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Short Communication

# 'How many calories did I just eat?' An experimental study examining the effect of changes to serving size information on nutrition labels

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**Abstract**

*Objective:* To test modifications to nutrition label serving size information on understanding of energy (calorie) content among youth and young adults.

*Design:* Participants completed two online experiments. First, participants were randomly assigned to view a beverage nutrition label with a reference amount of per serving (250 ml), per container (473 ml) or a dual-column format with both reference amounts. Participants were then randomized to view a cracker nutrition label which specified a single serving in small font, a single serving in large font, or the number of servings per bag with single serving information below. In both experiments, participants estimated energy content. Logistic regression analysis modelled correct energy estimation. Finally, participants reported their preference for serving size display format.

*Setting:* Canada.

*Subjects:* Canadian youth and young adults (*n* 2008; aged 16–24 years).

*Results:* In experiment 1, participants randomized to view the nutrition label with per container or dual column were more likely to correctly identify energy content than those using per serving information ($P < 0{\cdot}01$). For experiment 2, the serving size display format had no association with correct energy estimation. The majority of participants (61·9 %) preferred the serving size format that included servings per package.

*Conclusions:* Labelling foods with nutrition information using a serving size reference amount for the entire container increased understanding of energy content. Consumers prefer nutrition labels that include more prominently featured serving size information. Additional modifications that further improve consumers' accuracy should be examined. These results have direct implications for nutrition labelling policy.

**Keywords**
Nutrition labelling
Serving size
Nutrition policy
Experimental

Nutrition labels are required in over fifty countries[1] and are aimed at increasing consumers' selection of healthy foods and improving diet. However, consumers struggle to understand labels, especially the serving sizes[2], which are the basis for interpreting food products' nutrition information. Current serving size reference values on food labels in Canada and the USA do not reflect how much people actually eat or drink during a sitting[3]. Consumers have difficulty using serving sizes to calculate energy consumption[4], hindering their ability to apply nutrition information to make healthier food choices[5].

Currently, most surveys on serving size labelling are limited to self-reported use and perceived understanding[2,6], which are distinctly different from consumers' ability to correctly and effectively apply label information[7]. Additionally, few studies experimentally test how specific serving size modifications affect the outcomes of functional tasks that require label use. Findings suggest that consumers' understanding of nutrient intake is improved through additional information on the number of servings in each package and the provision of nutrition information according to a single serving and the

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whole package (a 'dual-column' format)[8] or using more relatable quantities, such as per container[4].

The US Food and Drug Administration and Health Canada are revising nutrition labels on pre-packaged foods, including changes to serving size labelling[9,10]. In the proposed modifications, serving size reference values would be standardized among similar foods and adjusted to better reflect what people currently customarily consume. The proposed changes include more prominent display of energy information and, in the USA, a dual-column format is under consideration for some products.

The purpose of the current study was to test if modifications to the display of serving size information on nutrition labels increased understanding of energy content among youth and young adults. During the transitional period from adolescence to adulthood, diet quality declines[11], persisting into later life[12]. Comparatively little research examines nutrition label use in this critical age period[6]. The current study was developed for Canadian labels; however, many of the modifications also apply to the USA and other jurisdictions.

## Methods

### *Design and procedure*

An online cross-sectional survey was conducted in August 2014 among Canadian youth and young adults as part of a larger study on use and comprehension of the nutrition facts table (NFT). Participants aged 16–24 years were recruited from an online commercial panel (Nielsen Consumer Insights Panel). Quotas were set such that 50 % of the sample was aged 16–18 years and 50 % was each gender. A total of 2011 participants completed the survey; one was excluded due to data quality concerns and two due to geographic region out of scope, for a final sample size of 2008. Upon completion of the survey, participants were given remuneration of approximately $CAN 2–3. Sample weights were constructed using the Canadian 2014 National Household Survey population estimates for age, gender and geographic region. Surveys were offered in English only, and participant consent was obtained. Participants were asked not to use smart phones, calculators, Google or any other aids to assist answering any questions. The study received ethics clearance from the Office of Research Ethics at the University of Waterloo.

### *Measures*

*Experimental conditions and outcomes*

The current study consisted of two between-group experiments and a discrete-choice measure (below, 'calories' is kilocalories; 1 kcal = 4·184 kJ).

