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Do Canadian Adults Meet their Nutrient Requirements through Food Intake Alone?

Key findings:

- Five in 10 women and 7 in 10 men have energy intakes that exceed their energy needs.
- 25% of males and 23% of females, 19 years and older, have fat intakes above the Acceptable Macronutrient Distribution Range.
- 32% of males and 21% of females, 19 years and older, have carbohydrate intakes below the Acceptable Macronutrient Distribution Range.
- Many adults have inadequate intakes of magnesium, calcium, vitamin A and vitamin D (see Box 1).
- For nutrients with an Adequate Intake (AI), there is concern that Canadian adults may not be meeting their needs for potassium and fibre - although the interpretation of the adequacy of nutrients with an AI is limited.
- Canadian adults' sodium intakes are associated with an increased risk of adverse health effects.

Introduction

A healthy diet helps Canadians not only meet their nutrient needs, but can also help reduce the risk of obesity, type 2 diabetes, heart disease, certain types of cancer, and osteoporosis. Monitoring the nutritional health of Canadians requires information on food and nutrient intakes. The Canadian Community Health Survey, Cycle 2.2 Nutrition (CCHS 2.2), conducted in 2004, provides food and nutrient intake data for Canadians of all ages (a brief summary of the survey can be found in Appendix A). Data on Canadians' usual nutrient intakes can be used to assess the prevalence of excessive or inadequate intakes of certain nutrients by comparing nutrient intakes to reference values found in the Dietary Reference Intakes (DRIs) (Definitions and uses of the DRIs are found in Appendices B & C)[1].

This article provides an assessment of the energy and nutrient intakes of Canadian adults aged 19 years and older using data from the CCHS 2.2 – Nutrient Intakes from Food: Provincial, Regional and National Summary Data Tables Volumes 1-3[2]. Intakes are derived from food and beverages only (i.e., the contribution of dietary supplements to nutrient consumption is not reflected in this article).

Assessment of Usual Intakes

Energy Intake

The interpretation of self-reported energy intake should be done with caution as energy intake tends to be underestimated by survey respondents[3]. Analysis of CCHS 2.2 data has revealed that energy intake was underreported by approximately 10 % in adults[4]. The Institute of Medicine (IOM) suggests using indicators of relative body weight, such as the Body Mass Index (BMI), as markers of energy intake adequacy within groups. Thus, the proportion of individuals with a BMI below, within or above the acceptable range for that age group can be assumed to represent the proportion with inadequate, adequate or excessive energy intake, respectively, relative to energy expenditure[5].

Body mass index was calculated using measured heights and weights collected in the CCHS 2.2. Around 42% of Canadian adult males and 30% of adult females had BMIs within the overweight range (25.0-29.9 kg/m^2), while 23% of men and 23% of women were considered

Canada

obese (BMI >30.0 kg/m^2). According to the CCHS 2.2, a mere 34% of men and 44% of women, age 18 and older, had weights falling within the normal range of BMIs (18.5-24.9 kg/m^2) (6). Based on these findings, it can be assumed that approximately seven in ten men 18 years of age and older had energy intakes in excess of their requirements, while approximately five in ten women 18 years of age and older had energy intakes in excess of their requirements.

Macronutrient Intakes

Carbohydrates, Protein, and Total Fat

Nearly 100% of Canadian adults consumed protein in quantities within the Acceptable Macronutrient Distribution Range (AMDR). With respect to carbohydrates and total fat intake, a smaller proportion of Canadian adults consumed these nutrients in quantities within the AMDRs. Thirty-two percent of males and 21% of females, 19 years of age and over, had carbohydrates intakes below the AMDR. Meanwhile, 25% of males and 23% of females, aged 19 years and older, had fat intakes above the AMDR (See Table 1).

Saturated, Monounsaturated and Polyunsaturated Fats

The mean percentage of Canadian adults' total energy intake from saturated fat was approximately 10%, while their mean intake from monounsaturated fat was approximately 12-13%. While the IOM has not set DRIs for saturated or monounsaturated fats, they do recommend that saturated fat intake remain as low as possible (while consuming a nutritionally adequate diet) due to its positive relationship with coronary heart disease risk[7]. Notably, the modeling exercise for the development of Canada's Food Guide yielded a food intake pattern that would meet the nutrient requirements of adults with an average saturated fat content of 5.8-7.2% total energy[8]. Therefore, it seems possible to lower Canadians' saturated fat intake without compromising nutrient adequacy by following Canada's Food Guide.

