Research Article

Knowledge of Recommended Calorie Intake and Influence of Calories on Food Selection Among Canadians

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ABSTRACT

Objective: To examine knowledge of recommended daily calorie intake, use of calorie information, and sociodemographic correlates between knowledge and use.

Design: Population-based, random digit–dialed phone surveys.

Participants: Canadian adults (n = 1,543) surveyed between October and December, 2012.

Main Outcome Measures: Knowledge of recommended calorie intake and use of calorie information when purchasing food.

Analysis: Regression models, adjusting for sociodemographics and diet-related measures.

Results: Overall, 24% of participants correctly stated their recommended daily calorie intake; the majority (63%) underestimated it, whereas few (4%) overestimated it. Females, younger participants, those with a higher income and more education, and those who consumed fruits and vegetables at least 5 times daily were significantly more likely to state recommended intake correctly. Most respondents (82%) reported considering calories when selecting foods. Respondents considered calories more often if they were female, had a higher income and more education, perceived themselves to be overweight, were actively trying to control their weight, reported a healthier diet, or consumed fruits and vegetables at least 5 times daily.

Conclusions and Implications: Although most Canadians reported using calorie information to guide their food choices, few knew their daily recommended calorie intake. To promote healthy weights, policy initiatives, including education regarding daily calorie intake and changes to the Nutrition Facts table, may help consumers make better choices about food.

Key Words: nutrition, diet, food habits, health behavior, nutrition knowledge, overweight (*J Nutr Educ Behav*. 2016;48:199-207.)

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INTRODUCTION

An increasing proportion of Canadians are obese or overweight. In Canada, 61% of men and 44% of women are overweight or obese, including 18% of the population—approximately 4.5 million Canadians—who are obese.[1] In the past 15 years, the proportion of overweight individuals has steadily risen.[2] The rise in obesity has been accompanied by an increase in diet-related chronic disease, including diabetes and heart disease.[3]

Poor diet quality is the primary risk factor responsible for the increased prevalence of obesity.[4] In recent decades, dietary habits have changed as a result of the significant shift in lifestyle, including busier schedules, increased responsibilities in the workplace, and greater demands on family life.[5] The need and desire for convenience in food preparation and consumption have led to an increase in the use of prepackaged foods and eating outside the home.[6,7] Time spent in grocery stores must be quick and efficient, resulting in purchases that are mostly habit-based and automatic.[8]

Nutrition labels on prepackaged foods are the most commonly used source of nutrition information reported by Canadians.[9] In Canada, prepackaged foods must display a Nutrition Facts table (NFT), which provides information on 13 core nutrients and the number of calories per serving.[10,11] Previous research indicates that calories are 1 of the most frequently consulted types of nutrition information, both generally and on NFTs specifically.[9,12,13] However, it remains unclear how many individuals

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understand the context for calorie information, including how calorie amounts correspond to the recommended daily levels of energy intake.[12] To date, there is little information regarding the extent to which consumers are aware of recommended levels of energy consumption required to maintain a healthy weight. A qualitative study on the use and understanding of nutrition labels found that although participants claimed to understand nutrition labels, comprehension of what constituted a high-calorie food and knowledge of personal daily caloric needs were low.[12] Furthermore, poor comprehension of the NFT deterred individuals from consulting the labels.[12] Other qualitative research has found that few consumers refer to the daily value for nutrients: Participants were unclear about to whom the calorie and nutrient values applied and how this information was relevant to their own dietary requirements.[13] To the authors' knowledge, no published studies have examined whether Canadian consumers are aware of the calorie levels that are required to maintain their current weight.

Reading and using the nutrition information on labels, including the number of calories, may be an important way to help direct consumers toward healthier foods and maintaining healthier diets.[14,15] Daily recommended intake values are not provided for calories in Canadian NFTs. However, Health Canada provides recommendations for energy intake based on sex, age, and activity level as part of Canada's Food Guide.[16] To date, the extent to which Canadians are aware of Health Canada's guidelines and how they perceive their daily calorie targets remain unclear. The current study examined 3 primary research questions: (1) What proportion of Canadian adults can accurately report their daily recommended caloric intake? (2) How frequently do Canadians report using calorie information when making food selections? (3) Is awareness of daily recommended calorie intake related to the frequency of using calorie information to guide food selection? The study also examined associations of these main outcomes with sociodemographic and diet-related factors.

