



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



Introduction

A healthful diet promotes the normal growth and development of children, and helps prevent the development of obesity and related chronic diseases as they age¹. Monitoring the nutritional health of Canadian children 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 children's usual nutrient intakes can be used to assess the prevalence of excessive or inadequate consumption 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)².

This article provides an assessment of the energy and nutrient intakes of Canadian children, aged 1 to 8, using data from the CCHS 2.2 – Nutrient Intakes from Food: Provincial, Regional and National Summary Data Tables Volumes 1-3³. 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 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

Key findings:

- One in five Canadian children have energy intakes that exceed their energy needs.
- A notable proportion of the diets of 1-3 year-old children contain total fat in quantities below the recommended range.
- The diets of children provide adequate amounts of most vitamins and minerals, with the exception of vitamin D (see [Box 1](#)) and calcium (4 – 8 years only).
- For nutrients with an Adequate Intake (AI), there is concern that Canadian children may not be meeting their needs for potassium and fibre - although the interpretation of the adequacy of nutrients with an AI is limited.
- Canadian children's sodium intakes are associated with an increased risk of adverse health effects.

group can be assumed to represent the proportion with inadequate, adequate, or excessive energy intake, respectively, relative to energy expenditure⁴. The BMI categories established by the International Obesity Task Force were used to interpret the BMI data collected as part of CCHS 2.2⁵. The result was that 77.9 % of 2-8 year-olds were considered neither overweight nor obese whereas 14.6 % were considered overweight and a further 7.6 %, obese. Based on this, one can conclude that nearly 80% of 2-8 year-olds had adequate energy intakes, whereas about one in five had BMIs suggestive of excessive energy intake. Given that the Task Force did not identify a BMI category reflecting underweight, it is not possible to estimate the prevalence of children with inadequate (i.e. too low) energy intakes.

Macronutrient Intake

Carbohydrates, Protein, and Total Fat

According to the CCHS 2.2, more than 96% of children 1-8 years-old had protein and carbohydrate intakes that fell within the Acceptable Macronutrient Distribution Range (AMDR) (Table 1). With respect to total fat, 88% of 4-8 year-old Canadians had intakes within the AMDR. In contrast, just 51.7% of 1-3 year-olds had total fat intakes within the AMDR, while 47% had intakes below the recommended range (Table 1).

Table 1. Proportion of Canadian children 1-8 years with macronutrient intakes below, within or above the Acceptable Macronutrient Distribution Ranges (AMDR) (2004)

Macronutrients	% children below AMDR	% children within AMDR	% children above AMDR	Dietary Reference Intake AMDR (% of total energy intake)
Total fat				
1-3 years	47.0	51.7	<3	30-40%
4-8 years	5.5	87.7	6.8	25-35%
Protein				
1-3 years	0	96.4	F	5-20%
4-8 years	<3	99.2	0	10-30%
Carbohydrates				
1-3 years	F	95.4	F	45-65%
4-8 years	<3	98.5	<3	45-65%

<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.

The large proportion of 1-3 year-old children with fat intakes below the AMDR is notable. Energy-dense foods, such as those with high fat content, play an important role in helping young children meet their energy needs for growth and development; this is especially relevant for children who eat a small quantity of food. It has also been suggested that a low-fat diet during childhood can lead to inadequate intake of certain micronutrients, including fat soluble vitamins⁵. However, given that no BMI category was established to indicate underweight, it is not possible to examine whether children with fat intakes below the AMDR have inadequate energy intakes. However, it is reassuring to note that the CCHS 2.2 results amongst children revealed a very low prevalence of inadequate micronutrient intakes.

Saturated, Monounsaturated and Polyunsaturated Fat

The data pertaining to the contribution of the various types of fat (saturated, monounsaturated, polyunsaturated) to total energy intake showed that 1-3 year olds and 4-8 year-olds consumed these nutrients in similar proportions. Saturated fat contributed ~12% of the 1-8 year-old Canadians' total energy intake, while polyunsaturated fat and monounsaturated fat contributed ~4% and ~11%, respectively. 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 risk⁶. Notably, the modeling exercise for the

development of Canada's Food Guide yielded a food intake pattern that would meet children's nutrient requirements with an average saturated fat content of 8-9% total energy⁷. Therefore, it seems possible to lower children's saturated fat intake without compromising nutrient adequacy by following Canada's Food Guide.

The IOM set Adequate Intakes (AIs) for the two polyunsaturated fatty acids: linoleic acid and α -linolenic acid (the essential fatty acids). With median α -linolenic acid usual intakes of 0.84 g/d and 1.23 g/d, respectively, 1-3 year-olds and 4-8 year-olds exceeded their corresponding AIs for that fatty acid (0.7g/d and 0.9g/d) meaning a low prevalence of inadequate intake in these age groups in Canada. In contrast, 1-8 year-old children's median intakes of linoleic acid fell below the AI. 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 population⁶. 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 children's 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 10:1⁶. 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 children's diets fell within this range at a ratio of 7:1, for 1-3 year-olds, and 8:1, for 4-8 year-olds.