Experiment 1 examined ways to display serving size reference values on the NFT. Participants were randomized to view one of three different NFT formats on a typical 473 ml carton of chocolate milk sold in Canadian grocery stores. The nutrition information reference amount conditions were the current label with information: (i) per serving (250 ml); (ii) per container (473 ml); and (iii) in dual-column format with serving size per 250 ml and per 473 ml. Participants were asked 'How many calories would you consume if you drank the entire carton?' Responses were recoded as a binary outcome: 'correct' (numeric values ranging from 300 and 306 calories, to accommodate variations in number rounding) or 'incorrect' (all other numeric values and 'don't know').

Experiment 2 examined ways to display serving size on the NFT. Participants were randomized to view an image of the front of a bag of crackers and one of three NFT conditions with different displays of serving size: (i) current label with text in a small font specifying what constitutes a serving size; (ii) a large font for serving size; and (iii) a label with current information plus information on the number of servings per package in a large font. Participants were asked 'If you ate half a bag of these crackers, how many calories would you have eaten?' Responses were recoded as a binary outcome: 'correct' (450 calories) or 'incorrect' (all other numeric values and 'don't know'). Participants then completed a discrete-choice task in which they were asked 'In your opinion, which of these labels provide the MOST USEFUL information on serving size?' while displaying all three images tested in Experiment 2. The order of the images was randomized (see online supplementary material, Fig. S1 for example images).

### *Sociodemographic variables*

Sociodemographic information included age (16–18 years, 19–21 years, 22–24 years), gender, ethnicity (white, other and not stated), region (British Columbia, Prairies, Ontario, Quebec, Atlantic provinces and not stated) and BMI class (underweight, normal weight, overweight, obese and not stated, using self-reported height and weight categorized using WHO guidelines[13]).

### *Statistical analysis*

Statistical analysis was conducted using the statistical software package IBM SPSS Statistics Version 22.0. Descriptive frequencies for sociodemographic variables were conducted and $\chi^2$ tests were used to examine differences in sociodemographic variables across experimental conditions. Logistic regression examined experimental outcomes, using an indicator variable for experimental condition. Adjusted odds ratios and 95 % confidence intervals are reported. The $\chi^2$ test was used to examine statistical significance of stated preference for NFT format. All analyses were conducted using sample weights, with the exception of the sample table, for which unweighted data are reported.

## Results

### *Sample characteristics*

Of the sample, 50·0 % were 16–18 years old, 25 % were 19–21 years and 25 % were 22–24 years. Females made up approximately half of the sample (50·1 %). The majority of the sample stated a white ethnicity (58·4 %), while the remainder specified 38·4 % other and 3·2 % not stated. The regional distribution was 18·3 % British Columbia, 23·3 % Prairies, 41·8 % Ontario, 6·2 % Quebec, 8·6 % Atlantic provinces and 1·8 % not stated. Based on participants' self-reported height and weight, BMI was classified as normal weight for over half of the sample (56·2 %). The remaining participants were classified as underweight (10·4 %), overweight (14·8 %), obese (7·0 %) or not stated (11·6 %). There were no significant differences between experimental conditions for any of the sociodemographic variables.

### *Experiment 1: serving size reference amount*

In Experiment 1, participants were randomly assigned to view labels with different serving sizes. Overall, three-quarters of respondents (74·6 %) correctly identified how many calories they would consume if they drank the entire carton of chocolate milk. Incorrect responses included overestimates (49·8 %), underestimates (36·5 %) and 'don't know' (13·7 %). The majority of participants randomized to the per-container condition and the dual-column condition correctly calculated caloric intake (93·8 % and 83·8 %, respectively), compared with less than half of participants (48·8 %) who viewed the current per-serving condition (Fig. 1). Participants were more likely to correctly estimate calories if they viewed the per-container (OR = 15·9; 95 % CI 11·1, 22·6) or dual-column label (OR = 5·4; 95 % CI 4·2, 7·0) compared with those who viewed the per-serving label. Additionally, participants in the per-container condition were more likely to answer correctly (OR = 2·9; 95 % CI 2·0, 4·3) than those in the dual-column condition.