The percentage of Canadian adults' total energy intake from polyunsaturated fat was between 5.5 and 5.7%. Adequate intakes (AIs) have been established for two polyunsaturated fatty acids, α-linolenic acid (omega-3)

Table 1. Proportion of Canadian adults 19 years and older with macronutrient intakes below, within or above the Acceptable Macronutrient Distribution Ranges (AMDR) (2004)

Macronutrients	% adults below AMDR		% adults within AMDR		% adults above AMDR		Dietary Reference Intake AMDR (% of total energy intake)
	Men	Women	Men	Women	Men	Women	
Total fat							
19-30 years	<3	<3	81.7	88.4	18.0 [E]	F	25-35%
31-50 years	<3	<3	71.2	71.7	27.5	28.0	
51-70 years	<3	<3	76.2	75.8	23.0	23.3	
71+ years	3.1 [E]	<3	74.6	82.3	22.3	16.6	
19+	1.2 [E]	0.6 [E]	73.9	76.5	24.8	22.8	
Protein							
19-30 years	<3	<3	99.1	99.2	0.0	<3	10-30%
31-50 years	<3	<3	98.8	99.3	0.0	0.0	
51-70 years	<3	<3	100.0	100.0	0.0	0.0	
71+ years	<3	<3	100.0	99.8	0.0	0.0	
19+	<3	<3	99.8	99.6	0.0	0.0	
Carbohydrates							
19-30 years	22.8	8.5	76.4	90.9	<3	<3	45-65%
31-50 years	35.0	29.2	64.6	70.3	<3	<3	
51-70 years	35.9	22.0	63.8	77.5	<3	<3	
71+ years	21.7	11.3 [E]	76.9	80.1	<3	<3	
19+	31.8	21.5	67.6	77.9	0.6 [E]	0.6 [E]	

E : Data with a coefficient of variation from 16.6% to 33.3%; interpret with caution.
<3 : Data with a coefficient of variation greater than 33.3% with a 95% confidence interval entirely between 0 and 3%; interpret with caution.
F: Data with a coefficient of variation greater than 33.3%with a 95% confidence interval not entirely between 0 and 3%; suppressed due to extreme sampling variability.

and linoleic acid (omega-6). With respect to α-linolenic acid, Canadian men 19-70-years-old and women 19 and older had median intakes of this nutrient exceeding the AIs of 1.6 g/d and 1.1 g/d, respectively; therefore a low-prevalence of inadequate intakes is assumed. However, men over the age of 70 had a median intake of α-linolenic acid of 1.57 g/d compared to the AI of 1.6 g/d, therefore no assessment of adequacy can be made.

Adult Canadians of all age and gender groups had median intakes of linoleic acid that fell short of their respective AIs. Bearing in mind the pervasiveness of linoleic acid in the Canadian food supply, this result may seem surprising; thus, the way in which the AI for this nutrient was established is worth taking into consideration when trying to interpret this finding. The AI for linoleic acid is based on observed intakes from the United States, where the presence of linoleic acid deficiency is basically non-existent in the free-living population[7]. Yet, considering that linoleic acid deficiency is equally non-existent in the free-living population in Canada, and that the Canadian food supply may systematically provide less linoleic acid due to the preferential use of canola oil rather than soybean oil (the predominant oil in the United States), had the AI values been set based on Canadian observed intakes they may have been lower than the current DRI values. Therefore, an assessment of adults' linoleic acid intake using an AI based on Canadian data may have had a different outcome.

The linoleic acid: α-linolenic acid ratio is an indicator of the balance between omega-6 and omega-3 fatty acids in the diet. The IOM recommends a linoleic acid: α-linolenic acid ratio between 5:1 and 10:1[7]. However, it is recognized that this suggested ratio is based on limited data and that more research is needed in this area. According to CCHS 2.2 data, the ratio of omega-6 to omega-3 fatty acids in adults' diets fell within this range with ratios between 7:1 and 8:1, depending on the age and sex group.

Dietary Fibre

The AIs for fibre have been set at 14g/1000 kcal/day for all age groups 1 year and over. This translates to approximately 38 g/d for men 19-50, 30 g/d for men 51 and older, 25 g/d for women 19-50, and 21 g/d for women 51 and older. For each of these age and gender groups, the median fibre intake fell below their respective AIs. Thus, an assessment of Canadian adults' fibre intake is not possible. The AI is based on total fibre intakes which encompass both naturally occurring dietary and functional fibre.
Since the Canadian Nutrient File does not contain data on functional fibre (i.e. isolated, extracted or synthetic fibre added to food), the estimated fibre intakes of Canadian adults in CCHS 2.2 only reflect naturally occurring dietary fibre intake. Therefore, total fibre intakes are likely underestimated in the CCHS 2.2 data when compared to the AI. Despite this likely underestimation of intake, the importance of an appropriate fibre intake should still be promoted to the Canadian population.

