The efficacy of calorie labelling formats on pre-packaged foods: An experimental study among adolescents and young adults in Canada

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ABSTRACT

OBJECTIVES: Several countries have proposed changes to calorie labelling on nutrition facts tables (NFTs) on pre-packaged foods. As most research to date has examined general use of NFTs, there is a lack of evidence to guide specific design changes to calorie information on labels. This study examined the efficacy of various calorie labelling formats on recall, comprehension, and consumer preferences for calorie information.

METHODS: Experiments were conducted as part of an online survey with a national sample of 2,008 Canadians aged 16–24. In Task 1, participants were shown one of six labelling formats (e.g., *%DV*, *Traffic Light*) with calories in either small or large font, and asked to recall the amount of calories. Task 2 examined comprehension of calories in the context of recommended daily intake (RDI), using the same NFT as in Task 1. Task 3 identified participants' preferences for labelling formats.

RESULTS: NFTs with calories in large font enhanced calorie recall ($p < 0.001$). When small font was displayed, the *Traffic Light* format performed best at improving recall ($p < 0.01$). With large font, the highest recall was in the *Current*, *RDI* and *Traffic Light* formats (all $p < 0.05$). Comprehension of servings per RDI was highest in the *Infographic* format, with no difference by font size ($p < 0.001$). Respondents preferred the large font calorie condition and the *Infographic* format ($p < 0.001$).

CONCLUSIONS: Enhancements in visibility and design can improve the efficacy of calorie labelling on pre-packaged foods. The findings have direct implication for proposed changes to calorie labelling on NFTs in Canada and the United States.

KEY WORDS: Nutrition policy; health policy; food labeling; recommended dietary allowances

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

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Calories are the body's energy currency and are essential for our regular function and performance. However, the consumption of calories at levels above daily requirements is becoming increasingly common due to a high availability of energy-dense foods and increasingly large portion sizes, and has been positively associated with obesity and its related diseases, including cardiovascular disease, diabetes, musculoskeletal disorders and some cancers.[1] Daily energy requirements vary significantly according to factors such as age, gender and physical activity level, but there are clear guidelines outlined in both Canada and the United States that identify each group's approximate energy needs.[2,3]

In Canada, as similarly done in the US,[4] calorie information is displayed in a Nutrition Facts table (NFT) on the labels of pre-packaged food items.[5] NFTs are an important source of nutrition information for consumers: in 2008, over two thirds (68%) of Canadians reported obtaining nutrition information from food labels, and more than half of all Canadians (57%) report that they always or usually read the nutrition label.[6] With respect to calories, 74% of Canadians consider the total calories of a food item at least sometimes when choosing the foods they eat.[6] Studies in the US have produced similar findings, indicating that roughly half of American adults report using nutrition labels in general when making food purchasing decisions, and approximately 46% report "often" using calorie information specifically.[7–10]

Health Canada and the US Food and Drug Administration (USFDA) have recently proposed updates to nutrition labels on prepackaged foods, including changes to the presentation of calorie information.[11,12] The proposed modifications in both Canada and the US recommend increasing the prominence of calorie information by using larger, bolded font sizes. The effects of these proposed label changes have been investigated only briefly in focus groups by the USFDA, and in an online study by Lando and Lo that focused on examining dual-column Nutrition Facts labels.[13,14] Both studies found that enlarged calorie information had little effect among various other label alterations. Additional studies have examined other measures to increase the use and comprehension of nutrition labels, including the addition of

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interpretive information, such as colours and symbols.[15] Overall, there is relatively little evidence on alternative ways of communicating calorie information on pre-packaged food nutrition labels.

The purpose of the current study was to experimentally test the efficacy of various calorie labelling formats at improving recall of calorie information and at portraying calorie content in the context of total diet. The current study also examined use of calorie information among young people, and their preferences for calorie labelling formats. Young people are a key demographic for nutrition education in Canada, as they report the poorest diet quality across all age groups, with high total caloric intakes and high consumption of "other" foods that are typically energy dense.[16,17]

METHODS

The study was conducted in August 2014 as a component of a larger online experimental study among young people in Canada. Participants aged 16–24 years were recruited from an online commercial panel (Nielsen Consumer Insights Panel). A stratified random sample of Nielsen online panelists were sent an e-mail invitation to complete the survey. Quotas in the larger study were set such that there were an equal (50%) number of females and males, and that 50% of participants were aged 16–18. Participants residing outside of the Canadian provinces were excluded. A total of 2,011 participants completed the survey; one participant was excluded due to data quality concerns and two due to geographic region being out of scope, for a final sample size of 2,008 participants.

