

# Consumer Understanding of Calorie Amounts and Serving Size: Implications for Nutritional Labelling

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## ABSTRACT

**Objective:** Increased consumption of sugar-sweetened beverages has contributed to rising obesity levels. Under Canadian law, calories for pre-packaged foods and beverages are presented by serving size; however, serving sizes differ across products and even for the same product in different containers. This study examined consumer understanding of calorie amounts for government nutrition labels and industry labelling schemes.

**Methods:** A national sample of 687 Canadian adults completed an online survey. Participants were randomized to view images of Coke® bottles that displayed different serving sizes and calorie amounts. Participants viewed either the regulated nutrition information on the “back” of containers, or the voluntary calorie symbols displayed on the “front” of Coke® products. Participants were asked to determine how many calories the bottle contained.

**Results:** Across all conditions, 54.2% of participants correctly identified the number of calories in the beverage. Participants who viewed government-mandated nutrition information were more likely to answer correctly (59.0%) than those who saw industry labelling (49.1%) (OR=5.3, 95% CI: 2.6-10.6). Only 11.8% who viewed the Coke® bottle with calorie amounts per serving correctly identified the calorie amount, compared to 91.8% who saw calorie amounts per container, regardless of whether information was presented in the Nutrition Facts Table or the front-of-pack symbol (OR=242.9, 95% CI: 112.1-526.2).

**Conclusions:** Few individuals can use nutrition labels to correctly identify calorie content when presented per serving or using industry labelling schemes. The findings highlight the importance of revising labelling standards and indicate that industry labelling initiatives warrant greater scrutiny.

**Key words:** Nutrition labelling; food labelling; nutrition policy; comprehension; front-of-package labelling

La traduction du résumé se trouve à la fin de l'article.

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Obesity is a growing public health problem. In Canada, more than two thirds of adults are overweight or obese.<sup>1</sup> Excess energy intake is a main driver behind the obesity epidemic.<sup>2</sup> Increased consumption of sugar-sweetened beverages, including soft drinks, is a potentially important contributor to increased energy intake.<sup>3</sup> Sugar-sweetened beverages are characterized by high caloric content with little to no nutritional value.<sup>1</sup> In North America, beverages are often sold in large containers holding several times the recommended serving. An American study suggested that actual soft drink portion sizes exceeded the federally recommended standard portion sizes by 35-103%.<sup>4</sup>

Nutrition information on pre-packaged foods is mandatory in most high-income countries.<sup>5</sup> In Canada, the Nutrition Facts Table must appear on the back or side of all pre-packaged food items and is the primary source of nutrition information for Canadian consumers.<sup>6,7</sup> The Nutrition Facts Table uses serving size labelling, which displays the nutrition information for a single serving of the product. Serving size labelling aims to address “portion distortion”, a phenomenon whereby individuals perceive large portion sizes as appropriate amounts to eat at a single eating occasion.<sup>8</sup> Current Canadian labelling regulations allow a range of serving sizes to be displayed for different items. For example, servings of non-carbonated and carbonated beverages can range from 250 mL to 375 mL, and are selected at the discretion of the manufacturer.<sup>9</sup> Several studies have shown that consumers have difficulty interpreting serving size information.<sup>10,11</sup> A cross-sectional study examining health label literacy found that difficulty with serving sizes and incorrect calculations were the primary reason for errors in inter-

preting nutrition content.<sup>12</sup> A recent study found that only 37% of individuals could correctly identify the amount of carbohydrates in a 20-oz multiple-serving beverage container.<sup>13</sup> Qualitative research commissioned by Health Canada also indicates that inconsistent serving sizes for similar products are a point of confusion for Canadians in trying to understand the Nutrition Facts Table.<sup>14</sup> Across studies, lower levels of comprehension have been associated with lower income, education, literacy and numeracy skills.<sup>5,12,13</sup>

Front-of-package labelling has been introduced as a simplified method of informing consumers about the calorie and nutrient content of packaged foods. Several large food and beverage companies have recently launched large front-of-package campaigns. One such initiative is the *Clear of Calories* campaign, launched by the American and Canadian Beverage Associations and implemented by leading companies, including *The Coca-Cola Company*

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**Table 1.** Sample Characteristics (N=687)