Vitamins and Minerals

Vitamins and Minerals with an Estimated Average Requirement

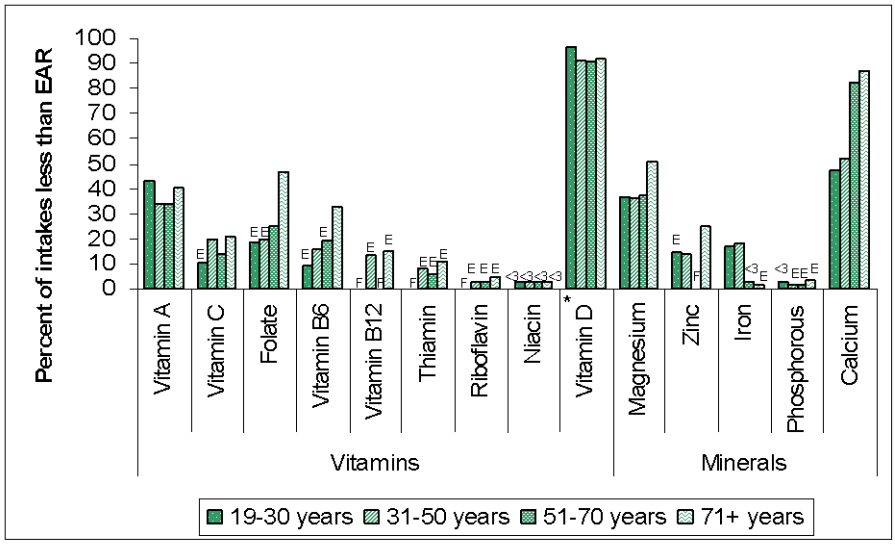
When developing Canada's Food Guide, Health Canada established that less than 10% of diets with nutrient contents below the Estimated Average Requirement (EAR) would be the threshold for a low prevalence of inadequate intakes[8]. Among Canadians age 19 and over, the CCHS 2.2 data showed that low prevalence of inadequate intakes (<10% below EAR) existed for niacin, riboflavin and phosphorous. In addition, a low prevalence of inadequate thiamin intakes were seen in Canadian adults, with the exception of women over 70 who had a prevalence of inadequacy only slightly higher at 11.4%. A low prevalence of inadequate iron intakes was seen in men age 19 and older and women age 51 and older; 16-19% of women 19-50 consumed iron in amounts that fell below the EAR (Figures 1 & 2).

Among Canadians 19 and older, 10-35% had vitamin B12 and vitamin C intakes below the EAR. Similarly, 10-35% of Canadians from most age and sex groups consumed folate, vitamin B6, and zinc in inadequate amounts. However, less than 10% of women and men age 19-30 consumed vitamin B6 and folate in inadequate amounts, respectively. Also, 41% of men over 70 years of age consumed zinc in inadequate amounts (Figures 1 & 2).
The prevalence of inadequate intakes was highest for vitamin A, vitamin D (see Box 1), and magnesium and calcium.

Box 1. Vitamin D Intake Assessment

Estimates of the prevalence of inadequate intakes of vitamin D from food must be interpreted with caution. Vitamin D is unique as it can also be synthesized by the body from sunlight (UV radiation). In addition, vitamin D intakes from supplements have not been considered in this assessment. While there appears to be a high prevalence of inadequate intakes of vitamin D from dietary sources, available clinical measures do not suggest wide-spread vitamin D deficiency in the Canadian population[9,10]. Vitamin D status in some sub-populations, however, may warrant further consideration.

Figure 1. Prevalence of inadequacy for nutrients with an Estimated Average Requirement in Canadian adult males 19+ years (2004)



E Data with a coefficient of variation from 16.6% to 33.3%; interpret with caution.

