



Assessing nutritional value of ready-to-eat breakfast cereals in the province of Quebec (Canada): a study from the Food Quality Observatory

Julie Perron¹, Sonia Pomerleau¹, Pierre Gagnon¹, Joséane Gilbert-Moreau^{1,2} , Simone Lemieux^{1,2}, Céline Plante³, Marie-Claude Paquette³, Marie-Ève Labonté^{1,2} and Véronique Provencher^{1,2,*}

¹Centre NUTRISS – Nutrition, santé et société, Institut sur la nutrition et les aliments fonctionnels (INAF), Université Laval, 2440, boulevard Hochelaga, Québec, QC G1V 0A6, Canada: ²École de nutrition, Université Laval, Québec, Canada: ³Institut national de santé publique du Québec, Québec, Canada

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Abstract

Objective: The Food Quality Observatory was created in the province of Quebec (Canada) in 2016. In this study, the Observatory aimed to generate a methodology to (1) test the use of sales data combined with nutrient values to characterise the nutritional composition of ready-to-eat (RTE) breakfast cereals offered and purchased in the province of Quebec (Canada) and (2) verify the extent to which a front-of-pack label based on the percentage of daily value (DV) for total sugar, as a strategy to improve the food supply, would be distributed in this food category.

Design: Nutritional information were obtained by purchasing each RTE breakfast cereal available in the Greater Montreal area. Cereals were then classified according to their processing type.

Setting: The nutritional values of 331 RTE breakfast cereals available in Quebec were merged with sales data covering the period between May 2016 and May 2017. A total of 306 products were successfully cross-referenced.

Results: Granola and sweetened cereals were the most available (36.6% and 19.6%, respectively) and purchased (19.8% and 40.9% of sales, respectively). When compared with other types of cereals, granola cereals had a higher energy, fat, saturated fat, protein content and a lower Na content. A larger proportion of chocolate (65%) and sweetened cereals (49%) were above 15% of the DV for sugar.

Conclusions: This study showed that the methodology developed generates important data to monitor nutritional quality of the food supply and ultimately contribute to improve the nutritional quality of processed foods.

Keywords
Food supply
Nutritional value
Food purchases
Ready-to-eat breakfast cereals

According to the WHO, food environment is one of the key factors to promote a healthy diet⁽¹⁾. Recent studies showed the influence of the food environment on food choices and food consumption which revealed the importance of monitoring food outlets and food quality in stores^(2,3). Moreover, processed foods represent a third of the total volume of food purchased in supermarkets and grocery stores in the province of Quebec (Canada)⁽⁴⁾. Processed foods are often high in fat, sugar and Na, and studies show that chronic overconsumption can lead to an increased risk of non-communicable diseases⁽⁵⁾.

To better understand the food environment to which populations are exposed, many countries are monitoring food's nutritional value and its evolution over time. The International Network for Food and Obesity/non-communicable diseases Research, Monitoring and Action Support (INFORMAS)⁽⁶⁾ and the Food Monitoring Group⁽⁷⁾ already monitor food composition in different countries in order to support governmental regulation and voluntary commitments by industry in creating healthier food environments. In parallel, the Observatory of Food Quality in France (OQALI) evaluates the nutritional

*Corresponding author: Email veronique.provencher@fsaa.ulaval.ca

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composition of different food categories. For instance, they observed an improvement in the nutritional composition of pizzas and ready-to-eat (RTE) meals (i.e. lower fat and saturated fat content) between 2009–2012 and 2015–2016⁽⁸⁾. The observed differences were mainly explained by product reformulation by the industry rather than changes in consumers' choices towards healthier options. OQALI as well as other researchers in Europe and in the USA found that there is a high variability in nutritional quality among processed foods, even among products within a same food category^(6,7,9,10). Although an increase in use of sales data has been observed over the past 5 years⁽¹¹⁾, access remains very difficult for researchers and thus, a limited number of studies has combined such data with the nutritional composition found on food labels in order to estimate what consumers actually buy and eat. This combination is highly relevant since it could contribute to better target products for reformulation. Indeed, it may help to focus policy-makers efforts on the types of products that sell the most, since a small improvement in nutrient content of great sellers can have a large and significant impact on public health⁽¹²⁾. Furthermore, it may allow to monitor and assess the impact of the introduction of new regulations (i.e. nutrition facts table, front-of-pack (FOP) labelling) on food purchases. Except for Na⁽¹³⁾ and sugar⁽¹⁴⁾, no study reporting overall nutritional value of food products in Canada has been yet published, which supports the relevance of monitoring the food environment and the nutritional quality of the food supply in provinces such as Quebec.