### *Experiment 2: serving size display*

In Experiment 2, participants were randomized to view labels with serving information displayed using differing font size and servings per bag information. Of the entire sample, two-thirds correctly estimated calorie content (65·9 %) for half a bag of crackers. Incorrect responses included overestimates (40·0 %), underestimates (41·8 %) and 'don't know' (18·2 %). The serving size display condition was not significantly associated with correctly estimating the number of calories (Fig. 2).

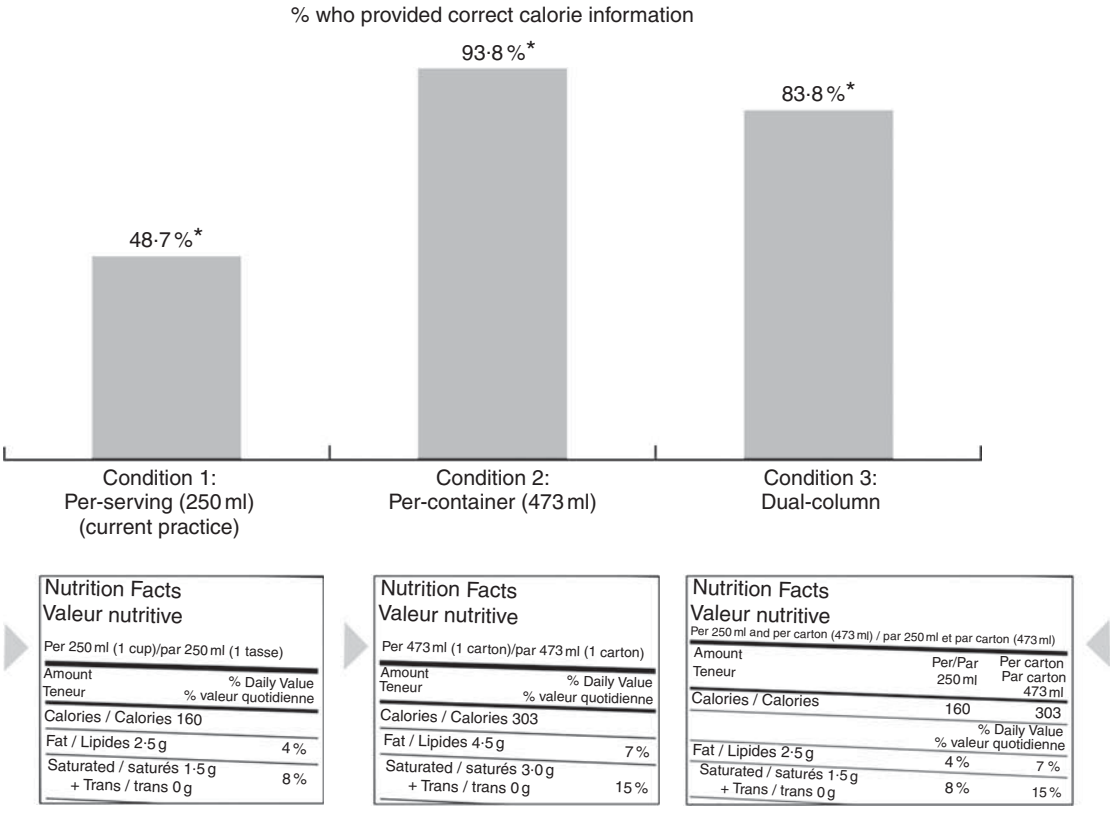


**Fig. 1** The effect of serving size on correct energy (calorie) estimation among Canadian youth and young adults aged 16–24 years (*n* 1994) recruited from an online commercial panel, August 2014. Arrows added here for emphasis and did not appear on images shown to participants. *All comparisons were significantly different at the $P < 0.05$ level ('calories' = kilocalories; 1 kcal = 4·184 kJ)

