP models as assessed by the κ statistic. Indeed, agreement was considered slight to fair between each of the PAHO models and the FSANZ-NPSC model (Modified-PAHO: $\kappa = 0.19$; PAHO: $\kappa = 0.27$), whereas it was substantial ($\kappa = 0.73$) between the PAHO and Modified-PAHO models.

Another way to evaluate agreement between models was by determining the number and proportion of foods that would be classified as eligible by all 4 models or not eligible by any model (**Table 4**). Overall, 8.1% of foods would be eligible based on all models. The top 5 types of such foods, based on Schedule M subcategories, were as follows: pastas without sauce ($n = 414$); vegetables without sauce ($n = 165$); grains, such as rice and barley ($n = 107$); fresh, canned, or frozen fruit ($n = 90$); and beans, peas, and lentils ($n = 89$) (data not shown). Additionally, 47.4% of foods would not be allowed by any model. The proportion of noneligible foods varied considerably between food categories, with none of the food items in eggs and egg substitutes not allowed by any model, and ≥86.5% of products in sugars and sweets and dessert toppings and fillings not allowed by any model. Supplemental Table 1 also shows subcategories in which 100% of products would not be allowed by any model (e.g., brownies; toaster pastries; and candies, including chocolate bars).

Tables 5 and **6** present the results of subanalyses based only on food products that had on-package marketing to children, representing 4.9% ($n = 747/15,227$) of all products analyzed. The Modified-PAHO model was still the strictest by allowing only 1.9% (0.9%, 2.8%) of products that were targeting children, whereas the most permissive model remained the FSANZ-NPSC, with 24.2% (95% CI: 21.2%, 27.3%) of such products targeting children classified as being eligible to be

TABLE 3
Agreement between classifications made by 4 nutrient profile models applied to Canadian prepackaged foods ($n = 15,227$)[1]

	Foods eligible or not eligible to be marketed to children, %					
	PAHO		Modified-PAHO		EURO	
	Eligible ($n = 2413$)	Not eligible ($n = 12,802$)	Eligible ($n = 1497$)	Not eligible ($n = 13,705$)	Eligible ($n = 4534$)	Not eligible ($n = 10,692$)
FSANZ-NPSC[2]						
Eligible ($n = 7455$)	14.5	34.5	9.5	39.5	27.4	21.6
Not eligible ($n = 7728$)	1.3	49.5	0.4	50.4	2.3	48.5
κ (95% CI)[3]	0.27 (0.26, 0.29)		0.19 (0.18, 0.20)		0.52 (0.51, 0.53)	
PAHO[4]						
Eligible			9.7	6.1	11.5	4.4
Not eligible			0.1	83.9	18.3	65.8
κ (95% CI)[3]			0.73 (0.71, 0.74)		0.37 (0.36, 0.39)	
Modified-PAHO[5]						
Eligible					8.4	1.4
Not eligible					21.3	68.7
κ (95% CI)[3]					0.33 (0.31, 0.34)	

[1] EURO, WHO Regional Office for Europe; FSANZ-NPSC, Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion; Modified-PAHO, modified version of Pan American Health Organization model; PAHO, Pan American Health Organization.

[2] There were missing data for 0.3% of the food items for each of the comparisons between the FSANZ-NPSC model and the PAHO, Modified-PAHO, and EURO models.

[3] Missing data were excluded from the calculation of the simple κ statistic. Agreement between the models was assessed as follows: slight, 0.01–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; and almost perfect, 0.81–0.99 (40).

[4] There were missing data for 0.2% of the food items for the comparison between the PAHO model and the Modified-PAHO model and missing data for 0.1% of the food items for the comparison between the PAHO model and the EURO model.

[5] There were missing data for 0.2% of the food items for the comparison between the Modified-PAHO model and the EURO model.