In 2016, the Quebec government created the very first government health prevention policy⁽¹⁵⁾, a policy of major importance aiming to improve population health and quality of life. Several actions have been established within a framework to improve the nutritional quality of the food supply and further encourage food companies to improve the nutritional quality of their products. Meanwhile, the implementation of an Observatory aiming to monitor the nutritional quality of the food supply was deemed a priority for a network of researchers and knowledge users (representatives from governmental, non-governmental, par-public and private organisations). Hosted by the Institute of Nutrition and Functional Foods at *Université Laval*, the Food Quality Observatory (henceforth Observatory) was thus officially launched in 2016 and is currently supported by the Quebec's Ministry of Health and Social Services as well as the Quebec's Ministry of Agriculture, Fisheries and Food. By generating reliable and useful information on the nutritional quality of food products available, the Observatory aims to contribute to the creation of healthier food environments, which will in turn facilitate healthier food choices and likely improve the overall health of the population.

The food category of RTE breakfast cereals has been selected to test the methodology and the feasibility of the studies to be undertaken by the Observatory. Indeed,

breakfast is an important meal of the day^(16–20), and RTE breakfast cereals are part of the daily diet of a large proportion of the population^(21,22). Several studies which have analysed the impact of RTE breakfast cereals on dietary intakes and human health show variations in their nutritional value. Despite many positive impacts on diet quality (since they may provide whole grains, nuts, fruits, fibre, etc.) and cardiometabolic health^(19,20,23–27), some RTE breakfast cereals are highly processed and high in some nutrients of public health concern (e.g. added sugar, Na and preservatives)^(28,29).

It is also known that information on processed food products such as nutrition facts table, claims and other nutritional information can be difficult to understand for consumers⁽³⁰⁾. Strategies have been implemented to facilitate consumers' food choices and to improve the nutritional quality of the food supply. Among these strategies, UK adopted in 2006 a voluntary FOP traffic light system coded for fat, saturated fat, sugar and Na⁽³¹⁾. In 2013, the UK government published guidelines for uniform FOP colour-coded labelling⁽³²⁾. Since then, most of the UK supermarkets and many food manufacturers provide that label⁽³³⁾. Australia and New Zealand adopted in 2014 a voluntary Health Star Rating FOP system⁽³⁴⁾. Two years after the adoption of the FOP system, energy density and Na content were found to be lower whereas fibre content was higher in labelled products compared with their composition prior to the adoption of the FOP system⁽³⁵⁾. In 2016, Chile adopted a FOP warning symbol for food products exceeding specified amounts of energy, saturated fat, sugar and Na⁽³⁶⁾. After implementation, Chile observed that food companies reformulated products to adapt to the new regulation⁽³⁷⁾. All food categories combined, total sugar content showed the highest reduction after the FOP implementation, suggesting that sugar content of RTE breakfast cereals would thus be of major interest. The number of products with FOP 'high in sugar' before (with a simulation) and after implementation in Chile was significantly reduced in cereal products (e.g. cookies, crackers, cakes, breads) which included breakfast cereals. Indeed, median of total sugar almost had dropped by 50 % between 2013 and 2019, with 51 % of cereal products having a warning symbol in 2013 in comparison to 47 % in 2019. In 2017, a voluntary FOP label using letters from A to E was adopted to characterise the nutritional quality of food products in France (Nutri-Score)⁽³⁸⁾. Since then, Belgium, Switzerland and Spain also adopted the Nutri-Score. In Canada, a standardised FOP warning symbol on food exceeding 15 % of the daily value (DV) for saturated fats, total sugar and Na is currently under consideration by the government⁽³⁹⁾. While it remains difficult at this point to confirm if nutrient-specific warning labels are more successful than summary labels⁽⁴⁰⁾, such a warning symbol could potentially act as a nudge for the food industry to reformulate their products while easily and rapidly informing consumers about less healthy food options.



Moreover, this warning symbol would target specifically nutrients of interest which are known to be consumed in excess by consumers. In the case of RTE breakfast cereals, a FOP warning symbol – particularly for total sugar which is a nutrient of interest in this food category – could potentially affect a large number of products, including great sellers⁽⁴¹⁾.

Therefore, the aims of the present study were to generate a methodology to (1) test the use of sales data combined with nutrient values to characterise the nutritional composition of RTE breakfast cereals offered and purchased in the province of Quebec (Canada) and (2) verify the extent to which a FOP label based on the percentage of DV for total sugar, as a strategy to improve the food supply, would be distributed in this food category.