METHODS

The current analysis examined Canadian data from a larger study conducted in both Canada and the US to investigate nutrition labeling on menus.[17] Population-based telephone surveys were conducted with 3,000 adults, 1,000 each in the US, the province of British Columbia (BC), and the rest of Canada, to examine and compare the impact of changes to labeling policies in the US and BC. The larger study included questions about the frequency of visiting restaurants, factors affecting food choices, awareness and use of nutrition information, as well as a range of sociodemographic information.

Participants and Recruitment

Participants were recruited using random digit dialing. Probability-based samples were recruited in Canada (excluding BC and the territories) and within the province of BC, with oversampling in BC owing to the design of the larger study. British Columbia sought to evaluate the implementation of a voluntary nutritional labeling intervention in restaurants. Participants were contacted via landlines and cell phones using data purchased from ASDE Survey Sampler (Gatineau, Quebec, Canada). Landline records were created from a modified Mitofsky–Waksberg method and geographically stratified. The Mitofsky–Waksberg method for random digit dialing involves a 2-stage design clustered approach to reduce the number of unproductive calls. Cell phone records were created by random generation given the absence of published lists, resulting in a modified approach.[18] Participants recruited via landline were selected from within a household using the next-birthday method, whereas those recruited via cell phone were treated as a single-person household. The next-birthday method, which is used to select a sample that is representative of all household members, is done by asking the respondent what person in the household is expected to have the next birthday.[19] Trained interviewers contacted potential participants, ascertained eligibility, and obtained verbal consent from selected participants. Phone numbers determined to be fax lines, businesses, not in service, or with no eligible respondents in the household were considered ineligible. Participants were not eligible if they were under 18 years of age or if there was a significant language barrier. Interviews were conducted in English and French by trained interviewers at the Survey Research Centre at the University of Waterloo.

The current study included only Canadian participants (n = 2,001), and an additional 53 participants were deleted because of incomplete information, leaving a sample of 1,948 participants for analysis.

Study Protocol

Interviews were conducted from October to December, 2012. Approximately 8% of completed interviews came from cell phone numbers and 92% from landlines. In Canada, 79% of households had a landline in 2013.[20] Calls were made throughout the week, except for Saturdays. Weekday calls were made during daytime hours and evening hours, with a larger volume of calls made in the evening owing to a higher response rate (74.1%) compared with daytime calls (25.9%). A maximum of 14 call attempts were made per phone number, although the majority of completed interviews (67.6%) were completed in ≤ 3 call attempts. The mean length of completed interviews was 17 minutes. The researchers obtained verbal consent after introduction, before any survey questions were asked. The study was reviewed by and received clearance from the Office of Research Ethics at the University of Waterloo, Waterloo, Ontario, Canada.

Measures

Demographics. Demographic information included sex, age group (age 18–24, 25–34, 35–54, or ≥ 55), ethnicity (white or other), annual household income (< $40,000, $40,000–< $80,000, ≥ $80,000, or not reported), and education (high school or less, some additional training [trade certificate or diploma below the bachelor's level], or higher education [bachelor's degree or greater]). Body mass index (BMI) was

calculated from self-reported height and weight, and classified according to the International Classification as defined by the World Health Organization (underweight, < 18.50; normal range, 18.50–24.99; overweight, 25.00–29.99; obese, ≥ 30.00; or not reported).[21]

Diet-related measures. The researchers assessed weight perception by asking, "Do you consider yourself now to be … overweight, underweight, or about the right weight?" Weight-related efforts were determined by asking, "Which of the following are you trying to do about your weight …lose weight, gain weight, stay the same weight, or are you not trying to do anything about your weight?" Perceived diet quality was determined by asking, "In general, how healthy is your overall diet?" Response options included poor, fair, good, very good, and excellent. Measures for weight perception, weight-related efforts, and perceived diet quality were adapted from the National Health and Nutrition Examination Survey of Diet Behavior and Nutrition, 2009–2010.[22] A measure of fruit and vegetable consumption was created by adapting Canadian Community Health Survey questions asking how often a participant consumed fruit juice, fruit, green salad, potatoes (excluding french fries, fried potatoes, or potato chips), carrots, and other vegetables (respondents could indicate the number per day, per week, per month, per year, or never).[23] Total daily fruit and vegetable consumption was then calculated and categorized as < 5/d or at least 5/d, a threshold used in other Canadian research.[24,25]