TABLE 4
Canadian prepackaged foods that would be eligible to be marketed to children by all 4 nutrient profile models and not eligible by any model, overall and by food category[1]

Schedule M category number and description[2]	Foods analyzed, *n*	Foods eligible by all models, *n* (%)	Foods not eligible by any model, *n* (%)
All	15,227[3]	1234 (8.1)	7220 (47.4)
1. Bakery products	2084[3]	43 (2.1)	1490 (71.5)
2. Beverages	482[3]	35 (7.3)	217 (45.0)
3. Cereals, other grain products	988[4]	648 (65.6)	169 (17.1)
4. Dairy products and substitutes	1240[3]	21 (1.7)	494 (39.8)
5. Desserts	827	0 (0.0)	555 (67.1)
6. Dessert toppings, fillings	116[3]	0 (0.0)	101 (87.1)
7. Eggs and substitutes	56	0 (0.0)	0 (0.0)
8. Fats, oils	535	2 (0.4)	327 (61.1)
9. Marine, fresh water animals	440	17 (3.9)	58 (13.2)
10. Fruit, fruit juices	1089[3]	93 (8.5)	284 (26.1)
11. Legumes	180	91 (50.6)	1 (0.6)
12. Meat, poultry, their products, substitutes	895	1 (0.1)	504 (56.3)
13. Miscellaneous	446[3]	30 (6.7)	329 (73.8)
14. Combination dishes	1357[5]	17 (1.3)	346 (25.5)
15. Nuts, seeds	220	1 (0.5)	49 (22.3)
16. Potatoes, sweet potatoes, yams	140	8 (5.7)	4 (2.9)
17. Salads	70	0 (0.0)	12 (17.1)
18. Sauces, dips, gravies, condiments	1229[3]	31 (2.5)	817 (66.5)
19. Snacks	794	6 (0.8)	554 (69.8)
20. Soups	456	6 (1.3)	19 (4.2)
21. Sugars, sweets	749[4]	0 (0.0)	648 (86.5)
22. Vegetables	834[5]	184 (22.1)	242 (29.0)

[1] The 4 nutrient profile models evaluated were the Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion, the Pan American Health Organization nutrient profile model, a modified version of the Pan American Health Organization model, and the WHO Regional Office for Europe nutrient profile model.
[2] Schedule M categories are defined in the Canadian Food and Drug Regulations (27).
[3] Missing data for <0.5% of food items.
[4] Missing data for 1.0% to <1.5% of food items.
[5] Missing data for 0.5% to <1.0% of food items.

marketed to them (Table 5). The overall proportion of foods that would be eligible for marketing to children under each NP model in the present subanalyses represented, at most, half of the one observed in the main analyses when all foods from FLIP 2013 were analyzed [e.g., 24.2% (Table 5) compared with 49.0% (Table 2) of foods considered eligible for marketing, respectively, under the FSANZ-NPSC]. Agreement between the various models as assessed by the κ statistic was also lower than that observed in the main analyses (Table 6). Cross-classification analyses showed that >73% of foods with on-package marketing to children not permitted by the FSANZ-NPSC model were also not permitted by the PAHO, Modified-PAHO, and EURO models, whereas this proportion was >90% for all other possible comparisons. In the categories of dessert toppings and fillings, miscellaneous, and nuts and seeds, none of the products targeting children were allowed by any model examined (Table 5).

DISCUSSION

This study showed that the proportion and types of foods and beverages in the Canadian prepackaged food supply that would be permitted to be marketed to children based on governmental or intergovernmental NP models that have been developed for marketing restrictions vary greatly (i.e., from less than one-sixth to almost half of Canadian prepackaged foods) depending on the selected model. Subanalyses also showed that each of the models would be more stringent when evaluating only food items carrying attributes that are appealing to children. This suggests that food items specifically targeting children essentially represent products for which consumption should be limited to an occasional basis, and that the adoption of an NP model for marketing restrictions could largely reduce children's exposure to those foods.