Methods

Data collection

In order to reach the objectives described above, a database containing the nutritional value of each RTE breakfast cereal was created by *Protégez-Vous* – a Quebec-based non-profit organisation specialising in consumer information and product testing – and was used by the Observatory following a data-sharing agreement. Nutritional and labelling information were obtained by *Protégez-Vous* by purchasing every RTE breakfast cereal in supermarkets, grocery stores and specialty grocery stores from the Greater Montreal area (Quebec, Canada) in September 2016. Cereals that were considered in this study were only cold breakfast cereals available in individual packaging (no multiple packages with several varieties of cereals) and those with nutritional information available on packaging. All information present on the product packaging (e.g. brand, nutrition facts table, list of ingredients, nutrition and health claims, serving size, etc.) were coded in the database using double coders. The reference portion of 55 g was chosen because it represented the reference amount for cereals (i.e. amount typically consumed in one occasion) at the time of the study. Nutritional value variables listed for the purposes of this study were as follows: energy (kJ), total fat (g), saturated fat (g), total sugar (g), fibre (g), protein (g) and Na (mg). The price per reference portion (55 g) and per unit (e.g. one box) were also documented by calculating the average of the prices observed in the various stores visited.

This nutritional value database was merged with a sales database (provided by Nielsen company⁽⁴²⁾) of RTE breakfast cereals sold in the province of Quebec for 52 weeks between May 2016 and May 2017 using unique product codes (UPC). For each product, the database included the following data: sales in Canadian dollars (CAD\$), sales in kilograms (kg) and sales in unit. Sales information comes from the optical reading of the products purchased in the main food chains of Quebec markets.

Classifications

RTE breakfast cereals were grouped by two different coders into different classifications to facilitate comparisons (e.g. muesli, sweetened, granola, etc.). The classifications were adapted from OQALI in France⁽⁴¹⁾. Each classification includes products with common characteristics in terms of their type of ingredients and/or technology used during processing. Definitions of these classifications are presented in supplemental materials.

Statistical analyses

To provide a general description of the nutritional value and the price per serving of RTE breakfast cereals found on the shelves available in Quebec (food supply), means and standard deviations illustrating the distribution of each of these variables were first calculated (n 331). The descriptive analyses were then repeated by weighting by sales volume in kg (food purchases; n 306). Weighting the averages for sales better represents what Quebecers buy – and eventually consume – by giving a higher weight to the most popular cereals and a lower weight to the cereals which are less purchased. Since the analyses weighted for sales were produced from the combined database, the number of products analysed was lower than the one for the unweighted analysed (in which only the nutritional value data are available). Kruskal–Wallis tests and ANOVA were used to compare means and weighted for sales means nutrient content and prices between different cereal types. For all statistical tests, the significance threshold was corrected using the Bonferroni correction method to compensate for multiple comparisons. Statistical tests were conducted using SAS software version 9.4.

Results

A total of 331 different RTE breakfast cereals were identified in the Quebec food supply. Nutritional value and all packaging information were referenced for these cereals. Using the UPC, this dataset was merged with the sales database which contains more than 700 RTE breakfast cereals sold over 1 year. A total of 306 products with sales information were successfully cross-referenced with the 331 cereals identified in the food supply representing 92% of RTE breakfast cereals identified in the Quebec food supply. The sales volume of products for which nutritional and purchasing information were both available amounted to CAD\$ 230 million which represents 90% of all sales of RTE breakfast cereals in Quebec. Products present in the sales database but missing in the nutritional database were mostly multiple packages with several varieties, discontinued products or different sizes of the products already included in the study.

Table 1 shows the variety of RTE breakfast cereals according to their type and purchase percentage. The most

**Table 1** Availability and purchases of ready-to-eat (RTE) breakfast cereals according to their type

RTE breakfast cereals	<i>n</i>	%	Purchases (%)
Total	331	100.0	100.0
Type			
Granola	121	36.6	19.8
Sweetened	65	19.6	40.9
Plain	51	15.4	14.2
Muesli	34	10.3	5.8
Chocolate	17	5.1	3.5
Bitesize	17	5.1	6.5
Light	15	4.5	5.1
Fibre	11	3.3	4.2

represented types of cereals were granola (36.6%), sweetened (19.6%), plain (15.4%) and muesli cereals (10.3%), whereas the most purchased were the sweetened (40.9%) and the granola type (19.8%).

Table 2 shows the nutritional value and price per portion of all types of RTE breakfast cereals for both offered (as found on the shelves; *n* 331) and purchased RTE breakfast cereals (weighted by sales volume; *n* 306). A large variability was observed in saturated fat, total sugar and Na content of the different types of cereals. The variability was even higher in purchased than offered RTE breakfast cereals, emphasising once again on the importance of monitoring both food offered and purchased at the same time. Mean saturated fat content weighted for sales varied between 0.1 g (plain) and 2.7 g (granola) per 55 g of RTE breakfast cereals, while mean total sugar content varied between 6 g (plain) and 18 g (chocolate) and mean Na between 117 mg (granola) and 328 mg (plain). More particularly, when compared with others, granola cereals purchased had a higher energy, fat, saturated fat, protein content, a lower Na content and a similar total sugar content. Results remained similar when the unweighted nutritional composition of cereals was considered. Selling price of granola cereals was higher than other RTE breakfast cereals. When compared with others, sweetened cereals purchased had a higher total sugar content, and lower energy, fat and protein content. In addition to the previous results, when the unweighted nutritional composition was considered, Na content was higher and saturated fat and fibre contents were lower. Selling price of sweetened cereal was similar to others.