	Experimental Conditions				Overall N=687 % (n)
	FOP/serving n=153 % (n)	FOP/ container n=183 % (n)	Nutrition Facts/serving n=171 % (n)	Nutrition Facts/container n=180 % (n)	
Sex					
Female	77.1% (118)	73.8% (135)	77.2% (132)	77.2% (141)	76.6% (526)
Male	22.9% (35)	26.2% (48)	22.8% (39)	22.8% (39)	23.4% (161)
Age (years)					
18-34	32.0% (49)	32.8% (60)	34.4% (59)	29.4% (53)	32.2% (221)
35-44	49.7% (76)	51.4% (94)	52.6% (90)	55.0% (99)	52.3% (359)
≥45	18.3% (28)	15.8% (29)	12.9% (22)	15.6% (28)	15.6% (107)
BMI*					
Underweight	2.6% (4)	1.6% (3)	4.7% (8)	2.8% (5)	2.9% (20)
Normal	49.7% (76)	41.0% (75)	47.4% (81)	51.4% (93)	47.3% (325)
Overweight	23.5% (36)	33.9% (62)	26.9% (46)	22.8% (41)	26.9% (185)
Obese	23.5% (36)	21.3% (39)	19.9% (34)	20.6% (37)	21.3% (146)
Not reported	0.7% (1)	2.2% (4)	1.2% (2)	2.2% (4)	1.6% (11)
Education					
High school or less	30.1% (46)	24.6% (45)	15.2% (26)	25.6% (46)	23.7% (163)
Certificate or diploma	42.5% (65)	39.3% (72)	48.0% (82)	36.7% (66)	41.5% (285)
Bachelor's Degree	17.6% (27)	27.3% (50)	23.4% (40)	22.8% (41)	23.0% (158)
University degree greater than bachelor's degree	9.2% (14)	7.7% (14)	13.5% (23)	14.4% (26)	11.2% (77)
Not reported	0.7% (1)	1.1% (2)	0% (0)	0.6% (1)	0.6% (4)
Income					
<\$40,000	22.9% (35)	23.5% (43)	19.9% (34)	23.9% (43)	22.6% (155)
\$40,000 - \$80,000	36.6% (56)	34.4% (63)	34.5% (59)	29.4% (53)	33.6% (231)
>\$80,000	32.0% (49)	32.2% (59)	39.8% (68)	34.5% (62)	34.6% (238)
Not reported	8.5% (13)	9.8% (18)	5.8% (10)	12.2% (22)	9.2% (63)
Ethnicity					
White	73.9% (113)	71.6% (131)	77.2% (132)	77.2% (139)	75.0% (515)
Other	24.8% (38)	26.8% (49)	22.2% (38)	21.7% (39)	23.9% (164)
Not reported	1.3% (2)	1.6% (3)	0.6% (1)	1.1% (2)	1.2% (8)

FOP = Front-of-package, industry-led voluntary labelling; Nutrition Facts = government-mandated labelling.

\* BMI categories: Underweight = BMI <18.5; Normal weight = BMI 18.5-24.99; Overweight = BMI 25-29.99; Obese = BMI ≥30.

**Table 2.** Estimation of Calorie Content by Experimental Condition (N=687)

Labelling Condition	% Underestimated % (n)	% Overestimated % (n)	% Correct % (n)
Front of Package per serving	71.9% (110)	21.6% (33)	6.5% (10)
FOP per container	5.5% (10)	9.8% (18)	84.7% (155)
Nutrition Facts per serving	73.7% (126)	9.9% (17)	16.4% (28)
Nutrition Facts per container	0% (0)	0.6% (1)	99.4% (179)
Overall	35.8% (246)	10.0% (69)	54.2% (372)

and *PepsiCo*.<sup>15</sup> The voluntary program prominently displays calorie and serving size information on the front label of beverage containers. In Canada, some beverages are labelled with the calorie content of the entire bottle, while others are labelled per 250 mL or 355 mL serving, similar to the information presented in the Nutrition Facts Table.

To date, there is no published evidence examining consumer understanding of these industry labelling schemes in Canada. The current study sought to examine calorie estimation of beverage products with various serving sizes. The study examined consumers' ability to correctly identify calorie content in beverages when presented with calories per serving or per container of actual Coke products. The study also examined potential differences in consumer understanding when the consumer is shown the government-mandated Nutrition Facts Table on the back of containers, versus the front-of-pack labelling scheme currently appearing on Coke® products. Finally, the study examined individual differences in consumer understanding by socio-demographic factors.