Calorie measures. Knowledge of recommended calorie intake was assessed by asking, "On average, how many calories should a healthy, moderately active adult [male/female] consume each day to maintain a healthy weight?" Numeric responses (limited to between 0 and 100,000) were then classified as correct or not, based on Health Canada recommendations for daily energy requirements.[16] Although the recommendations vary according to sex, age, and activity level,[16] correct responses were defined broadly to include the sex-specific ranges for all adult age groups and activity levels: 2,200–3,000 calories for men and 1,750–2,350 calories for women.

The influence of calories on food selection was measured by asking, "On a scale from 1 to 10, where 1 is never and 10 is always, how often do you consider calories when deciding what foods to buy?" using a 10-point scale.

Analysis

A total of 53 participants were excluded from the sample for incomplete data for sex, age, education, fruit and vegetable consumption, weight perception, weight-related efforts, perceived diet quality, and recommended calorie intake. Incomplete data for BMI and income were recoded as not reported. Incomplete data for ethnicity was recoded as other. Eight participants selected "don't know" for the influence of calories on food selection; their values were recoded to 1 (never). The final sample included in regression models was 1,948 participants.

Univariate results are reported using means and SDs for continuous outcomes and percentages for binary outcomes. A logistic regression model was fitted to examine correlates of correctly identifying daily recommended calorie intake. A linear regression model was fitted to examine correlates of the frequency of using calorie information to guide food selection, in which a higher score indicates greater frequency (range, 1–10). The authors used the Durbin–Watson statistic to confirm the independence of observations and used plots to verify assumptions of homoscedasticity and normal distribution and to identify potential outliers. Each regression model included sex, age group, BMI, ethnicity, income, education, weight perception, weight-related efforts, perceived diet quality, and fruit and vegetable consumption. Pairwise contrasts for levels within a variable are shown if the effect of the overall variable was significant. The relationship between the awareness of recommended calorie intake and the influence of calories on food selection was tested using a Mann–Whitney–Wilcoxon test. All analyses were

Table 1. Demographic, Weight-Related, and Diet-Related Characteristics of the Study Sample (n = 1,948)

Characteristic	% (n)
Sex	
Male	41.5 (809)
Female	58.5 (1,139)
Age	
Mean (SD)	52.2 (16.3)
Age, y	
18–24	4.8 (94)
25–34	10.4 (203)
35–54	34.5 (672)
≥ 55	50.3 (979)
Ethnicity	
White	87.5 (1,704)
Other	12.5 (244)
Income	
< $40,000	22.7 (443)
$40,000 to < $80,000	29.1 (566)
≥ $80,000	31.1 (605)
Not reported	17.1 (334)
Education	
High school or less	27.4 (534)
Some additional training	36.5 (711)
Higher education	36.1 (703)
Body mass index[a]	
Underweight	1.8 (35)
Normal weight	41.0 (798)
Overweight	29.3 (571)
Obese	15.7 (305)
Not reported	12.3 (293)
Weight perception	
Overweight	38.3 (746)
Underweight	3.2 (62)
About the right weight	58.5 (1,140)
Weight-related effort	
Lose weight	40.6 (790)
Gain weight	3.6 (71)
Stay the same weight	27.7 (539)
No current weight efforts	28.1 (548)
Perceived diet quality	
Poor	2.6 (50)
Fair	15.9 (309)
Good	38.1 (743)
Very good	34.1 (664)
Excellent	9.3 (182)
Daily fruit and vegetable consumption	
< 5/d	53.3 (1,039)
≥ 5/d	46.7 (909)

[a]Percentages may not add up to 100 due to rounding.

conducted using SPSS (version 21, IBM Corp, Armonk, NY, 2012).

RESULTS

Sample Characteristics

Table 1 shows sample characteristics of participants included in the analysis (n = 1,948). Nearly 60% of participants were female and more than 80% were white. Less than half of the sample (41%) had a self-reported BMI within normal range, and 45% was overweight or obese.