Figure 1 shows the large variation of total sugar content between the different types of cereal as well as between products within the same category. One RTE breakfast cereal out of five exceeded 15% of the DV for total sugar (i.e. 15 g) and would get a FOP warning symbol according to Health Canada policy under review. More specifically, chocolate (65%) and sweetened cereals (49%) were those exceeding 15% DV most often. Moreover, this figure illustrates the sales for each product and shows that many important sellers were sweetened cereals and most of them exceeded 15% of the DV for total sugar. Actually, 65% of sweetened cereals' sales are above the 15% of DV for total sugar.

Discussion

The overview of RTE breakfast cereals offered and purchased in the province of Quebec generated in this study confirmed that the methodology of combining nutritional and sales data in Quebec and relating this data to the percentages of DV is feasible and relevant. First, 331 different RTE breakfast cereals have been identified and sales data were available for 306 of them which allowed coverage of a large part of the total cereals market (90%) in the analyses. This overview also represents a wide variety of RTE breakfast cereals, similar to what has been observed in other countries^(10,43–45). Moreover, the present study showed that granola and sweetened cereals are the most frequently found in the market with, respectively, 36.6% and 19.6% of the RTE breakfast cereals offered, as well as 19.8% and 40.9% of the RTE breakfast cereals purchased. These findings differ from what is observed elsewhere since, in comparison, chocolate cereals and light cereals were the most frequent RTE breakfast cereals in France⁽⁴¹⁾, while those two types of cereal each represented only 5% of the supply in Quebec. We also found that the nutritional value differs greatly between types of RTE breakfast cereals offered in the province of Quebec, as it has also been observed in other countries^(41,46). Total sugar content of Quebec RTE breakfast cereals greatly varies between types of cereals and even within same type. For example, the large range observed for total sugar content among sweetened cereals (i.e. from 1.8 g to 30.6 g/55 g serving) clearly demonstrates interesting opportunities for improvement. While large variations had also been observed elsewhere in the world, the mean total sugar content is higher in Quebec than in Australia⁽⁴⁷⁾, UK⁽⁴⁸⁾ and Belgium⁽⁴⁵⁾, which again underline the need for reformulation in this food category.

Additionally, a great proportion of chocolate (65%) and sweetened (49%) cereals are above 15% of DV for total sugar (i.e. 15 g/55 g serving). This means that most of these cereals would carry, on the front of the package, the FOP warning symbol currently under consideration by Health Canada. Since chocolate cereals represent only 3.5% of total RTE breakfast cereals purchases, reformulating total sugar content of these products – even if desirable – would have little impact in terms of public health. However, 65% of sweetened cereals' sales (sweetened cereals represent 40.9% of total RTE breakfast cereals purchases) are above the 15% of DV for total sugar. Thus, small reduction of total sugar content in these products may have a major public health impact. These cereals should therefore be closely monitored in the future to ensure that improvement efforts through reformulation are made by the industry. Reformulated products without nutritional warnings were perceived as more healthful and had higher purchase intention scores than their regular counterparts with warning, while nutrient claims did not have a relevant effect on

Table 2 Nutritional value and price (per 55 g serving) of ready-to-eat (RTE) breakfast cereals according to their type.†