**METHODS**

**Sample description**

A total of 687 participants from a national sample of Canadians were recruited using an online commercial panel consisting of over 400,000 consumers through Global Market Insite, Inc. (GMI,

Bellevue, Washington).<sup>16</sup> Invitations to participate in the web-survey were emailed to panel members over the age of 18; the invitation did not indicate the nature or purpose of the study.<sup>16</sup> The current study was part of a larger study on the marketing of children's food products, and was completed online. Participants were eligible for the study if they were over the age of 18, a parent of at least one child between 4-10 years of age, and the primary shopper for their household. This study received ethics clearance from the University of Waterloo Office of Research Ethics.

**Study protocol**

Participants were randomized to view a Coke® beverage in one of four labelling conditions: 1) a 591 mL bottle with front-of-package calorie information *per serving*, 2) a 591 mL bottle with front-of-package calorie information *per container*, 3) a 591 mL bottle with the Nutrition Facts Table *per serving*, and 4) a 591 mL bottle with the Nutrition Facts Table *per container*.

**Measures**

*Demographics*

Demographic information of participants included sex, age (18-34, 35-44, and ≥45), education (high school or less, certificate or diploma, bachelor's degree, or university degree or certificate greater

**Figure 1.** Experimental labelling conditions



than a bachelor's degree), ethnicity (White or other) and income (<\$40,000, \$40,000-\$80,000, or >\$80,000 annually). Self-reported height and weight were collected to calculate body mass index (BMI) using categories defined by the World Health Organization.<sup>17</sup>

*Nutritional Knowledge, Understanding of Nutrition Labels and General Health*

*Nutrition label use* was assessed by the question, "When shopping for food, do you usually look at the nutrition information provided on the package?", with a 5-point Likert scale (1=never; 5=always). *Perceived nutritional knowledge* was examined using the statement, "I am knowledgeable about health and nutrition issues", using a 5-point Likert scale (1=strongly agree; 5=strongly disagree). A measure of *perceived general health* was assessed by asking, "In general, how would you rate your overall health?", with a 5-point Likert scale (1=poor; 5=excellent).

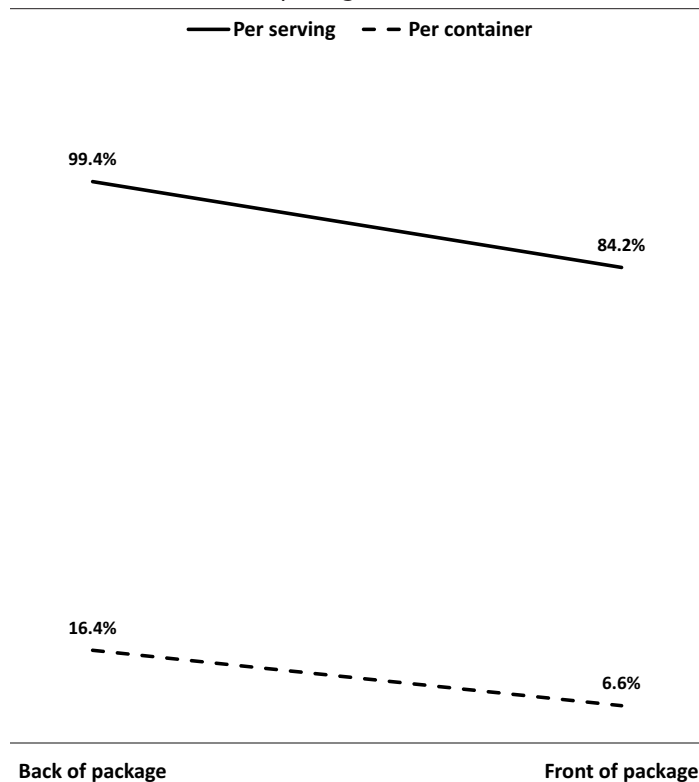
*Calorie Content*

Participants were asked "How many calories are in this bottle of Coke®?", with an open response field in which participants could fill in a number of calories. This question was asked while the image of the Coke® bottle and calorie information were displayed on the screen.