Participants were provided with remuneration of approximately CAD $2–$3 upon completion of the survey. Sample weights were constructed using population estimates from the Canadian 2011 National Household Survey (NHS) for age, gender and geographic region.[18] Although the larger study recruited 50% of participants from youth ages 16–18 years, the current study reweighted the sample based on 2011 NHS age category data. Surveys were only offered in English, and participant consent was obtained. Participants were encouraged to refrain from using Google, smartphones, calculators or any other resources to assist with answering survey questions. Ethical approval for the study was received from a University of Waterloo Research Ethics Committee.

Protocol

The study consisted of one item examining participants' use of calorie information and other nutrition information on the NFT, two experimental tasks examining the efficacy of various calorie labelling formats, and a discrete-choice task examining consumer preferences for calorie labelling formats, in addition to socio-demographic characteristics.

Socio-demographic Measures

Participants reported their age, gender, ethnicity, and self-reported height and weight to calculate body mass index (BMI). Province of residence was provided by the survey firm, and was grouped into five regions: British Columbia (BC), Prairies (Alberta, Saskatchewan, Manitoba), Ontario, Quebec, and Atlantic Canada (Nova Scotia, Newfoundland and Labrador, New Brunswick, Prince Edward Island).

Use of Calorie Information

Participants were asked "When you look at the Nutrition Facts table on a food package either in the store or at home, how often do you usually look at the following information?" This item was asked of calories, serving size, sodium, fat, saturated fat, trans fat, cholesterol, carbohydrates, sugars, fibre, protein, vitamin A, vitamin C, iron, calcium and % daily value (%DV). The response options available to the participants included "never", "rarely", "sometimes", "often", "always", "don't know" and "refuse".

Task 1

Task 1 examined the efficacy of formats for calorie labelling. Participants were randomized into a 2 (font size) × 6 (calorie format) between-subjects factorial design. Participants were randomized to view an NFT with calorie information displayed in either the current font size used by Health Canada, or in a font approximately three times as large. Each NFT featured one of the following six attributes: 1) the *current Canadian Nutrition Facts table* with no additional changes to the calorie information; 2) calorie information with a *%DV* based on a 2000 kcal diet; 3) calorie information plus *"High/Haut" or "Low/Bas" text descriptors*; 4) calorie information plus an *infographic* showing how much of a 2000 kcal diet was in one serving of the product; 5) the current NFT with a *Reference Daily Intake (RDI) statement* at the bottom describing that the %DVs are based on a 2000 calorie diet; or 6) calorie information plus a *traffic light symbol* displaying high, medium or low calorie content. These six formatting conditions were selected as a result of discussions with Health Canada surrounding evidence from the existing literature and their potential changes to NFTs in Canada. See Figure 1 for the six NFT conditions with calorie information displayed in the large font size.

Participants were told to look at the NFT, which was displayed for 10 seconds before it was removed from the screen. After being shown the image for 10 seconds, participants were taken to the next screen and asked to recall how many calories were in one serving of the product, with an open-ended response. The correct response for every condition was 400 calories.

Task 2

To examine comprehension of calorie information in the context of daily recommended limits, the same NFT as in Task 1 was returned to the screen, and participants were asked "How many servings of this product would equal your recommended daily value for calories?" with an open-ended response. The correct response was approximately five servings, which would be the equivalent of a 2000 kcal diet.

Task 3

Task 3 used a discrete-choice task to examine consumer preferences for displaying calorie information. Participants were shown two NFTs side by side, one with calorie information in a *small font (current Nutrition Facts table)* and one with calorie information in a *large font*, as shown in Figure 2. The position of the NFTs (i.e., left side of screen vs. right side of screen) was randomized. Participants were then shown the six calorie conditions seen in Figure 1 with calorie information either in small or large font, according to their preference for font size indicated in the previous question.