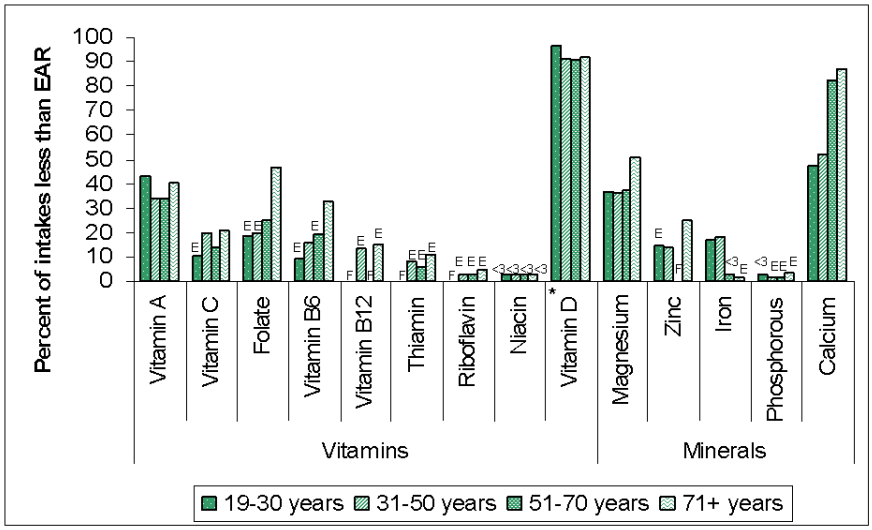
F Data with a coefficient of variation greater than 33.3% with a 95% confidence interval not entirely between 0 and 3%; suppressed due to extreme sampling variability.

<3 Data with a coefficient of variation greater than 33.3% with a 95% confidence interval entirely between 0 and 3%; interpret with caution.

* Vitamin D dietary intake data cannot stand alone and consideration must be given to serum 25OHD levels.

More than 35% of Canadians age 19 and over consumed vitamin A in quantities below the EAR, with the prevalence of inadequate intakes rising to greater than 40% in most adult age and sex groups. Similarly, more than 34% of Canadians over the age of 19 consumed magnesium in quantities below the EAR, with the prevalence of inadequate intakes rising to greater than 40% in half the adult age and sex groups (Figures 1 & 2). As for calcium, both males and females over 19 years had a prevalence of inadequate intakes ranging from 26.5% to 80.1 % and 47.5% to 86.9%, respectively. Trends in both sexes showed an increasing prevalence of calcium inadequacy with older age. Of all the nutrients with an EAR, vitamin D had the highest prevalence of inadequate intakes (see figure 1 and Box 1).

Figure 2. Prevalence of inadequacy for nutrients with an Estimated Average Requirement in Canadian adult females 19+ years (2004)



E Data with a coefficient of variation from 16.6% to 33.3%; interpret with caution.

F Data with a coefficient of variation greater than 33.3% with a 95% confidence interval not entirely between 0 and 3%; suppressed due to extreme sampling variability.

<3 Data with a coefficient of variation greater than 33.3% with a 95% confidence interval entirely between 0 and 3%; interpret with caution.

* Vitamin D dietary intake data cannot stand alone and consideration must be given to serum 25OHD levels.

Vitamins and Minerals with an Adequate Intake

Nothing can be concluded about the prevalence of inadequacy for most age and sex groups' intakes of potassium due to the limited usefulness of the AI in assessing the usual nutrient intakes of groups (Appendix C). The median potassium intakes of Canadians age 19 and older, both male and female, were below the AI of 4700 mg/d.

The median sodium intakes of all Canadians over the age of 19 exceeded the AI (which varies between 1200 mg/d and 1500mg/d depending on the age group). Furthermore, with the exception of women over the age of 70, the median sodium intakes of Canadians over the age of 19 exceeded 2300 mg/d, the Tolerable Upper Intake Level (UL). Men 19-30 had the highest median sodium intake at 4046 mg/d – nearly 2000 mg/d more than the level where the risk of adverse health effects begins to increase. According to the CCHS 2.2 data, 78% of Canadian adults had sodium intakes in excess of the UL.

Table 2. Assessment of adequacy for nutrients with an Adequate Intake (AI) in Canadian adults 19 and older (2004)

Age	Potassium	Sodium
Males		
19-30	<AI	
31-50	<AI	
51-70	<AI	High prevalence of excessive intakes; increased risk of adverse health effects
70+	<AI	
Females		
19-30	<AI	
31-50	<AI	
51-70	<AI	
70+	<AI	Low prevalence of inadequate intake*

<AI : Median intake < AI; no assessment can be made regarding the prevalence of inadequacy of this nutrient in this age group.
* : The AI for this nutrient was not based on intakes of apparently healthy populations. While this age groups' median intake was at or above the AI, indicating a low prevalence of inadequate intakes, there is less confidence in this assessment.