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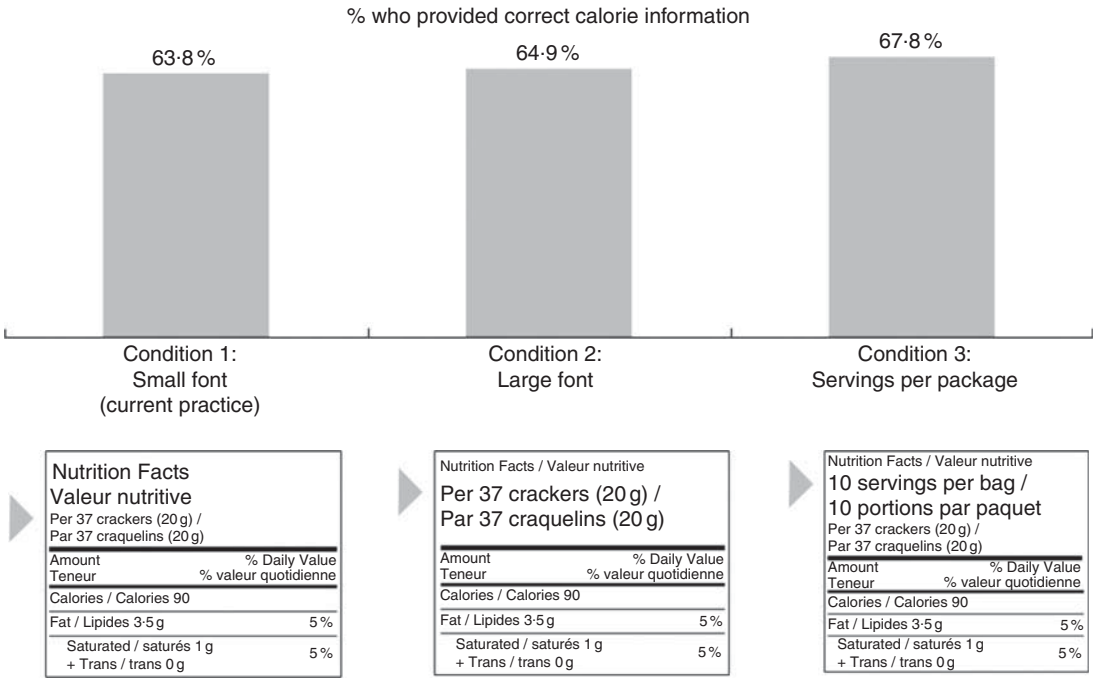


**Fig. 2** The effect of serving size display on correct energy (calorie) estimation among Canadian youth and young adults aged 16–24 years (*n* 1993) recruited from an online commercial panel, August 2014. Arrows added here for emphasis and did not appear on images shown to participants. No comparison was significantly different at the $P<0·05$ level ('calories' = kilocalories; 1 kcal = 4·184 kJ)

### *Stated preference for serving size format of the nutrition facts table*

As shown in Fig. 3, when participants viewed all three serving size displays, the majority of participants preferred the serving size display that included the number of servings per package (61·7 %), compared with the small font (9·7 %) label and large font label for serving size (28·7 %; $\chi^2=845·7$, $P<0·001$). The same pattern of results was observed regardless of the participant's previous experimental condition in Experiment 2 ($P<0·001$ in all cases).

## Discussion

The current study adds to the limited evidence on the impact of serving size labelling formats by demonstrating how different designs can improve understanding of energy (calorie) content among youth and young adults. To our knowledge, the present study is the first testing serving size label modifications to include individuals under 18 years of age. The findings offer the type of concrete information on specific label designs needed by regulators when developing policy changes. Many participants struggled using serving size displays that required mathematics, while providing serving size and nutrition information per container or in a dual-column format increased understanding of energy content, consistent with other research[4,8]. The additional information in the dual-column display may have created confusion for participants, thereby reducing its effectiveness relative to the per-container display.

Increasing the font size for the serving size reference amount did not appear to improve label usability, as reported elsewhere[8]. However, the experimental setting may have lessened the effect of font size by intentionally directing participants' attention to the label. Although these formats did not aid participants in correctly responding in this task, a preference for the number of servings nutrition label that featured the number of servings in a package with a large font and in a prominent position at the top of the NFT may suggest that consumers would like to use this information when purchasing or eating packaged food.

Given the greater effectiveness of the per-container and dual-column labels relative to the current display format, further research is warranted on how these alternative formats influence other outcomes such as consumer food perceptions, purchasing habits and eating behaviours. For example, since US national surveys show half of respondents misinterpreted serving size as 'the amount people should eat'[14], larger serving size reference amounts (such as 'per container') could lead to greater portion sizes, as observed in an experimental setting[15]. Tests also demonstrate that consumers perceived products with smaller serving sizes to be healthier[8,16]. Available evidence on dual-column formats indicates that nutrition information display aids in identifying more healthful products[8] and is associated with eating smaller portions of candy among non-dieters[17].