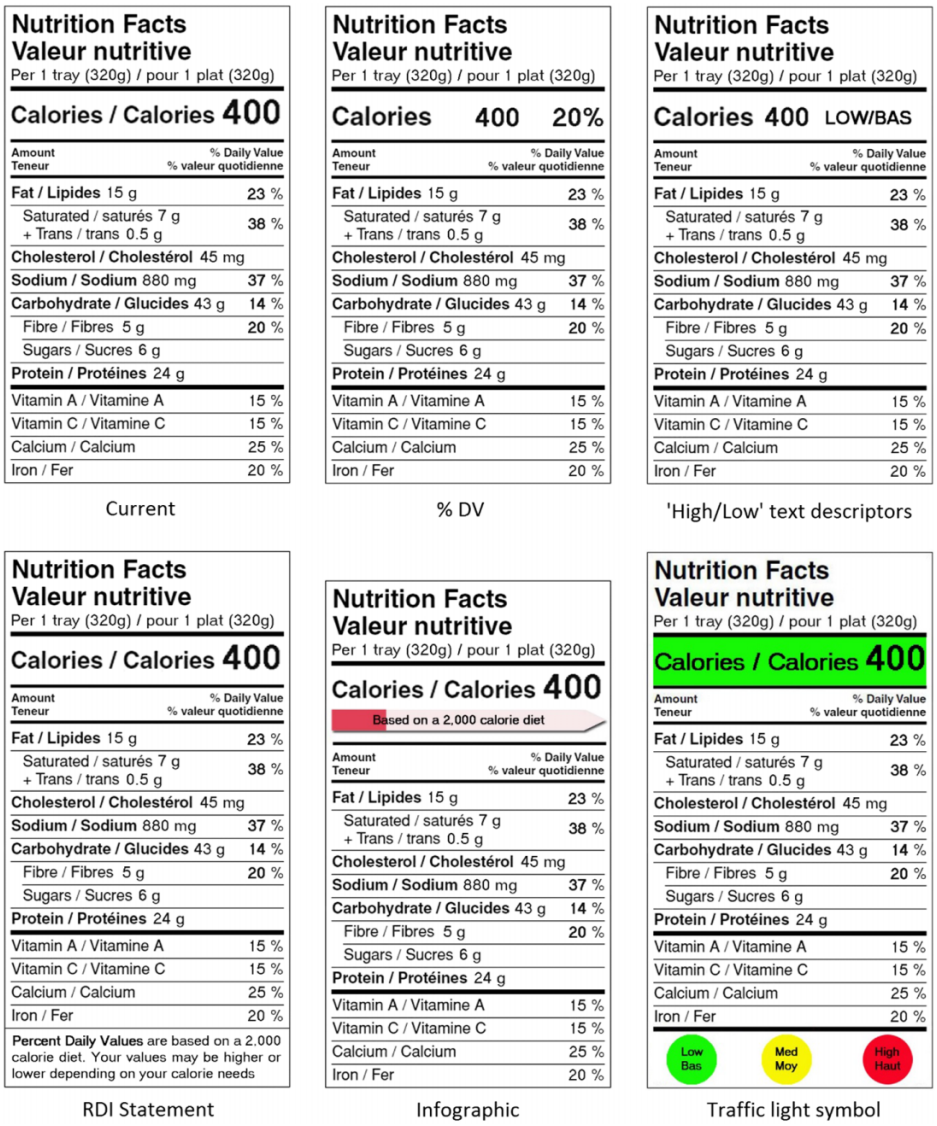

Figure 1. Nutrition Facts table conditions with calorie information in large font

Figure 2. Current Nutrition Facts tables with calorie information in small and large font

Participants were asked which label had the most useful information on calories.

Analysis

Statistical analyses were conducted using SPSS software (version 22.0; IBM Corp., Armonk, NY, USA; 2014). Chi-square tests were used to test for socio-demographic differences between experimental conditions. McNemar chi-square tests were used to test differences in proportions.

For Task 1 and 2, separate logistic regression models were fitted to examine the effect of labelling condition on correct responses (1 = correct, 0 = incorrect/don't know). Both outcomes were tested using chi-square tests to identify whether there were significant differences according to font size; if so, regression models were stratified by font size. For Task 1, there was a significant difference in font size, and thus separate models were run for *small font* and *large font*. The model included an indicator variable for labelling condition (*current*, *%DV only*, *high/low*

information, *infographic*, *RDI*, *traffic light*) to examine individual contrasts. An additional model was conducted with indicator variables for font size and labelling condition, and included an interaction term (*font size × labelling condition*) to examine differences in the efficacy of the various labelling conditions with small and large font. For Task 2, there was no significant difference between font size, and the model was not stratified. The model included an indicator variable for labelling condition. All analyses were conducted using sample weights, with the exception of the sample table, for which unweighted data are reported.