**Analysis**

Chi-square tests were used to test for demographic differences between experimental conditions. Logistic regression modelling was used to test for differences in the proportion of individuals who responded correctly. Two outcomes were used: an exact response (260 calories) and a more lenient "range" measure, where a correct response was defined as a response within a 10-calorie range above or below the correct answer (1=correct response; 0=incorrect

**Figure 2.** Estimation of calorie content: Serving size vs. location on package (% correct)



response). Patterns of significance were the same for both outcome measures; therefore results are reported only for exact correct responses. Odds ratios (OR) and 95% confidence intervals (95% CI) are reported. Labelling location (front-of-package=0, Nutrition Facts Table=1), serving size portion (entire container=0, single serving=1), socio-demographic variables (age, sex, education, BMI, ethnicity, income), perceived nutrition knowledge, label use and perceived general health were included in the regression model. All analyses were conducted using SPSS v.20 (IBM Corp., Somers, NY).

**RESULTS**

Sample characteristics are shown in Table 1. There were no significant differences between conditions for any demographic measures.

Across all four conditions, 54.2% (n=372) of participants correctly identified the exact number of calories in the entire beverage container and 61.0% (n=419) were able to identify the number of calories within a 10-calorie range of the correct answer. Of the entire sample, 35.8% underestimated and 10% overestimated the calorie content.

Table 2 shows the proportion of correct responses, underestimation and overestimation for each experimental condition. Figure 2 also illustrates the overall effect of labelling conditions on correct estimation of calorie content of the container. Participants were able to correctly identify the exact calorie content of the entire beverage container 59.0% of the time when presented with the back-of-package Nutrition Facts Table, and 49.1% of the time when viewing the front-of-package industry labelling. In conditions with *per container* labelling, 91.8% of participants correctly identified the calorie content of the bottle, compared to 11.8% of participants who saw *per serving* labelling.

A logistic regression model was conducted to test for differences in the proportion of participants who could correctly identify the calorie amount between experimental conditions (where 0=incorrect calorie amount and 1=correct calorie amount), adjusting for age group, sex, BMI, education level, income, ethnicity, perceived nutritional knowledge, frequency of label use, and perceived general health. Both portion labelled (serving vs. container) and type of label (Nutrition Facts Table vs. industry label) were significant. Participants who viewed calories per container were significantly more likely to correctly estimate the calories per container compared to those who viewed the calories per serving (OR=242.9, 95% CI: 112.1-526.2,  $p<0.001$ ). Those who viewed the government-mandated Nutrition Facts Table were significantly more likely to answer correctly than those who saw voluntary front-of-package labelling (OR=5.3, 95% CI: 2.6-10.6,  $p<0.001$ ). There were no significant overall differences in correctly estimating calorie content for the demographic measures age, sex, education, BMI, ethnicity, income, nutrition label use and perceived nutritional knowledge or health.

## DISCUSSION

Overall, almost half of participants were not able to correctly identify the calories in commonly consumed beverage containers when viewing nutrition labels. In addition, approximately one in ten Canadian parents of children ages 4-10 could correctly identify calorie content when the serving size was less than the entire container. This was true regardless of whether they viewed the government-mandated Nutrition Facts Table on the back of containers or the front-of-pack calorie labels voluntarily provided by manufacturers. There was slightly improved performance with the use of the Nutrition Facts Table compared to the front-of-package labelling in both *per serving* and *per container* conditions. This likely reflects consumer familiarity with the Nutrition Facts Table, as it has been mandatory in Canada since 2003.

Several factors could account for the high proportion of incorrect responses. First, the “per serving” information on the Coke® containers was written in very small and often blurry text. Prior to the study, we visited several stores and were unable to find bottles with more legible calorie labels, suggesting that this is likely representative of challenges consumers face. Second, respondents who attempted to use the serving size information may have had difficulty calculating the total number of calories due to poor numeracy skills, as higher numeracy rates have previously been associated with higher label comprehension.<sup>14</sup> This is unlikely in this study, as the education level of the sample was higher than that of the general Canadian public. Finally, the serving size used on the many beverage containers may be counter-intuitive to consumers. The existing regulations in Canada allow the same product to display different serving sizes when sold in different containers. For example, at the time of the study, Coke® products were labelled as *per serving* for 591 mL bottles, and *per container* for 355 mL cans. As a result, a higher calorie number was posted on cans (160 calories) than on the larger bottle container (110 calories per serving). At the time of the study, the 591 mL container included 2.4 servings; however, many respondents may have assumed that the labelled amount was for the entire container. Previous research has found that less than 40% of individuals correctly acknowledged multiple servings in multi-serving food and beverage products.<sup>11,18</sup> This is consistent with the current findings: more than 40% of participants

who viewed the “110 calories per serving” label estimated the content of the bottle to be 110 calories. This suggests that labelling per serving may systematically lead consumers to underestimate the calorie content of products, and this may contribute to higher levels of consumption.