Recommended Calorie Intake

Overall, 24.4% of individuals stated a recommended daily calorie intake within the acceptable range of correct responses. Responses ranged from 1 to 160,000 kcal/d, with the majority of participants underestimating caloric needs (64.1%) and only 3.5% overestimating the recommended daily amount. Figure 1 shows the proportion of participants who correctly stated recommended calorie intake, by sociodemographic, weight-related, and diet-related measures.

Table 2 shows the results of a logistic regression model examining correlates of correctly stating the recommended caloric intake. Sex, age, income, education, and fruit and vegetable consumption were significantly associated with knowledge of calories based on Health Canada recommendations for daily energy requirements.[16] Participants were more likely to estimate recommended caloric intake correctly if they were female, aged 25–34 or 35–54 years (vs aged ≥ 55 years), had some additional training or higher education (vs high school education or less), had an annual household income of ≥ $80,000 (vs < $40,000, $40,000 to < $80,000, and those who did not report income), or consumed fruits and vegetables ≥ 5 times/d. Body mass index, ethnicity, weight perception, weight-related efforts, and perceived diet quality were not significantly associated with correctly estimating caloric intake.

Influence of Calories on Food Selection

Figure 2 shows the distribution of responses for use of calories when making food purchases. On a scale from 1 (never) to 10 (always), the mean score was 5.4 (SD, 2.9). The largest proportion of participants selected 1 (18.2%) and the second largest proportion selected 8 (15.9%). Scores on the calorie influence scale were significantly associated with knowledge of the recommended daily calorie intake ($P < .05$). Using parametric testing, those who identified a correct