Consistent with our results, studies in other countries have shown that the selection of an NP model has a large impact on the proportion and types of either packaged food products or food- and drink-related media advertisements considered eligible for marketing to children (9, 10, 21–23). Combined with these other studies, our study highlights the importance of carefully examining the underlying characteristics of NP models that could be adapted or developed for use as part of a specific public health policy. Those characteristics include the types and number of nutrients or food components considered, the definition of food categories, the selected reference amounts, and the established thresholds, among others (41, 42).

Similar to observations by Scarborough et al. (21) and Ni Mhurchu et al. (22), the various models evaluated were more consistent in identifying foods that would not be eligible for marketing to children than in identifying eligible foods. This

TABLE 5
Number and proportion (%) of Canadian prepackaged foods specifically targeting children that would be eligible for marketing according to 4 nutrient profile models, overall and by food category (n = 747)[1]

Schedule M category number and description[2]	Foods with on-package marketing to children analyzed, n	Foods eligible to be marketed to children							
		FSANZ-NPSC		PAHO		Modified-PAHO		EURO	
		n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)
All	747	181[3]	24.2 (21.2, 27.3)	26	3.5 (2.2, 4.8)	14	1.9 (0.9, 2.8)	46	6.2 (4.4, 7.9)
1. Bakery products	173	4	2.3 (0.1, 4.6)	1	0.6 (0, 1.7)	1	0.6 (0, 1.7)	3	1.7 (0, 3.7)
2. Beverages	11	2	18.2 (0, 45.4)	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)
3. Cereals and other grain products	51	11	21.6 (9.9, 33.3)	1	2.0 (0, 5.9)	1	2.0 (0, 5.9)	2	3.9 (0, 9.4)
4. Dairy products and substitutes	74	38	51.4 (39.7, 63.0)	0	0 (0, 0)	0	0 (0, 0)	5	6.8 (0.9, 12.6)
5. Desserts	144	39	27.1 (19.7, 34.4)	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)
6. Dessert toppings and fillings	7	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)
9. Marine and fresh-water animals	2	2	100 (100, 100)	0	0 (0, 0)	0	0 (0, 0)	2	100 (100, 100)
10. Fruit and fruit juices	58	33	56.9 (43.8, 70.0)	8	13.8 (4.6, 22.9)	5	8.6 (1.2, 16.1)	4	6.9 (0.2, 13.6)
12. Meat, poultry, their products, and substitutes	4	4	100 (100, 100)	0	0 (0, 0)	0	0 (0, 0)	4	100 (100, 100)
13. Miscellaneous	14	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)
14. Combination dishes	69	39	56.5 (44.5, 68.5)	0	0 (0, 0)	0	0 (0, 0)	24	34.8 (23.3, 46.3)
15. Nuts and seeds	9	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)
16. Potatoes, sweet potatoes, and yams	4	4	100 (100, 100)	0	0 (0, 0)	0	0 (0, 0)	0	0 (0, 0)
19. Snacks	54	3	5.6 (0, 11.9)	7	13.0 (3.7, 22.2)	7	13.0 (3.7, 22.2)	0	0 (0, 0)
20. Soups	1	1	100 (100, 100)	0	0 (0, 0)	0	0 (0, 0)	1	100 (100, 100)
21. Sugars and sweets	72	1[4]	1.4 (0, 4.2)	9	12.5 (4.7, 20.3)	0	0 (0, 0)	1	1.4 (0, 4.2)

[1] EURO, WHO Regional Office for Europe; FSANZ-NPSC, Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion; Modified-PAHO, modified version of Pan American Health Organization model; PAHO, Pan American Health Organization.

[2] None of the foods in Schedule M categories 7 (egg and egg substitutes), 8 (fats and oils), 11 (legumes), 17 (salads), 18 (sauces, dips, gravies, and condiments), and 22 (vegetables) were specifically marketed to children on their package. Schedule M categories are defined in the Canadian Food and Drug Regulations (27).

[3] Missing data for 0.1% of food items.