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 AIs of

approximately 19 g/d for the 1-3 year-olds and 25 g/d for the 4-8 year-olds. The median intake of dietary fiber of the 1-3 year-olds was 9.9 g/d, while it reached 13.4 g/d among the 4-8 year-olds. These intakes were below the AIs of both age groups. The AI is based on total fibre intakes which encompass both naturally occurring dietary and functional fibres. 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 children in CCHS 2.2 only reflect naturally occurring dietary fibre intake. Therefore, the total fibre intakes of children 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

For nutrients that have an established Estimated Average Requirement (EAR) and with the exception of calcium (ages 4 -8 only) and vitamin D (see [Box 1](#)), a very low prevalence of inadequate intakes was observed among Canadian children ages 1-3 and 4-8. Within both children's age groups, fewer than five percent had inadequate intakes of vitamin A, vitamin B6, vitamin B12, vitamin C, niacin, riboflavin, thiamin, folate, zinc, phosphorus, magnesium, calcium (ages 1 – 3 only) and iron. Whereas for vitamin D, 86.0% of those 1-3 years old and 92.7% of those 4-8 years old had usual intakes below the EAR (see [Box 1](#)). Also, for children aged 4 - 8 years, 23.3 % had usual intakes below the EAR for calcium. Moreover, the proportion of intakes that were greater than the Tolerable Upper Intake Level (UL) was very low for most vitamins and minerals. The majority of intakes were between the EAR and the UL.

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^(8,9). Vitamin D status in some sub-populations, however, may warrant further consideration.

Vitamins and Minerals with an Adequate Intake

Table 2 depicts the results of an assessment of the adequacy of 1-8 year old children's intakes of potassium and sodium. Based on the results of the CCHS 2.2, no assessment could be made regarding the prevalence of inadequacy of potassium among 1-8 year old children as the median intakes of 1-3 year olds (2321 mg/d) and 4-8 year olds (2549 mg/d) fell below the respective AIs of 3000 mg/d and 3800 mg/d.

The median sodium intake of the 1-3 and the 4-8 year old Canadians exceeded their respective AIs. Moreover, 77% of 1-3 year olds and 93% of 4-8 year olds had usual intakes of sodium exceeding the UL set for their age group (1500 mg and 1900 mg/d, respectively). This finding suggests that 1-8 year old Canadians have an increased risk of adverse health effects due to their sodium intake (Table 2).

Table 2. Assessment of adequacy for nutrients with an Adequate Intake (AI) in Canadian children 1-8 years (2004)

Age	Potassium	Sodium
1-8 years	Median intake <AI; no assessment can be made regarding the prevalence of inadequacy of this nutrient	High prevalence of excessive intakes; Increased risk of adverse health effects

Key Points

Results from the CCHS 2.2 revealed that:

- The combined incidence of overweight and obesity suggests that one in five children had energy intakes that exceed their energy expenditure. Since many chronic illnesses are associated with obesity and given that childhood obesity is an important predictor of adult obesity, preventing overweight and obesity in childhood is essential⁽¹⁰⁾.
- A notable proportion of 1-3 year-olds had fat intakes, as a percent of total energy, below the AMDR. Understanding the implications of this finding requires additional analysis such as examining food intakes in this age group to explore potential

differences in the dietary patterns of children with a fat intake within the AMDR and those whose intakes fall below the recommendations.

- The diet of Canadian children 1-8 years-old provided adequate amounts of most vitamins and minerals examined and acceptable proportions of energy from protein and carbohydrate.
- Although a high proportion of the vitamin D intakes were below the EAR, there are other means of obtaining vitamin D. For this reason, dietary intake data on vitamin D cannot stand alone and a biomarker of vitamin D status, serum 25OHD, must be considered (see [Box 1](#)).
- Median potassium and fibre intakes were below the AI. While interpreting the adequacy of intakes of these nutrients is limited by the AI, there is concern that children may not be meeting their needs.
- More than 75% of children had sodium intakes greater than the UL, the amount associated with an increased risk of adverse health effects.

References

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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_escs-eng.php) (total respondents, n = 35,107; respondents aged 1-8 years, n = 5,352) 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 help¹.
 - 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 2001b².
 - 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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Appendix B

Definitions¹

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 way¹:

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.

Note: Most of the DRIs for children and adolescents have been extrapolated from adult reference values. Given the lack of studies available when the DRIs were developed, these extrapolated reference values represent the best estimates of the nutrient requirements of 1-18 year olds.

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.