RESULTS

Study sample

Sample characteristics can be found in Table 1. There were no significant differences in socio-demographic measures among the experimental conditions in either of Tasks 1 or 2.

Perceptions of calories

More than half (62.0%) of participants reported looking at calorie information "often" or "always" when they looked at the NFT on a food package either in the store or at home. Calories were the nutrient most commonly looked at "often" or "always", and were looked at significantly more than the next most commonly viewed nutrients, which included total fat (54.8% of participants; $\chi^2 = 45.09$, $p < 0.001$), sugars (54.5%; $\chi^2 = 43.00$, $p < 0.001$), serving size (52.0%; $\chi^2 = 77.42$, $p < 0.001$) and sodium (50.8%; $\chi^2 = 93.79$, $p < 0.001$).

Task 1

Overall, just over half of the sample (50.9%) correctly recalled that the product contained 400 calories. Participants were significantly more likely to recall the number of calories in the product when calories were displayed in a large font compared to small font (61% vs. 42%, $\chi^2 = 66.67$, $p < 0.001$).

There was an overall effect of labelling condition for both small and large font, as shown in Figure 3 ($\chi^2 = 28.41$, $p < 0.001$ and $\chi^2 = 37.12$, $p < 0.001$ for small and large font respectively). Statistically significant contrasts among conditions are represented by matching letters in Figure 3. In the *small font* condition, the *traffic light* condition performed better than all the other conditions: those who saw the *traffic light* condition were more likely to respond correctly than those who saw the *current* labelling condition (OR = 2.47, 95% CI 1.61–3.80, $p < 0.001$), the *%DV* condition (OR = 2.15, 95% CI 1.37–3.38, $p = 0.001$), the *high/low* condition (OR = 2.66, 95% CI 1.70–4.18, $p < 0.001$), the *RDI* condition (OR = 2.53, 95% CI 1.64–3.90, $p < 0.001$) and the *infographic* condition (OR = 1.79, 95% CI 1.16–2.76, $p = 0.009$).

In the *large* font condition, those who saw the *current* condition were more likely to respond correctly than those in the *%DV* condition (OR = 2.00, 95% CI 1.28–3.13, $p = 0.002$), the *high/low* condition (OR = 2.84, 95% CI 1.82–4.43, $p < 0.001$) and the *infographic* condition (OR = 1.66, 95% CI 1.07–2.60, $p = 0.025$). Those in the *RDI* condition were more likely to respond correctly than those in the *%DV* condition (OR = 1.96, 95% CI 1.26–3.04, $p = 0.003$), the *high/low* condition (OR = 2.77, 95% CI 1.78–4.31, $p < 0.001$) and the *infographic* condition (OR = 1.62, 95% CI 1.05–2.52, $p = 0.031$). Those in the *infographic* condition were more likely to respond correctly than those in the *high/low* condition (OR = 1.71, 95% CI 1.10–2.65, $p = 0.017$). Finally, those in the *traffic light* condition were more likely to respond correctly than those in the *%DV* condition (OR = 1.92, 95% CI 1.22–3.03, $p = 0.005$), the *high/low* condition (OR = 2.72, 95% CI 1.72–4.29, $p < 0.001$) and the *infographic* condition (OR = 1.59, 95% CI 1.01–2.51, $p = 0.045$).

In the model including an interaction term, the interaction between font size and condition was significant ($\chi^2 = 21.09$, $p = 0.001$). Compared to the difference between small and large font in the *current* condition, there was significantly less difference between font sizes in the *%DV* condition (OR = 2.30, 95% CI 1.22–4.32, $p = 0.01$), the *high/low* condition (OR = 2.63, 95% CI 1.40–4.96, $p = 0.003$), the *infographic* condition (OR = 2.30, 95% CI 1.23–4.28, $p = 0.009$) and the *traffic light* condition (OR = 2.58, 95% CI 1.37–4.84, $p = 0.003$).