[4] Missing data for 1% of food items.

could be expected considering that all the models primarily took into account nutrients to limit, such as sodium and sugars. Only one of the models, the FSANZ-NPSC, considered the contribution of nutrients or food components to encourage, and this may, at least in part, explain the higher percentages of foods allowed by the FSANZ-NPSC overall and in the majority of food categories as compared with the other models. A limited number of studies that assessed New Zealand or European packaged foods have similarly shown that the UK Ofcom model or its derivatives (e.g., the FSANZ-NPSC and Health Star Rating system) are 7–15% and 25% more permissive than the EURO and PAHO models, respectively (22, 29).

A permissive model, such as the FSANZ-NPSC model, also classified a substantial number of items that were not consistent with dietary guidelines as eligible for marketing to children, whereas those same products were permitted in very low proportions or not permitted at all under more restrictive models, such as the EURO and PAHO models. From the perspective of protecting vulnerable populations (3), opting for a mandatory and fairly stringent model would be the approach most consistent with the intent of restricting the exposure to, and the power of, the promotion of unhealthy foods to children in various media channels. Questionable or undesirable food items would be less likely to pass the criteria of the system. This is particularly important considering that a complete ban of food and beverage marketing to children would likely represent the most effective policy to implement. For example, a total ban in place since 1980 in the province of Québec, Canada (43) has been linked to lower obesity rates in children aged 6–11 y than in children in other provinces (17). However, such bans are not always feasible, depending on the legislation system in place.

To limit subjectivity in the application of an NP model to a food supply, clear, nonambiguous definitions for food categories need to be established. Although we acknowledge that considering the extent of food processing (NOVA system) is a novel and interesting avenue given that it has been shown to predict diet quality among Canadians (44), the categorization of foods according to this method in the original PAHO model resulted in much higher discrepancies between team members than the categorization of foods in the other NP models. For example, PAHO's definition of minimally processed foods includes "combinations of 2 or more unprocessed or minimally processed foods" (29). Because fruit juices without added sugars fall into this category, a food product, such as sliced pineapples with an ingredient list that indicates "pineapple, pineapple juice," would also, by definition, fall in that same category. In contrast, it appears more accurate to consider this product as processed given the substantial amount of sugars added by the inclusion of pineapple juice. The idea of exempting fruit juice without added sugars from being assessed against the criteria is also concerning because juice itself is a source of free sugars (36) and therefore not considered in line with many dietary guidelines. As

TABLE 6
Agreement between classifications made by 4 nutrient profile models applied to Canadian prepackaged foods with on-package marketing to children (n = 747)[1]

	Foods eligible or not eligible to be marketed to children, %					
	PAHO		Modified-PAHO		EURO	
	Eligible (n = 26)	Not eligible (n = 721)	Eligible (n = 14)	Not eligible (n = 733)	Eligible (n = 46)	Not eligible (n = 701)
FSANZ-NPSC[2]						
Eligible (n = 181)	1.6	22.7	1.2	23.1	5.9	18.4
Not eligible (n = 565)	1.9	73.9	0.7	75.1	0.3	75.5
κ (95% CI)[3]	0.06 (0.00, 0.11)		0.06 (0.01, 0.11)		0.32 (0.25, 0.40)	
PAHO						
Eligible			1.9	1.6	0.8	2.7
Not eligible			0.0	96.5	5.4	91.2
κ (95% CI)[3]			0.69 (0.53, 0.86)		0.13 (0.01, 0.25)	
Modified-PAHO						
Eligible					0.8	1.1
Not eligible					5.4	92.8
κ (95% CI)[3]					0.18 (0.04, 0.31)	

[1] EURO, WHO Regional Office for Europe; FSANZ-NPSC, Food Standards Australia New Zealand-Nutrient Profiling Scoring Criterion; Modified-PAHO, modified version of Pan American Health Organization model; PAHO, Pan American Health Organization.