Key Points

Results from the CCHS 2.2 revealed that:

- The combined prevalence of overweight and obesity among Canadian adults indicates that 7 in 10 men and 5 in 10 women had energy intakes that exceed their energy expenditure.
- Twenty-five percent of males and 23% of females, 19 years and older, had fat intakes above the AMDR.
- Thirty-two percent of males and 21% of females, 19 years and older, had carbohydrate intakes below the AMDR.
- With respect to micronutrients with an EAR, the majority of Canadians consumed most of these nutrients in adequate amounts. Magnesium, calcium, vitamin A and vitamin D (see Box 1) were the nutrients with the highest prevalence of inadequate intakes.
- Median potassium, and fibre intakes were below the AI for most age groups. While interpreting the adequacy of intakes of these nutrients is limited by the AI, there is concern that adults may not be meeting their needs. Further analyses on food intake will provide more insight.
- The majority of Canadians consumed sodium in quantities that exceed the UL, the amount associated with an increased risk of adverse health effects.

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Appendix A

Data Source and Dietary Recalls

- The data were obtained from the CCHS 2.2 (http://www.hc-sc.gc.ca/fn-an/surveill/nutrition/commun/cchs_focus-volet_escc-eng.php) (total respondents, n = 35,107; respondents aged 19 years and older, n = 18, 820) which was designed to provide reliable information about food and nutrient intakes, nutritional well-being and their key determinants at the national and provincial levels. Interviews with children aged 11 and younger were conducted with parental / guardian help[1].
- Analysis was performed using Statistics Canada's CCHS 2.2 Share File. Estimates of usual nutrient intakes were based on 24-hour dietary recalls. The nutrient content of foods and beverages reported by respondents was obtained from the Canadian Nutrient File, version 2001b[2].
- Day to day variation in an individual's nutrient intake was assessed and usual intake was estimated using the Software for Intake Distribution Estimation (SIDE). The bootstrap method, which takes into account the complex survey design, was used to estimate standard errors [3;4].

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   Ref Type: Data File
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Appendix B

Definitions[1]

Dietary Reference Intakes (DRIs)
A set of nutrient reference values used in Canada and the United States to plan or assess nutrient intakes of individuals or groups.

Estimated Average Requirement (EAR)
The average daily nutrient intake level that is estimated to meet the requirement of half the healthy individuals in a life-stage and gender group. The EAR is used to calculate the Recommended Dietary Allowance – the average daily nutrient intake level that is sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a life-stage and gender group.

Adequate Intake (AI)
The recommended average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group of apparently healthy people who are assumed to be maintaining adequate nutritional status. An AI is fixed when there is insufficient evidence to establish the distribution of requirements and subsequently, to determine an EAR.

Tolerable Upper Intake Level (UL)
The highest average daily nutrient intake level likely to pose no risk of adverse health effects to almost all individuals in a life-stage and gender group. As intake increases above the UL so does the potential risk of adverse effects.

Acceptable Macronutrient Distribution Range (AMDR)
The range of intake of an energy source (i.e. fat, protein, carbohydrate) that is associated with a reduced risk of chronic disease while providing adequate amount of essential nutrients.

1. Institute of Medicine. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington: The National Academies Press; 2006.

Appendix C

Using the Dietary Reference Intakes to Assess a Group's Nutrient Intakes

According to the Institute of Medicine, which oversees the establishment of the DRIs, usual nutrient intakes estimated from 24-hour recalls should be assessed against the appropriate DRIs in the following way[1]:

1) for nutrients with an Estimated Average Requirement (EAR) the proportion of the group with a usual intake below the EAR indicates the prevalence of inadequate intake of that nutrient within the group. Similarly, the proportion with a usual intake above the EAR represents the percent of the group that meet or exceed their requirements. This approach, called the EAR cut-point method, applies to all nutrients with an EAR except iron in menstruating women (in which case the probability approach must be used because of an asymmetrical requirement distribution).

2) for nutrients with an Adequate Intake (AI) when the group's median usual intake is at or above the AI there is a low prevalence of inadequate intake of that nutrient. However, when the group's median usual intake is below the AI one cannot assume that this corresponds to inadequacy. An AI is fixed when there is insufficient evidence to establish the distribution of requirements and subsequently determine an EAR for a nutrient. It is thus not possible to determine the proportion of the group below their requirements based on the AI. Overall, the AI has limited use in assessing usual nutrient intakes of groups.

3) for nutrients with a Tolerable Upper Intake Level (UL) the proportion of the group with a usual intake above the UL corresponds to the percent of the group at potential risk of adverse health effects due to excessive intake of a given nutrient.

4) for nutrients with an Acceptable Macronutrient Distribution Range (AMDR) the proportion of the group within the AMDR corresponds to the percent of the group with macronutrient intakes within the range of intake associated with reduced risk of chronic diseases while providing adequate amounts of essential nutrients.

1. The Subcommittee on the Interpretation and Uses of Dietary Reference Intakes, The Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary Reference Intakes: Applications in Dietary Assessment. Washington: The National Academies Press; 2000.