RTE breakfast cereals Type	Energy (kJ)		Fat (g)		Saturated fat (g)		Total sugar (g)		Fibre (g)		Protein (g)		Na (mg)		Price (CA\$)																	
	Mean	SD	Supply	Purchases	Supply	Purchases	Supply	Purchases	Supply	Purchases	Supply	Purchases	Supply	Purchases	Supply	Purchases																
Total (n 331)	912	96	879	84	3.9	3.6	2.6	2.6	0.9	1.3	0.8	1.6	1.1	6	13	6	4.7	3.1	4.4	3.8	5	2	5	2	148	117	216	125	0.75	0.35	0.60	0.15
Granola (n 121)	979*	100	971*	84	6.8*	3.7	5.9*	3.3	1.6*	1.7	2.7*	2.9	1.1	3	12	1	4.7	1.3	4.5	1.1	6*	2	6*	2	90*	72	117*	82	0.84*	0.34	0.60	0.16
Sweetened (n 65)	879	59	862*	42	1.9*	1.6	1.9*	1.2	0.3*	0.5	0.4	0.4	1.6*	6	17*	5	3.3*	1.8	3.7	1.9	4*	1	4*	1	201*	122	218	125	0.66	0.37	0.61	0.13
Plain (n 51)	900	71	887	29	1.8*	3.0	0.7*	1.4	0.2*	0.3	0.1*	0.2	5*	4	6*	2	3.7	2.7	1.6*	2.7	5	2	4	1	199	130	328*	78	0.75	0.45	0.53	0.14
Muesli (n 34)	866*	50	833*	67	3.4	1.9	2.5	1.6	0.9	0.8	0.4	0.5	12	4	14	3	4.6	1.3	5.1	1.2	5	1	5	1	101	87	168	75	0.66	0.23	0.58	0.12
Chocolate (n 17)	883	84	916	42	3.2	2.2	4.0	1.5	0.9	1.6	0.5	1.7*	4	18*	2	2.9	1.6	3.8	1.4	4*	1	4	0	192	114	281	70	0.87	0.36	0.74*	0.13	
Bitesize (n 17)	854	54	874	42	1.5*	0.8	1.8	0.8	0.2	0.2	0.3	0.2	6*	4	7*	4	6.0*	2.3	6	1.7	5	1	6*	1	177	158	182	129	0.58	0.21	0.48*	0.10
Light (n 15)	874	42	862	38	3.1	1.8	2.1	1.6	0.5	0.5	0.3	0.5	11	3	11	3	6.4	3.3	4.4	3.3	8	3	7*	3	196	102	265	114	0.79	0.11	0.78*	0.10
Fibre (n 11)	757*	113	674*	105	2.2	1.4	1.8	0.5	0.7	1.2	0.2	0.3	10	4	11	4	15.0*	8.1	17.5*	6.4	5	1	6*	1	212	118	281	93	0.66	0.17	0.60	0.10

*Significantly different from other cereals ($P < 0.00078$). This threshold equals to the Bonferroni correction for supply and purchases separately.

†Supply represents the average nutritional value of the cereals found on the shelves (n 331).

‡Purchases represents the average nutritional value of cereals weighted by sales volume (n 306).

consumers' perception⁽⁴⁹⁾. Such a FOP symbol could thus be a win-win for consumers and companies.

Monitoring the evolution of the nutritional composition of RTE breakfast cereals is of major importance. No improvement has been seen between 2006 and 2010 in nutritional composition of RTE breakfast cereals in Australia⁽⁴⁷⁾ nor in New Zealand between 2013 and 2017, suggesting that industry self-regulation of the nutritional composition of this food category needs reconsideration⁽⁴⁶⁾. However, in the UK, a significant Na reduction was observed in breakfast cereals between 2004 and 2015 confirming the success of the UK voluntary Na reduction programme⁽⁵⁰⁾. Similarly, OQALI had observed a significant Na reduction in chocolate and sweetened RTE breakfast cereals (30 mg and 60 mg/100 g, respectively) between 2008 and 2011⁽⁵¹⁾. However, those changes were not significant after weighting for sales, suggesting that the biggest sellers did not change the nutritional composition of their products.

Since few studies have combined nutritional data with sales data to monitor the actual food supply, the present study is the first in Canada to assess the nutritional value of RTE breakfast cereals that are both offered and purchased. However, the present study has some limitations. The nutritional database is an overview at a given time that may not represent the whole portrait of the food supply during the whole year. Different products may not have been identified, such as the products that entered the market after data collection or those sold at another moment during the year but that were discontinued before the data collection. Additionally, not all RTE breakfast cereals were successfully matched to sales data (n 25). In fact, the sales database available through the Nielsen company does not include some RTE breakfast cereals, such as certain private labels of specific grocery stores. Moreover, even if food sales data can give an overview of food intakes^(52,53), it is not possible to ensure that RTE breakfast cereals purchased are actually eaten by the consumers who bought them.

In terms of perspectives, the Observatory will use the methodology described in this paper to address other food categories that can have a significant impact on population health with the aim of monitoring the evolution of the nutritional value of the food supply in years to come. Currently, sliced breads, luncheon meats, RTE soups, granola bars, frozen meals, pasta sauces, yogurts and dairy desserts, sausages, cookies and crackers have also been analysed which sums up to more than 4000 food items (www.offrealimentaire.ca). These databases will give the possibility to characterise Quebec and Canadian food categories from different angles: target consumers, presence of claims, artificial sweeteners or food additives, etc.