Table 1. Sample characteristics of the actual non-weighted sample who completed the online survey and were included in the sample ($N = 2008$)

Characteristic	% (*n*)
Gender	
Male	49.9% (1001)
Female	50.1% (1007)
Age (years)	
16–18	50.0% (1004)
19–21	25.0% (503)
22–24	25.0% (501)
Ethnicity	
White	58.4% (1173)
Other	38.4% (771)
Not stated	3.2% (64)
Region	
BC	18.3% (368)
Prairies (AB, SK, MB)	23.3% (468)
Ontario	41.8% (839)
Quebec	6.2% (124)
Atlantic provinces (NS, NB, PEI, NL)	8.6% (173)
Not stated	1.8% (36)
BMI (kg/m^2)	
<18.5 (underweight)	10.4% (209)
18.5–24.9 (normal weight)	56.2% (1129)
25.0–29.9 (overweight)	14.8% (297)
30+ (obese)	7.0% (140)
Not reported	11.6% (233)

Task 2

In Task 2, the same NFT as in Task 1 was returned to the screen, and participants were asked to identify the number of servings of the product that would equal their recommended daily value for calories. Overall, 43.0% of the sample answered this question correctly.

There were no significant differences in font size. As shown in Figure 4, there was a significant effect of calorie format on correct responses ($\chi^2 = 178.27$, $p < 0.001$). Participants who saw the *%DV* condition were more likely to respond correctly than those in the *current* condition (OR = 2.78, 95% CI 2.03–3.82, $p < 0.001$), the *high/low* condition (OR = 2.78, 95% CI 2.00–3.85, $p < 0.001$), the *RDI* condition (OR = 2.42, 95% CI 1.77–3.30, $p < 0.001$) and the *traffic light* condition (OR = 2.88, 95% CI 2.09–3.99, $p < 0.001$). Those who saw the *infographic* condition were significantly more likely

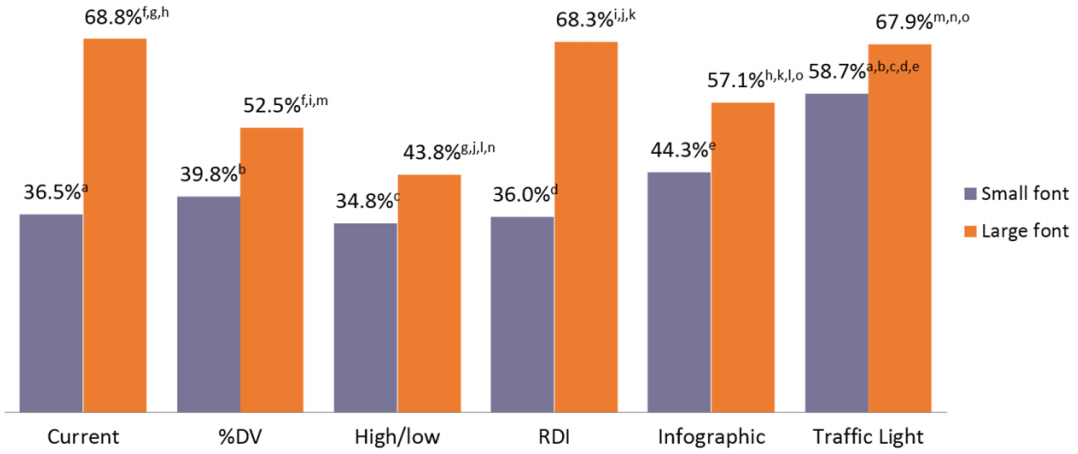

Figure 3. Percentage of respondents who correctly recalled calorie amounts in each labelling condition. "How many calories are in one serving of this product?" * Values with the same letters are significantly different at the $p < 0.05$ level (e.g., "a" denotes that the *current* labelling condition with small font produced significantly different recall in respondents than the *traffic light* condition with small font)