[2] There were missing data for 0.1% of the food items for each of the comparisons between the FSANZ-NPSC model and the PAHO, Modified-PAHO, and EURO models.

[3] Missing data were excluded from the calculation of the simple κ statistic. Agreement between the models was assessed as follows: slight, 0.01–0.20; fair, 0.21–0.40; moderate, 0.41–0.60; substantial, 0.61–0.80; and almost perfect, 0.81–0.99 (40).

described previously, such an ambiguous situation explains why we also tested a modified, across-the-board version of the PAHO model that did not exempt any product from being evaluated against the nutritional criteria. It was also observed that 86.5% of foods in FLIP 2013 (n = 13,166/15,227; data not shown) were classified as processed or ultra-processed, supporting the idea that the use of a model applicable to the entire packaged food supply might be the best approach in the Canadian context. Still, the use of the Modified-PAHO model was not without concerns. Our results highlight that applying a model to the entire food supply may require clear exemptions to be established for foods in line with dietary guidelines that naturally contain high amounts of a negative nutrient included in the model's algorithm (e.g., nuts, which have a high total fat content even in the absence of added fat). With prespecified exemptions, core foods, such as nuts, without any added ingredients would not be inappropriately ruled out.

A number of limitations and strengths need to be pointed out. First, the present analyses did not weight products by market share and did not specifically consider the foods most commonly consumed by children, nor the foods most heavily marketed to children in various media channels, such as television or the Internet. However, our analyses did provide a comprehensive evaluation of a large sample (>15,000 items) of foods that are available to children and their parents in Canadian grocery stores. Our analyses also provided specific data on foods that currently carry on-package marketing to children, representing a marketing channel that has continued to remain outside current industry- or government-based regulatory frameworks, such as the Canadian Children's Food and Beverage Advertising Initiative (45) or the Consumer Protection Act in Quebec (43). Second, we recognize that several other NP models meant for marketing restrictions exist worldwide (13, 14), but we decided not to consider models from regions (e.g., Asia) that were unlikely to be relevant in a North American context due to differences in food supplies. Additionally, we decided not to consider proposed models that are not currently in use [e.g., the nutrition standards of the Interagency Working Group on Food Marketing to Children, United States (46)]. We also only opted for models developed by authoritative bodies, which are more likely to be used by other government bodies and to be trusted and supported by consumers than industry-based models. This is important given that industry-based models have been shown to be less stringent than government-based models (23).

In conclusion, the present study showed wide variations in the degree of strictness and agreement between NP models having applications in restricting the commercial marketing of foods and beverages of low nutritional quality to children. This highlights the importance of carefully evaluating the characteristics underlying a model that is being developed or adapted for use in a specific public health policy. Where total bans of the commercial marketing of foods and beverages to children are not introduced, a relatively stringent and mandatory NP model that uses clearly defined categories and exemptions, and that is consistent with other nutrition-related policies in the jurisdiction (e.g., front-of-package labeling system), should be considered. Such a model would more closely align with the public health objective of protecting vulnerable populations and would ensure consistency between the country's policies and national dietary guidelines.

We thank Mavra Ahmed and Sheida Norsen, who assisted in preliminary calculations of FVNL points that supported the determination of FSANZ-NPSC scores used in the analyses of the present study. We also thank Laura Vergeer, who assisted in evaluating the presence of on-package marketing to children.

The authors' responsibilities were as follows—M-ÈL, TP, and MRL: designed the research; M-ÈL, JTB, and BF-A: calculated the FSANZ-NPSC scores; CM: assessed the presence of marketing to children on food

packages; M-ÈL and TP: conducted the research; TP: analyzed the data; M-ÈL: assisted in data analysis and wrote the manuscript; MRL: had primary responsibility for the final content; and all authors: critically reviewed and read and approved the final manuscript. TP is a graduate student and is employed part time by Intertek Scientific & Regulatory Consultancy. BF-A was a PepsiCo employee (2009–2015). These companies were not involved in any way in the present research. None of the remaining authors reported a conflict of interest related to the study.