In conclusion, the methodology used in this study provides an overview of the RTE breakfast cereals offered and purchased in the province of Quebec. This also leads to the identification of general findings regarding the nutritional value as well as to the information available on food

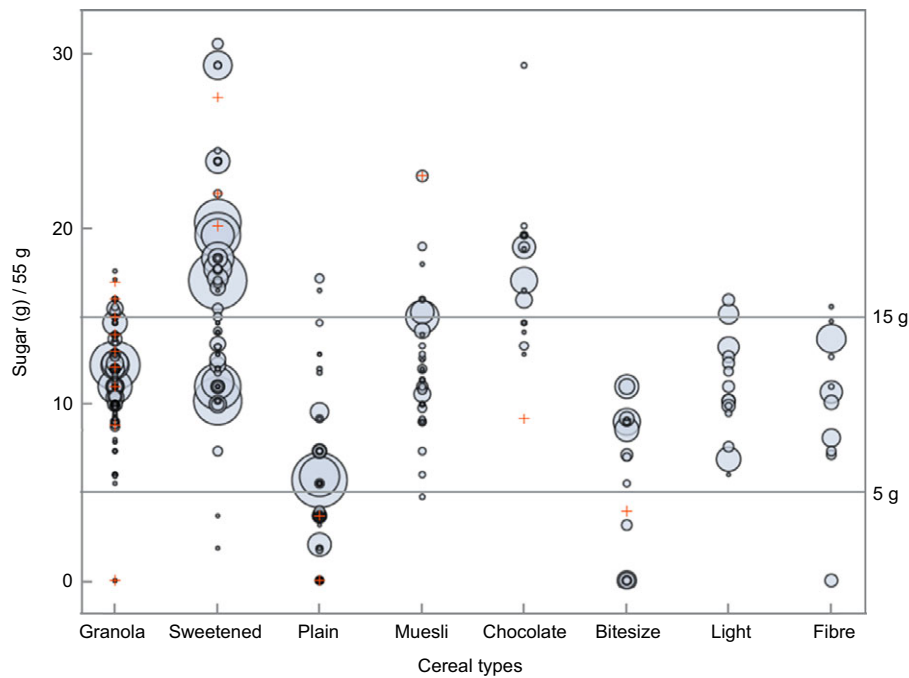


Fig. 1 (colour online) Distribution of sugar content of different types of ready-to-eat (RTE) breakfast cereals and their sales volume. The bigger the circles, the higher the sales (kg). Signs + represent RTE breakfast cereals for which sales data were not available

packaging. Consequently, with these results, it becomes possible to identify areas of improvement regarding the nutritional composition of processed foods, which is of great relevance for policy-makers and public health nutrition advocates for healthier food choices. These findings form the basis for monitoring nutritional value of RTE breakfast cereals in the future. The same methodology will also be used for other food categories and will then allow the monitoring of a significant portion of the food supply in Canada.

The full report is freely available (in French only) on www.offrealimentaire.ca.

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Supplementary material

For supplementary material accompanying this paper, visit <https://doi.org/10.1017/S1368980021001361>

References

1. World Health Organization (2020) Healthy Diet – How to promote healthy diet. <https://www.who.int/news-room/fact-sheets/detail/healthy-diet> (accessed October 2020).
2. Ni Mhurchu C, Vandevijvere S, Waterlander W *et al.* (2013) Monitoring the availability of healthy and unhealthy foods and non-alcoholic beverages in community and consumer retail food environments globally. *Obes Rev* **14**, 108–119.
3. Minaker LM, Shuh A, Olstad DL *et al.* (2016) Retail food environments research in Canada: a scoping review. *Can J Public Health* **107**, eS4–eS13.
4. Plamondon L, Durette G & Paquette MC (2019) The purchase of ultra-processed foods in supermarkets and big box stores in Quebec. Institut National de Santé Publique du Québec. https://www.inspq.qc.ca/sites/default/files/publications/2487_achat_aliments_ultra_transformes.pdf (accessed June 2020).
5. Srour B, Fezeu LK, Kesse-Guyot E *et al.* (2019) Ultra-processed food intake and risk of cardiovascular disease: prospective cohort study (NutriNet-Santé). *BMJ* **365**, 11451.
6. Neal B, Sacks G, Swinburn B *et al.* (2013) Monitoring the levels of important nutrients in the food supply. *Obes Rev* **14**, 49–58.
7. Dunford E, Webster J, Metzler AB *et al.* (2012) International collaborative project to compare and monitor the nutritional