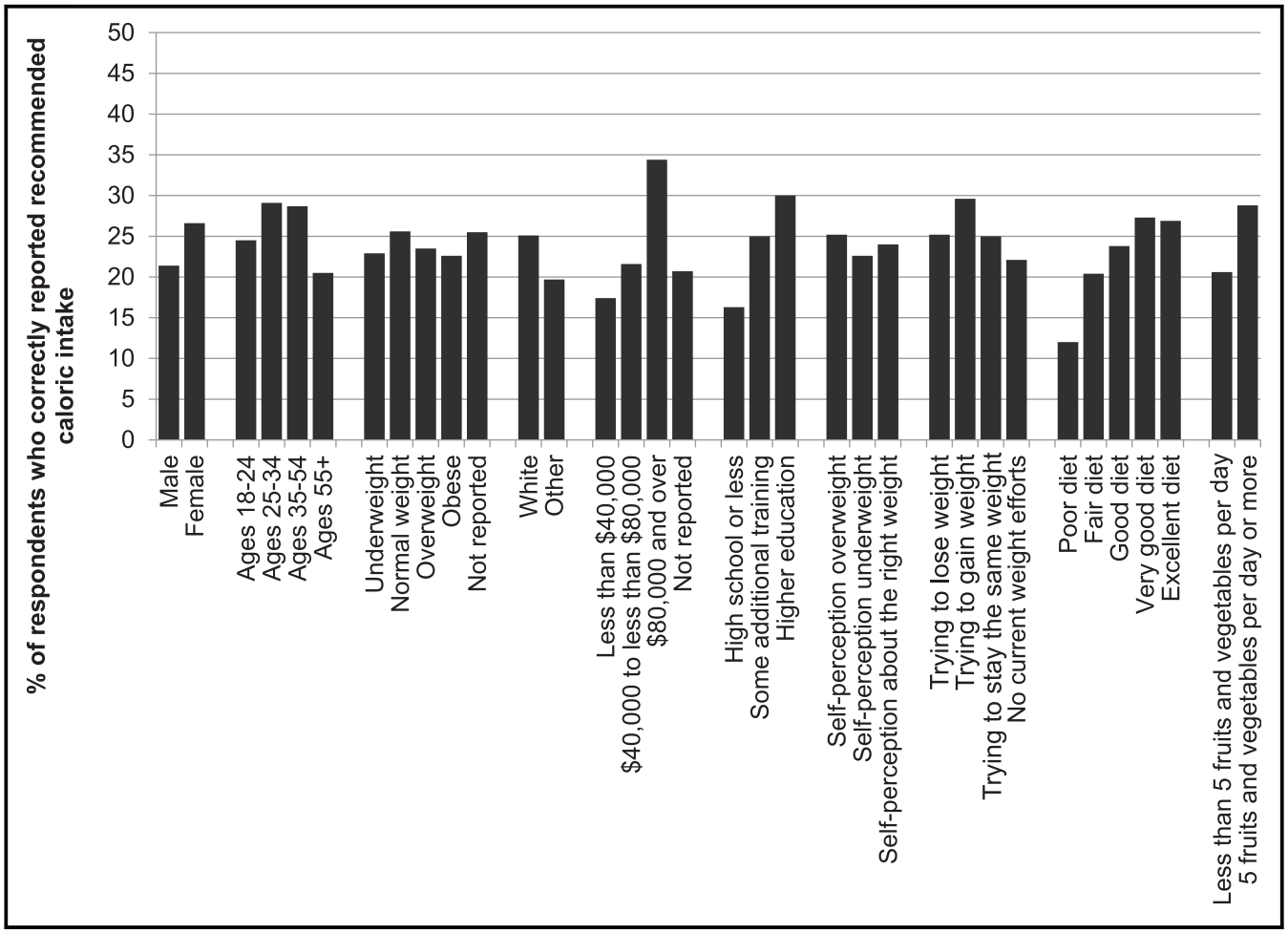

Figure 1. Proportions of respondents correctly reporting recommended calorie intake, by sociodemographic, weight-related, and diet-related variables (n = 1,948).

Table 2. Estimates for Pairwise Comparisons From a Logistic Regression Model for Correctly Reporting Recommended Calorie Intake (n = 1,948)

Characteristic	Odds Ratio (95% Confidence Interval)	*P*
Sex		
Female vs male	1.36 (1.07–1.73)	.01
Age, y		.003
25–34 vs 18–24	0.98 (0.54–1.77)	.94
35–54 vs 18–24	0.88 (0.51–1.52)	.65
≥ 55 vs 18–24	0.65 (0.38–1.12)	.12
35–54 vs 25–34	0.90 (0.63–1.30)	.58
≥ 55 vs 25–34	0.67 (0.46–0.95)	.03
≥ 55 vs 35–54	0.74 (0.58–0.94)	.01
Body mass index[a]		.99
Ethnicity		
White vs other		.06
Income		< .001
$40,000 to < $80,000 vs < $40,000	1.21 (0.87–1.68)	.26
≥ $80,000 vs < $40,000	2.05 (1.48–2.84)	< .001
Not reported vs < $40,000	1.14 (0.79–1.65)	.49
≥ $80,000 vs $40,000 to < $80,000	1.70 (1.29–2.23)	< .001
Not reported vs $40,000 to < $80,000	0.94 (0.67–1.33)	.73
Not reported vs ≥ $80,000	0.56 (0.40–0.78)	.001
Education		.002
Some additional training vs high school or less	1.45 (1.08–1.94)	.01
Higher education vs high school or less	1.73 (1.28–2.34)	< .001
Higher education vs some additional training	1.20 (0.93–1.53)	.16
Weight perception[a]		.18
Weight-related effort[a]		.19
Perceived diet quality[a]		.73
Daily fruit and vegetable consumption		
≥ 5/d vs < 5/d	1.32 (1.05–1.66)	.02

[a]Statistics for pairwise comparisons are not shown because the overall effect of the variable was not significant.

recommended daily caloric intake had a significantly higher mean score ($\overline{x} = 5.8$, $P < .05$) on the calorie influence scale than did those who did not ($\overline{x} = 5.2$, $P < .05$).

Table 3 shows the results of a linear regression model examining the influence of calories on food selection based on how often calories are considered when deciding what foods to buy, by sociodemographic characteristics, weight-related, and diet-related measures. Participants were more likely to consider calories more frequently if they were female, reported an income of ≥ $80,000, had a higher education, perceived themselves to be overweight (vs about the right weight), were trying to lose weight or stay the same weight, and consumed fruits and vegetables ≥ 5 times/d. Age, BMI, and ethnicity were not significantly associated with the influence of calories on food selection.