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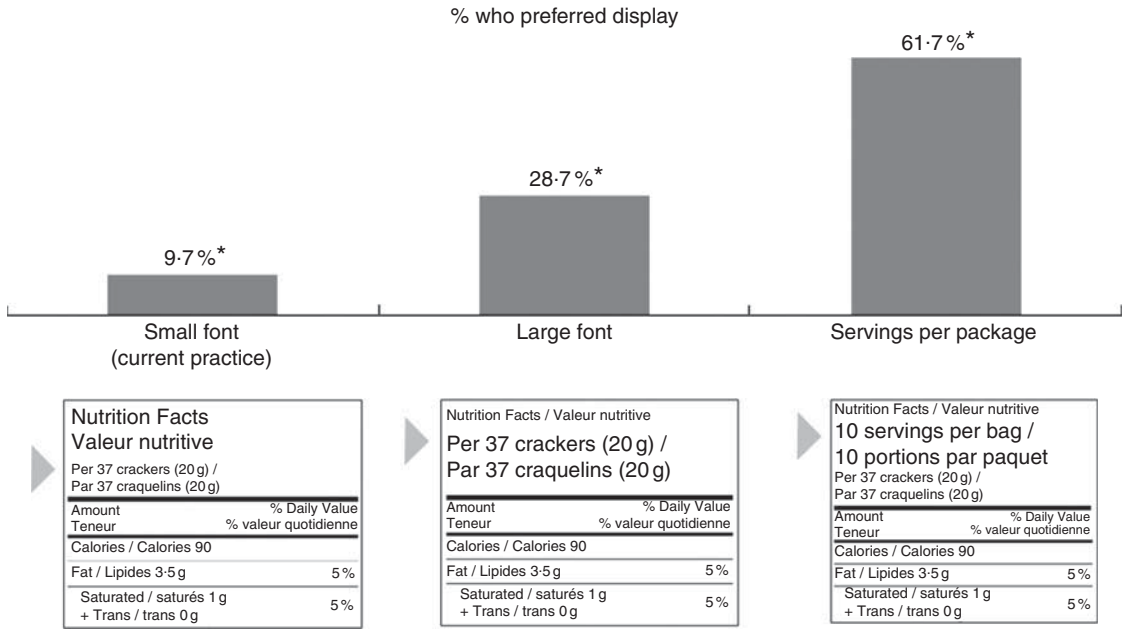


**Fig. 3** Preferred serving size display among Canadian youth and young adults aged 16–24 years (*n* 2008) recruited from an online commercial panel, August 2014. Arrows added here for emphasis and did not appear on images shown to participants. *All proportions were significantly different at the $P < 0{\cdot}001$ level

### *Limitations*

The study has several limitations. The cross-sectional sample did not permit the examination of effects over time and was not probability based. Participants were shown images on a computer screen and not the actual product, which may not represent natural interactions with the product information in a real-world setting. The sample prevalence of overweight and obese participants was lower in the current sample than the population average. However, a diverse, national sample was recruited and weighted for population estimates by region, gender and age, strengthening the study's generalizability to the larger Canadian youth and young adult population. It is anticipated that the tested label modifications will be less effective on older adults (especially those ≥65 years), as research has shown that young adults (18–24 years) are more likely to correctly calculate energy[18]. A major strength of the study is the use of a between-subjects experimental design that supports the internal validity of the effects of the label conditions on energy intake estimation.

## Conclusion

The current study found that labelling foods with nutrition information for the entire container increased understanding of energy content. However, consumers still struggled with applying nutrition information predicated on basic mathematical calculations. Given that only two-thirds of participants could correctly use the various serving size displays, additional display modifications that improve consumers' accuracy should be examined. Serving size information that was more prominent was preferred by consumers. Health Canada's proposed changes to serving size information are currently limited to addressing what constitutes a serving size and the consistent application of this measure across a product category. These changes may aid consumers in comparing products, but may not directly assist consumers in understanding the nutrition content of the foods they are eating. Innovative ways to communicate nutrition information on pre-packaged food labels, such as the use of colours, symbols or infographics, deserve further research.

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in the Declaration of Helsinki and all procedures involving human subjects/patients were approved by the Office of Research Ethics at the University of Waterloo. Written informed consent was obtained from all participants.

## Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1368980016000665

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