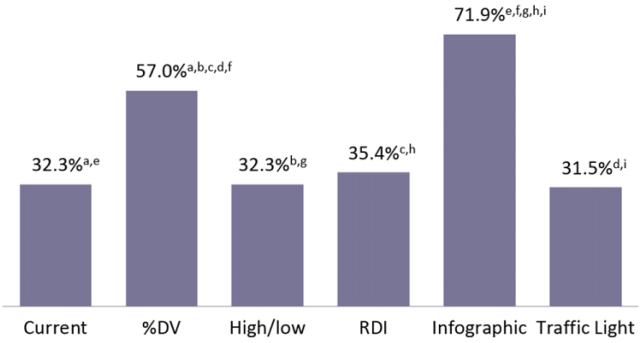

Figure 4. Percentage of respondents who correctly identified the number of servings per RDI (small and large fonts combined). "How many servings of this product would equal your recommended daily value for calories?" * Values with the same letters are significantly different at the $p < 0.001$ level

to respond correctly compared to those in the *current* condition (OR = 5.37, 95% CI 3.87–7.46, $p < 0.001$), the *%DV* condition (OR = 1.93, 95% CI 1.39–2.69, $p < 0.001$), the *high/low* condition (OR = 5.36, 95% CI 3.82–7.52, $p < 0.001$), the *RDI* condition (OR = 4.66, 95% CI 3.37–6.45, $p < 0.001$) and the *traffic light* condition (OR = 5.57, 95% CI 3.98–7.79, $p < 0.001$).

Task 3

When shown the *small font (current Nutrition Facts table)* and *large font* calorie information side by side, significantly more participants found the *large font* version the more useful (66.8% vs. 33.2%, $p < 0.001$). When asked which of the six calorie conditions had the most useful information on calories, there were significant differences in the number of participants who selected each condition as most useful ($\chi^2 = 2539.69$, $p < 0.001$). The condition most commonly cited as most useful was the *infographic* condition (47%), followed by the *traffic light* (26%), *%DV* (14%), *RDI* (8%), *current* (2%), *high/low* (2%) and "Don't know" (1%).

DISCUSSION

The current study demonstrates that increased font size and novel labelling formats can improve recall and comprehension of calorie content among young people. The young people in this study looked at calorie information more than any other nutrient displayed in the NFT, suggesting that calorie information is important to this population, even more so than "hot topic" nutrients such as sodium and sugars.

When asked to recall information they had seen only briefly, larger font size was more salient to participants. The calorie labelling formats performed differently within each font size condition, with the traffic light symbol being most effective with the small font size, and Canada's current NFT with no additional changes being most effective with the large font size, followed closely by the RDI and traffic light conditions. The high performance of the traffic light symbol in this study is consistent with previous research suggesting that traffic light labels improve attentional capture and increase consumers' understanding and correct interpretation of nutrient levels in food products.[19,20] The high performance of Canada's current NFT with the large font size may be explained by the fact that participants were shown NFTs that included additional and unfamiliar information with only a limited time for review. The conditions with lower performance all contained additional information in the calories heading, which may have distracted attention from the calorie number and led to poor performance in the recall task. The brief exposure to the nutrition information in this task was intentionally selected to replicate how consumers may interact with this information in a natural setting, where they may only glance briefly at nutrition information. Maximizing the salience of calorie information through large font size may be particularly important in the "real world" retail setting, with time pressures and many competing factors for consumers' attention.

Both the %DV and infographic formats, which provide contextual information immediately beside calorie information, helped young people comprehend calorie information in the context of daily recommended limits better than Canada's existing format and the other calorie labelling formats. The RDI statement performed fairly poorly, even in Task 2 when it would be expected to help the most with consumers' comprehension of calories in context of daily recommended limits. This may be due to its placement at the bottom of the NFT. Findings from previous eye tracking research have shown that consumers are less likely to view components located near the bottom of an NFT; most people stop reading after the first few lines.[21] These results may be indicative of what can be expected from Canada's recommendations to introduce a footnote explaining %DV at the bottom of the NFT, as well as the similar footnote currently used and proposed to be updated on the US nutrition labels.[11,12]

Policy-makers should be clear on the desired outcome of a policy when considering new calorie labelling formats. If the goal is to increase attentional capture and recall of calorie information among consumers, it may help to increase the font size or to add coloured symbolic formatting such as a traffic light symbol. If a policy aims to increase consumer understanding of how a particular food product's caloric content fits into the context of a total diet, then using the infographic or %DV formats may be important. The infographic format, which was also identified as most useful by respondents in this study, may be the best option to capture both of these goals.