- composition of processed foods. *Eur J Prev Cardiol* **19**, 1326–1332.
8. Observatoire de la qualité de l'alimentation (OQALI) (2019) Contributions of supply and demand to the evolution of the nutritional quality of food. https://www.oqali.fr/content/download/3691/34766/version/1/file/Oqali_2019_Contributions_de_l_offre_et_de_la_demande_a_l_evolution_de_la_qualite_de_l_alimentation.pdf (accessed June 2020).
 9. Baldrige AS, Huffman MD, Taylor F *et al.* (2019) The healthfulness of the us packaged food and beverage supply: a cross-sectional study. *Nutrients* **11**, 1704.
 10. Observatoire de la qualité de l'alimentation (OQALI) (2008) Study of the breakfast cereals sector. https://www.oqali.fr/content/download/3082/31680/version/1/file/Oqali_2009_rapport_c%e9%9ales.pdf (accessed March 2020).
 11. Bandy L, Adhikari V, Jebb S *et al.* (2019) The use of commercial food purchase data for public health nutrition research: a systematic review. *PLoS One* **14**, e0210192.
 12. Korošec Ž & Pravst I (2014) Assessing the average sodium content of prepacked foods with nutrition declarations: the importance of sales data. *Nutrients* **6**, 3501–3515.
 13. Arcand J, Jefferson K, Schermel A *et al.* (2016) Examination of food industry progress in reducing the sodium content of packaged foods in Canada: 2010 to 2013. *Appl Physiol Nutr Metabol* **41**, 684–690.
 14. Bernstein JT, Christoforou AK, Weippert M *et al.* (2020) Reformulation of sugar contents in Canadian prepackaged foods and beverages between 2013 and 2017 and resultant changes in nutritional composition of products with sugar reductions. *Public Health Nutr* **23**, 2870–2878.
 15. Gouvernement du Québec (2016) Government health prevention policy. <https://publications.msss.gouv.qc.ca/msss/fichiers/2016/16-297-08W.pdf> (accessed June 2020).
 16. Barr SI, Vatanparast H & Smith J (2018) Breakfast in Canada: prevalence of consumption, contribution to nutrient and food group intakes, and variability across tertiles of daily diet quality. A study from the International Breakfast Research Initiative. *Nutrients* **10**, 985.
 17. Barr SI, DiFrancesco L & Fulgoni VL (2014) Breakfast consumption is positively associated with nutrient adequacy in Canadian children and adolescents. *Br J Nutr* **112**, 1373–1383.
 18. Hopkins LC, Sattler M, Steeves EA *et al.* (2017) Breakfast consumption frequency and its relationships to overall diet quality, using healthy eating index 2010, and body mass index among adolescents in a low-income urban setting. *Ecol Food Nutr* **56**, 297–311.
 19. Williams P (2007) Breakfast and the diets of Australian children and adolescents: an analysis of data from the 1995 National Nutrition Survey. *Int J Food Sci Nutr* **58**, 201–216.
 20. Gibson S & Gunn P (2011) What's for breakfast? Nutritional implications of breakfast habits: insights from the NDNS dietary records. *Nutr Bull* **36**, 78–86.
 21. Leech RM, Boushey CJ & McNaughton SA (2021) What do Australian adults eat for breakfast? A latent variable mixture modelling approach for understanding combinations of foods at eating occasions. *Int J Behav Nutr Phys Act* **18**, 1–16.
 22. Albertson AM, Anderson GH, Crockett SJ *et al.* (2003) Ready-to-eat cereal consumption: its relationship with BMI and nutrient intake of children aged 4 to 12 years. *J Am Diet Assoc* **103**, 1613–1619.
 23. Albertson AM, Thompson D, Franko DL *et al.* (2008) Consumption of breakfast cereal is associated with positive health outcomes: evidence from the National heart, lung, and blood institute growth and health study. *Nutr Res* **28**, 744–752.
 24. Deshmukh-Taskar P, Nicklas TA, Radcliffe JD *et al.* (2013) The relationship of breakfast skipping and type of breakfast consumed with overweight/obesity, abdominal obesity, other cardiometabolic risk factors and the metabolic syndrome in young adults. The National Health and Nutrition Examination Survey (NHANES): 1999–2006. *Public Health Nutr* **16**, 2073–2082.
 25. van den Boom A, Serra-Majem L, Ribas L *et al.* (2006) The contribution of ready-to-eat cereals to daily nutrient intake and breakfast quality in a Mediterranean setting. *J Am Coll Nutr* **25**, 135–143.
 26. Albertson AM, Wold AC & Joshi N (2012) Ready-to-eat cereal consumption patterns: the relationship to nutrient intake, whole grain intake, and body mass index in an older American population. *J Aging Res* **2012**, 631310.
 27. Holmes B, Kaffa N, Campbell K *et al.* (2012) The contribution of breakfast cereals to the nutritional intake of the materially deprived UK population. *Eur J Clin Nutr* **66**, 10–17.
 28. Maschkowski G, Hartmann M & Hoffmann J (2014) Health-related on-pack communication and nutritional value of ready-to-eat breakfast cereals evaluated against five nutrient profiling schemes. *BMC Public Health* **14**, 1178.
 29. Cordain L, Eaton SB, Sebastian A *et al.* (2005) Origins and evolution of the Western diet: health implications for the 21st century. *Am J Clin Nutr* **81**, 341–354.
 30. Campos S, Doxey J & Hammond D (2011) Nutrition labels on pre-packaged foods: a systematic review. *Public Health Nutr* **14**, 1496–1506.
 31. Sacks G, Rayner M & Swinburn B (2009) Impact of front-of-pack 'traffic-light' nutrition labelling on consumer food purchases in the UK. *Health Promot Int* **24**, 344–352.
 32. Food Standards Agency (2013) Guide to creating a front of pack (FoP) nutrition label for pre-packed products sold through retail outlets. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/566251/FoP_Nutrition_labelling_UK_guidance.pdf (accessed March 2021).
 33. British Nutrition Foundation (2018) Helping you eat well – Looking at label. <https://www.nutrition.org.uk/healthyliving/helpingyoueatwell/labels.html?limit=1&start=3> (accessed October 2020).
 34. Commonwealth of Australia (2014) Health Star Rating System. <http://www.healthstarrating.gov.au/internet/healthstarrating/publishing.nsf/content/home> (accessed March 2021).
 35. Mhurchu CN, Eyles H & Choi Y-H (2017) Effects of a voluntary front-of-pack nutrition labelling system on packaged food reformulation: the health star rating system in New Zealand. *Nutrients* **9**, 918.
 36. DOF (2015) Sanitary regulation of food. Official Gazette of the Republic N°4193. http://web.minsal.cl/sites/default/files/decreto_etiquetado_alimentos_2015.pdf (accessed October 2020).
 37. Quintiliano Scarpelli D, Pinheiro Fernandes AC, Rodriguez Osic L *et al.* (2020) Changes in nutrient declaration after the food labeling and advertising law in Chile: a longitudinal approach. *Nutrients* **12**, 2371.
 38. Ducrot P, Méjean C, Julia C *et al.* (2015) Effectiveness of front-of-pack nutrition labels in French adults: results from the NutriNet-Sante cohort study. *PLoS One* **10**, e0140898.
 39. Taillie LS, Hall MG, Popkin BM *et al.* (2020) Experimental studies of front-of-package nutrient warning labels on sugar-sweetened beverages and ultra-processed foods: a scoping review. *Nutrients* **12**, 569.
 40. Temple NJ (2020) Front-of-package food labels: a narrative review. *Appetite* **144**, 104485.
 41. Goglia R, Spiteri M, Menard C *et al.* (2010) Nutritional quality and labelling of ready-to-eat breakfast cereals: the contribution of the French observatory of food quality. *Eur J Clin Nutr* **64**, S20–S25.