REFERENCES

1. Rodd C, Sharma AK. Recent trends in the prevalence of overweight and obesity among Canadian children. CMAJ 2016;188:E313–20.
2. Janssen I. The public health burden of obesity in Canada. Can J Diabetes 2013;37:90–6.
3. WHO. Consideration of the evidence on childhood obesity for the Commission on Ending Childhood Obesity. Report of the Ad hoc Working Group on Science and Evidence for Ending Childhood Obesity [Internet]. Geneva (Switzerland); WHO Press. 2016 [cited 2017 Jan 30]. Available from: http://apps.who.int/iris/bitstream/10665/206549/1/9789241565332_eng.pdf?ua=1).
4. Boyland EJ, Nolan S, Kelly B, Tudur-Smith C, Jones A, Halford JC, Robinson E. Advertising as a cue to consume: a systematic review and meta-analysis of the effects of acute exposure to unhealthy food and nonalcoholic beverage advertising on intake in children and adults. Am J Clin Nutr 2016;103:519–33.
5. Boyland EJ, Whalen R. Food advertising to children and its effects on diet: review of recent prevalence and impact data. Pediatr Diabetes 2015;16:331–7.
6. Sadeghirad B, Duhaney T, Motaghipisheh S, Campbell NR, Johnston BC. Influence of unhealthy food and beverage marketing on children's dietary intake and preference: a systematic review and meta-analysis of randomized trials. Obes Rev 2016;17:945–59.
7. Cairns G, Angus K, Hastings G, Caraher M. Systematic reviews of the evidence on the nature, extent and effects of food marketing to children. A retrospective summary. Appetite 2013;62:209–15.
8. Potvin Kent M, Dubois L, Wanless A. A nutritional comparison of foods and beverages marketed to children in two advertising policy environments. Obesity (Silver Spring) 2012;20:1829–37.
9. Rincón-Gallardo Patiño S, Tolentino-Mayo L, Flores Monterrubio EA, Harris JL, Vandevijvere S, Rivera JA, Barquera S. Nutritional quality of foods and non-alcoholic beverages advertised on Mexican television according to three nutrient profile models. BMC Public Health 2016;16:733.
10. Watson WL, Johnston A, Hughes C, Chapman K. Determining the 'healthiness' of foods marketed to children on television using the Food Standards Australia New Zealand nutrient profiling criteria. Nutr Diet 2014;71:178–83.
11. WHO. Report of the Commission on Ending Childhood Obesity [Internet]. Geneva (Switzerland); WHO Press. 2016 [cited 2017 Feb 1]. Available from: http://apps.who.int/iris/bitstream/10665/204176/1/9789241510066_eng.pdf.
12. WHO. Set of recommendations on the marketing of foods and non-alcoholic beverages to children. Resolution of the Sixty-third World Health Assembly Adopted 21 May 2010. WHA63.14 Marketing of food and non-alcoholic beverages to children [Internet]. Geneva (Switzerland); WHO Press. 2010 [cited 2017 Jan 30]. Available from: http://apps.who.int/iris/bitstream/10665/44416/1/9789241500210_eng.pdf.
13. Labonté ME, Poon T, Gladanac B, Ahmed M, Franco Arellano B, Rayner M, L'Abbe MR. Systematic review of nutrient profile models developed for nutrition-related policies and regulations aimed at noncommunicable disease prevention [Internet]. PROSPERO #CRD42015024750. 2015 [cited 2017 Jan 24]. Available from: http://www.crd.york.ac.uk/PROSPERO/display_record.asp?ID=CRD42015024750.
14. Labonté ME, Poon T, Gladanac B, Ahmed M, Franco Arellano B, Rayner M, L'Abbe MR. Systematic review of nutrient profile models developed for nutrition-related policies and regulations aimed at noncommunicable disease prevention. Appl Physiol Nutr Metab 2017;42:S23 (abstr).
15. Health Canada. Healthy eating strategy [Internet]. 2016 [cited 2017 Jan 30]. Available from: https://www.canada.ca/content/dam/canada/health-canada/migration/publications/eating-nutrition/healthy-eating-strategy-canada-strategie-saine-alimentation/alt/pub-eng.pdf.
16. Senate of Canada. Child Health Protection Act. An act to amend the Food and Drugs Act (prohibiting food and beverage marketing directed at children). Bill S-228. 1st Sess., 42nd Parliament, 64-65 Elizabeth II, 2015–2016 [Internet]. [cited 2017 Jan 30]. Available from: http://www.parl.gc.ca/content/hoc/Bills/421/Private/S-228/S-228_1/S-228_1.PDF.