Limitations and strengths

This survey was performed on a sample of adolescents and young adults, and therefore may not be applicable to other populations. The results of this study are also limited to six specific labelling formats, and therefore may exclude other possible formatting approaches. Further limitations of the study include a non-probability-based sample, and the use of an online survey, which may not represent how consumers naturally interact with nutrition labels in a real-world setting.

Despite limitations of the online survey, it also allowed the display of real food images, the manipulation of these images for each NFT, and randomization of participants to groups. Additional strengths of this study include a sample weighted for age, gender and geographic region based on the Canadian 2011 NHS, and the use of a between-subjects experimental design.

CONCLUSIONS

Overall, the results suggest a potential benefit from increased font size and prescriptive labelling formats for calorie content in packaged food products. Improving the prominence and comprehensibility of calorie content on food labels can aid consumers in making better food purchasing decisions, and make it easier for them to better tailor their calorie consumption to that of a healthy diet.

The findings from this study have implications for food labelling policies. The current study was developed for Canadian NFTs; however, many of the modifications can also be applied to the nutrition labels of the US and other jurisdictions. The enlarged font size used in this study is similar to that proposed in the US.[12] In Canada, stakeholders have expressed concern that too great a focus on calories could detract from other important factors when choosing healthy foods, therefore the proposed font size increase is not to the same extent as that used in this study.[22] Despite concerns over the emphasis on calories, excess energy intake remains the primary determinant in population-level changes in obesity. In addition, more consumers seek calorie information from NFTs than any other type of information. Future research should compare varying increases in calorie font size in order to find a balance between calorie information that is noticeable and comprehensible, without detracting from the other important nutrients displayed on the NFT. In addition, future research should assess differences in label use and effectiveness between categories of key demographic variables such as age, gender and BMI. The findings of this study, including the notable performance of the prescriptive labelling formats, can help to direct labelling policy decisions in Canada, as well as any other country considering changes to nutrition labels.

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RÉSUMÉ

OBJECTIFS : Dans plusieurs pays, on propose des modifications à l'étiquetage des calories dans les tableaux « Valeur nutritive » (TVN) apposés sur les aliments préemballés. Comme la plupart des études publiées jusqu'à maintenant portent sur l'utilisation générale des TVN, on manque de données probantes pour guider l'apport de modifications précises à la conception des étiquettes indiquant la teneur en calories. Notre étude porte sur l'efficacité de divers formats d'étiquetage des calories pour ce qui est de la mémorisation et de la compréhension de la teneur en calories et des préférences des consommateurs à cet égard.

MÉTHODE : Nous avons mené des expériences dans le cadre d'un sondage en ligne auprès d'un échantillon national de 2 008 Canadiens de 16 à 24 ans. Durant la tâche n° 1, nous avons montré aux participants l'un de six formats d'étiquetage (p. ex., *% valeur quotidienne*, *Feu de signalisation*) avec les calories indiquées en petits ou en gros caractères, et nous leur avons demandé de mémoriser le nombre de calories. La tâche n° 2 a permis d'examiner la compréhension des calories dans le contexte de l'apport quotidien recommandé (AQR) à l'aide du même TVN que pour la tâche n° 1. Durant la tâche n° 3, les participants ont indiqué leurs formats d'étiquetage préférés.

RÉSULTATS : Les TVN avec les calories en gros caractères ont amélioré la mémorisation des calories ($p < 0{,}001$). Quand les petits caractères étaient affichés, le format *Feu de signalisation* est celui qui a optimisé la mémorisation ($p < 0{,}01$). Avec les gros caractères, la mémorisation a été optimisée avec les formats *Actuel*, *AQR* et *Feu de signalisation* ($p < 0{,}05$ dans les trois cas). La compréhension des portions selon l'AQR a été maximisée avec le format *Infographique*, sans différence attribuable à la taille des caractères ($p < 0{,}001$). Les répondants ont préféré les modèles à gros caractères et le format *Infographique* ($p < 0{,}001$).

CONCLUSIONS : Des améliorations à la visibilité et à la conception peuvent améliorer l'efficacité de l'étiquetage des calories sur les aliments préemballés. Nos constatations ont des conséquences directes pour les modifications proposées à l'étiquetage des calories dans les TVN au Canada et aux États-Unis.

MOTS CLÉS : politique nutritionnelle; politique sanitaire; étiquetage aliments; rations alimentaires recommandées