## Strengths and limitations

The sample was limited to parents of children aged 4-10 years. In addition, the online survey did not allow participants to pick up and examine the container. This may have reduced the accuracy of calorie estimates; however, the study also served to focus attention on the calorie information and likely resulted in increased attention and scrutiny than would be typical in a naturalistic setting. Finally, the online sample had somewhat higher-than-average levels of education and income compared to the general population.<sup>19</sup> Previous research has noted that those with higher levels of income and education generally perform better on nutritional labelling tasks.<sup>13</sup> Poor performance on this task among a more educated sample suggests that the accuracy of calorie estimates could be even lower in the general population. Strengths of the study include the use of a large national sample and the use of actual product labels currently available on the Canadian market. The between-conditions experimental design is also a considerable strength in terms of drawing inferences about the impact of different labelling formats.

## CONCLUSION

Nutrition labels are only one of many approaches that will be required to address obesity at a population level. However, for this approach to be effective, consumers must be able to easily identify and understand information on product labels. The current study suggests that government-mandated nutrition labelling practices are confusing to Canadians. Very few individuals were able to use the information in the Nutrition Facts Table to calculate calorie content when there was more than one serving per container. Voluntary industry measures appear to be even less effective and can lead to dramatic underestimates of calorie intake.

Given steadily increasing rates of obesity, these findings highlight the need for substantive changes to the nutrition labelling of pre-packaged food and beverages in Canada. The findings suggest that providing calorie amounts for the entire container can dramatically increase the accuracy of calorie estimates. For products that clearly include multiple servings and for which serving sizes equivalent to the entire container are not appropriate, more intuitive labelling should be considered. An alternative is dual-column labels, which display nutritional information for one serving of a product in addition to information for the entire package.<sup>20</sup> At the very least, serving sizes should be standardized within product categories. Finally, voluntary industry labelling should be subjected to greater scrutiny to ensure that the labels enhance rather than reduce consumer understanding of nutrition information.

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## RÉSUMÉ

**Objectif :** La hausse de la consommation des boissons édulcorées au sucre contribue à l'augmentation des niveaux d'obésité. En vertu de la loi canadienne, le nombre de calories dans les aliments et les boissons préemballés est indiqué par portion, mais les portions diffèrent d'un produit à l'autre, et même pour des produits identiques conditionnés dans des emballages différents. Nous avons examiné la compréhension par les consommateurs du nombre de calories sur les étiquettes nutritionnelles du gouvernement et sur celles de l'industrie.

**Méthode :** Un échantillon national de 687 Canadiennes et Canadiens adultes a répondu à un sondage en ligne. Des participants sélectionnés au hasard ont visionné des images de bouteilles de Coke® affichant des portions et un nombre de calories différents. Les participants ont vu soit l'information nutritionnelle réglementée au « dos » du contenant, soit les symboles de calories affichés sur le « devant » du produit Coke®. Nous avons demandé aux participants de calculer combien de calories contenait la bouteille.

**Résultats :** Globalement, 54,2 % des participants ont correctement calculé le nombre de calories dans la boisson. Ceux qui ont visionné l'information nutritionnelle exigée par le gouvernement étaient plus susceptibles de répondre correctement (59 %) que ceux qui ont vu l'étiquetage de l'industrie (49,1 %) (RC=5,3, IC de 95 % : 2,6-10,6). Seulement 11,8 % des participants ayant vu la bouteille de Coke® indiquant le nombre de calories par portion ont correctement calculé les calories, contre 91,8 % des participants ayant vu la bouteille indiquant le nombre de calories par contenant, peu importe si l'information était présentée dans le tableau « Valeur nutritive » ou dans le symbole sur le devant de l'emballage (RC=242,9, IC de 95 % : 112,1-526,2).

**Conclusion :** Peu de gens savent se servir des étiquettes nutritionnelles pour calculer correctement le nombre de calories lorsque l'information leur est présentée par portion ou sur les étiquettes créées par l'industrie. Il est donc important de réviser les normes d'étiquetage, et les initiatives d'étiquetage de l'industrie mériteraient un examen approfondi.

**Mots clés :** étiquetage nutritionnel; étiquetage aliments; politique nutritionnelle; compréhension; étiquetage sur le devant de l'emballage