17. Heart and Stroke Foundation of Canada. The kids are not alright. How the food and beverage industry is marketing our children and youth to death. 2017 Report on the health of Canadians [Internet]. 2017 [cited 2017 Feb 1]. Available from: http://www.heartandstroke.ca/what-we-do/media-centre/report-on-health.
18. Stop Marketing to Kids Coalition. The Ottawa principles [Internet]. 2016 [cited 2017 Mar 13]. Available from: http://stopmarketingtokids.ca/the-ottawa-principles/.
19. Azaïs-Braesco V, Goffi C, Labouze E. Nutrient profiling: comparison and critical analysis of existing systems. Public Health Nutr 2006;9:613–22.
20. Clerfeuille E, Vieux F, Lluch A, Darmon N, Rolf-Pedersen N. Assessing the construct validity of five nutrient profiling systems using diet modeling with linear programming. Eur J Clin Nutr 2013;67:1003–5.
21. Scarborough P, Payne C, Agu CG, Kaur A, Mizdrak A, Rayner M, Halford JC, Boyland E. How important is the choice of the nutrient profile model used to regulate broadcast advertising of foods to children? A comparison using a targeted data set. Eur J Clin Nutr 2013;67:815–20.
22. Ni Mhurchu C, Mackenzie T, Vandevijvere S. Protecting New Zealand children from exposure to the marketing of unhealthy foods and drinks: a comparison of three nutrient profiling systems to classify foods. N Z Med J 2016;129:41–53.
23. Brinsden H, Lobstein T. Comparison of nutrient profiling schemes for restricting the marketing of food and drink to children. Pediatr Obes 2013;8:325–37.
24. Bernstein JT, Schermel A, Mills CM, L'Abbe MR. Total and free sugar content of Canadian prepackaged foods and beverages. Nutrients 2016;8.
25. Canadian Grocer. Executive report, Canadian grocery industry 2012–2013. Toronto (Canada): Rogers Publishing Limited; 2012.
26. Health Canada. Food and nutrition. Nutrient data. Canadian nutrient file, version 2015 [Internet]. 2015. [updated 2016 Jun 3; cited 2017 Feb 3]. Available from: http://www.hc-sc.gc.ca/fn-an/nutrition/fiche-nutri-data/index-eng.php.
27. Government of Canada. Food and drug regulations (C.R.C., c. 870), sections B.01.001, B.01.002A and D.01.001 [Internet]. Ottawa (Canada): Minister of Justice. 2016 [cited 2016 Mar 16]. Available from: http://laws-lois.justice.gc.ca/eng/regulations/c.r.c._c._870/page-165.html#h-353.
28. WHO Regional Office for Europe. WHO Regional Office for Europe nutrient profile model [Internet]. 2015 [cited 2016 Nov 1]. Available from: http://www.euro.who.int/en/health-topics/disease-prevention/nutrition/publications/2015/who-regional-office-for-europe-nutrient-profile-model-2015.
29. Pan American Health Organization. Pan American Health Organization nutrient profile model [Internet]. 2016 [cited 2016 Oct 24]. Available from: http://www.paho.org/hq/index.php?option=com_content&view=article&id=11662%3Apaho-nutrient-profile-model&catid=1370%3Amicronutrients&Itemid=41739&lang=fr.
30. Australian Government. ComLaw. Legislative instrument compilation. Australia New Zealand Food Standards Code - Standard 1.2.7 - nutrition, health and related claims - F2015C00967 [Internet]. 2015 [cited 2016 Jan 17]. Available from: https://www.comlaw.gov.au/Details/F2015C00967.
31. Department of Health (UK). Nutrient profiling technical guidance [Internet]. 2011 [cited 2016 Nov 15]. Available from: https://www.gov.uk/government/publications/the-nutrient-profiling-model.
32. Hebden L, King L, Kelly B, Chapman K, Innes-Hughes C, Gunatillaka N. Regulating the types of foods and beverages marketed to Australian children: how useful are food industry commitments? Nutr Diet 2010;67:258–66.
33. Government of UK, Public Health England. Review of the nutrient profiling model [Internet]. 2016 [cited 2017 Mar 13]. Available from: https://www.gov.uk/government/collections/review-of-the-nutrient-profiling-model.
34. Bernstein JT, Franco Arellano B, Schermel A, Labonté ME, L'Abbe MR. Healthfulness and nutritional composition of Canadian prepackaged foods with and without sugar claims. Appl Physiol Nutr Metab 2017. In press.