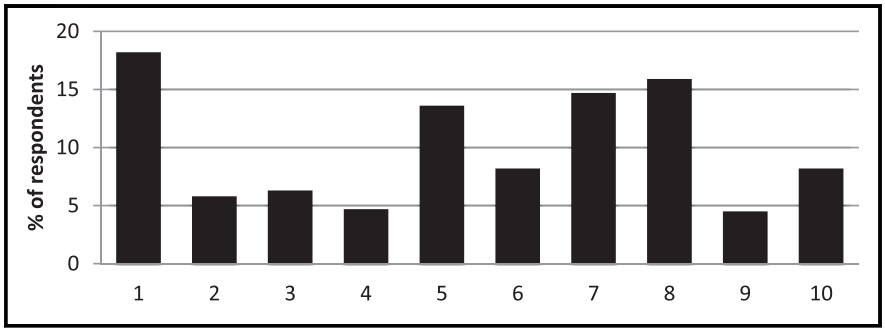

Figure 2. Distribution of participant responses to frequency of considering calories when deciding what foods to buy (n = 1,948). Note: Response option 1 was never and option 10 was always.

DISCUSSION

The findings indicate that a majority of participants could not correctly recall the caloric intake recommended by Health Canada to maintain a healthy weight. Fewer than 1 in 4 participants were able to correctly state a daily caloric intake within the correct range for their sex. This is consistent with findings from a US study in which fewer than one third of respondents provided a correct response for recommended caloric intake.[26]

Several sociodemographics were significantly associated with calorie knowledge. Females were more likely to state recommended caloric intake correctly, which is consistent with previous research showing that females score higher than males in nutrition knowledge tests.[27] Younger participants were also more likely to answer correctly. This may reflect a greater focus on nutrition education in Canadian schools in recent decades.[28-31] Participants with higher education and income were more likely to state recommended caloric intake correctly and also reported using calorie information for food selection more often. Numerous studies have documented better understanding and knowledge of nutrition recommendations among those with higher education levels and socioeconomic status and higher levels of employment (executive/white collar vs blue collar, full time vs part time, etc).[27,32-34] For example, a Canadian study found that participants with a higher education and income were more likely to estimate calorie content and percent daily value correctly from a nutrition label,[32] and a study of

Table 3. Estimates for All Pairwise Comparisons From a Linear Regression Model for Influence of Calories on Food Selection (n = 1,948)

Characteristic	β	SE	P
Sex			
Female vs male	1.19	0.13	< .001
Age group[a]			.48
Body mass index[a]			.87
Ethnicity[a]			.05
Income			.001
$40,000 to < $80,000 vs < $40,000	.22	0.17	.19
≥ $80,000 vs < $40,000	.66	0.17	< .001
Not reported vs < $40,000	.42	0.19	.03
≥ $80,000 vs $40,000 to < $80,000	.45	0.16	.004
Not reported vs $40,000 to < $80,000	.20	0.18	.27
≥ $80,000 vs not reported	.25	0.18	.18
Education			.01
High school or less vs some additional training	.01	0.15	.97
Higher education vs high school or less	.40	0.16	.01
Higher education vs some additional training	.41	0.14	.01
Weight perception			.02
Overweight vs underweight	.79	0.41	.05
Overweight vs about the right weight	.44	0.17	.01
About the right weight vs underweight	.35	0.37	.35
Weight-related effort			< .001
Lose weight vs gain weight	1.78	0.38	< .001
Lose weight vs stay the same weight	.40	0.17	.02
Lose weight vs no effort	1.96	0.16	< .001
Stay the same weight vs gain weight	1.38	0.37	< .001
Gain weight vs no effort	.17	0.37	.64
Stay the same weight vs no effort	1.55	0.16	< .001
Perceived diet quality			< .001
Fair vs poor	.76	0.40	.05
Good vs poor	1.46	0.38	< .001
Very good vs poor	2.18	0.39	< .001
Excellent vs poor	1.86	0.42	< .001
Good vs fair	.69	0.18	< .001
Very good vs fair	1.42	0.19	< .001
Excellent vs fair	1.09	0.26	< .001
Very good vs good	.72	0.14	< .001
Excellent vs good	.40	0.22	.07
Very good vs excellent	.32	0.22	.13
Daily fruit and vegetable consumption			
≥ 5/d vs < 5/d	.45	0.13	< .001

[a]Statistics for pairwise comparisons are not shown because the overall effect of the variable was not significant.