42. Nielsen MarketTrack (2017) Ready-to-eat Cereals, Quebec All Channels, 52 weeks ended May 27.
43. Nieto C, Rincon-Gallardo Patiño S, Tolentino-Mayo L *et al.* (2017) Characterization of breakfast cereals available in the Mexican market: sodium and sugar content. *Nutrients* **9**, 884.
44. Angelino D, Rosi A, Dall'Asta M *et al.* (2019) Evaluation of the nutritional quality of breakfast cereals sold on the Italian market: the food labelling of Italian products (FLIP) study. *Nutrients* **11**, 2827.
45. Vermote M, Bonnewyn S, Matthys C *et al.* (2020) Nutritional content, labelling and marketing of breakfast cereals on the Belgian market and their reformulation in anticipation of the implementation of the nutri-score front-of-pack labelling system. *Nutrients* **12**, 884.
46. Chepulis L, Hill S & Mearns G (2017) The nutritional quality of New Zealand breakfast cereals: an update. *Public Health Nutr* **20**, 3234–3237.
47. Louie JC, Dunford EK, Walker KZ *et al.* (2012) Nutritional quality of Australian breakfast cereals. Are they improving? *Appetite* **59**, 464–470.
48. Pombo-Rodrigues S, Hashem KM, He FJ *et al.* (2017) Salt and sugars content of breakfast cereals in the UK from 1992 to 2015. *Public Health Nutr* **20**, 1500–1512.
49. Schnettler B, Ares G, Sepúlveda N *et al.* (2019) How do consumers perceive reformulated foods after the implementation of nutritional warnings? Case study with frankfurters in Chile. *Food Qual Prefer* **74**, 179–188.
50. Pombo-Rodrigues S, Hashem KM, He FJ *et al.* (2017) Salt and sugars content of breakfast cereals in the UK from 1992 to 2015. *Public Health Nutr* **20**, 1500–1512.
51. Observatoire de la qualité de l'alimentation (OQALI) (2013) Study of the evolution of the breakfast cereals sector – 2008 and 2011 data. https://www.oqali.fr/content/download/3369/32632/file/Oqali_Rapport_evolution_cereales_2013.pdf (accessed March 2020).
52. Ransley JK, Donnelly JK, Khara TN *et al.* (2001) The use of supermarket till receipts to determine the fat and energy intake in a UK population. *Public Health Nutr* **4**, 1279–1286.
53. Martin SL, Howell T, Duan Y *et al.* (2006) The feasibility and utility of grocery receipt analyses for dietary assessment. *Nutr J* **5**, 10.