35. Government of Canada, Canadian Food Inspection Agency. Specific nutrient content claim requirements. Sodium (salt) claims [Internet]. 2016 [cited 2017 Mar 13]. Available from: http://www.inspection.gc.ca/food/labelling/food-labelling-for-industry/nutrient-content/specific-claim-requirements/eng/1389907770176/1389907817577?chap=9.
36. WHO. Guideline: sugars intake for adults and children [Internet]. Geneva (Switzerland): WHO. 2015 [cited 2017 Mar 13]. Available from: http://apps.who.int/iris/bitstream/10665/149782/1/9789241549028_eng.pdf?ua=1.
37. Murray C. Examining the nutritional content of prepackaged foods and beverages marketed to children in Canada. Canada: University of Toronto; 2014.
38. Colby SE, Johnson L, Scheett A, Hoverson B. Nutrition marketing on food labels. J Nutr Educ Behav 2010;42:92–8.
39. Elliott C. Marketing fun foods: a profile and analysis of supermarket food messages targeted at children. Can Public Policy 2008;34:259–73.
40. Viera AJ, Garrett JM. Understanding interobserver agreement: the kappa statistic. Fam Med 2005;37:360–3.
41. Sacks G, Rayner M, Stockley L, Scarborough P, Snowdon W, Swinburn B. Applications of nutrient profiling: potential role in diet-related chronic disease prevention and the feasibility of a core nutrient-profiling system. Eur J Clin Nutr 2011;65:298–306.
42. Scarborough P, Rayner M, Stockley L. Developing nutrient profile models: a systematic approach. Public Health Nutr 2007;10:330–6.
43. Gouvernement du Québec. P-40.1 - Consumer Protection Act [Internet]. 2016 [cited 2016 Oct 31]. Available from: http://legisquebec.gouv.qc.ca/en/ShowDoc/cs/P-40.1.
44. Moubarac JC, Batal M, Louzada ML, Martinez Steele E, Monteiro CA. Consumption of ultra-processed foods predicts diet quality in Canada. Appetite 2017;108:512–20.
45. Advertising Standards Canada. Canadian Children's Food & Beverage Advertising Initiative [Internet]. 2016 [cited 2017 May 16]. Available from: http://www.adstandards.com/en/childrensinitiative/default.htm.
46. Federal Trade Commission, CDC, FDA, USDA. Interagency Working Group on Food Marketed to Children tentative proposed nutrition standards [Internet]. 2009 [cited 2016 Dec 2]. Available from: https://cspinet.org/sites/default/files/attachment/ftcnewstandards.pdf.