Belgian women reported that education was the most important determinant of nutrition knowledge.[33] The influence of calories on food selection was rated higher among respondents with higher income levels, which may reflect the wider range of food options available and affordable to them, whereas those with a lower income may be more restricted by their options.[35] Healthy foods (ie, those that are nutrient-rich) tend to be more expensive than less healthy food options (ie, those that are nutrient-poor and generally energy-dense).[36,37]

Most participants considered calories when making food selections. Fewer than one fifth of participants from the current study reported never considering calories when making food purchases. This is consistent with previous findings that calories are one of the most sought-after components of nutrition information among Canadians.[9,12,13]

Previous research is consistent with the findings from the current study, in which women reported using calorie information more often than men. Previous research found that label

use differs by sex, with women more likely to consult the Nutrition Facts table[38] and more likely to order lower-calorie food items in response to calorie labeling.[39]

Among participants who perceived themselves to be overweight, calories were reportedly considered more often than among participants who perceived themselves to be underweight or about the right weight. Participants trying to control their weight (by losing or maintaining weight) were nearly twice as likely to consider calories, presumably because calorie counting and low-calorie diets are popular strategies for weight control.[40,41] Moreover, a self-reported healthier diet was also associated with considering calories more often. Calories are an important component in weight management, and these findings highlight gaps in understanding calories and applying this component of nutrition information.

There were no significant associations between the main outcomes and BMI or ethnicity. Previous studies in both youth and adult populations also reported no significant associations between levels of nutrition knowledge or use of calorie information and BMI or ethnicity.[42-45]

As expected, knowledge of recommended daily calorie intake was associated with more frequent use of caloric information when making food selections. However, some respondents with knowledge of calorie recommendations did not frequently use it when making food selections and may benefit from better understanding of how to apply such knowledge to their food choices. Conversely, while most respondents reported using calorie information at least some of the time, relatively few respondents correctly recalled their recommended calorie range, suggesting that many people use calorie information without the context of knowing their daily recommended intake, and thus could be better informed about the recommendations.

Limitations

The study has some limitations common to population-based surveys, including potential sample bias. Participants in the current study had higher income and education than the national averages, likely owing to the survey method.[46] This study also had a higher proportion of females than the national population. Greater inclusion of more educated and female respondents may have resulted in an overestimation of the proportion who correctly identified calories based on Health Canada recommendations, because previous research indicates that females and groups with higher income and education tend to score higher in nutrition-related (labeling) tasks and may have greater understanding of nutrition labels and dietary needs.[32,34] In addition, self-reported data were used for indicators of diet-related behavior and BMI. Individuals tend to over-report diet quality, healthful dietary behaviors, and height, and to underreport weight, especially when asked directly by an interviewer, which may result in social desirability bias.[47,48]

Strengths of the study include using a large nationally based sample, which included participants from all provinces in Canada. With respect to the main outcome of awareness of recommended calorie intake, an unprompted recall task was used, which represents a more reliable assessment than prompted recall or recognition tasks.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Although most Canadian respondents reported using calorie information when selecting foods, few could indicate accurately how many calories they should consume to maintain their weight. Excess energy consumption is an important public health issue because of the increasing rates of obesity in Canada and the strong relationship between caloric intake and obesity. The important role that calorie information can have in consumer behavior is reflected in recently proposed changes to nutrition labels in Canada and the US that aim to increase the visibility of calorie information on food product labels.[49,50] However, increasing the prominence of calorie information may not translate to improved dietary behaviors if consumers are unable to interpret those numbers with respect to their daily intake and calorie needs. Although energy intake is only 1 component of a healthy diet, the current findings provide insight into consumers' basic understanding and context of calorie amounts and highlight the need for basic consumer education to provide a context for calorie numbers. Future studies should examine alternative formats for displaying calorie information on Nutrition Facts tables, such as providing a reference amount or using symbols to indicate low, moderate, and high values to aid understanding.[51] Future research should also include longitudinal studies to examine the effect of knowledge and education on the use of nutrition information and long-term weight outcomes.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.