Health Canada Santé Canada

Your health and safety… our priority. Votre santé et votre sécurité… notre priorité.

Health Canada, 2009

Cat. H164-112/2-2009E-PDF

ISBN. 978-1-100-13486-4

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

Key findings:

- Three in ten adolescents have energy intakes that exceed their energy needs.
- The saturated fat intakes of Canadian adolescents could be further decreased.
- Many adolescents have inadequate intakes of magnesium, vitamin A, and phosphorous.
- While the interpretation of the adequacy of nutrients with an Adequate Intake is limited, there is a concern that adolescents may not be meeting their needs for potassium, calcium, and fibre.
- Canadian adolescents' sodium intakes are associated with an increased risk of adverse health effects.

Introduction

Adolescence is a period of significant and rapid growth and, as a result, nutrition needs during this period of life are greater than at any other point in the lifecycle[1]. Monitoring the nutritional health of Canadian adolescents 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 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 adolescents, aged 9-18, using data from the CCHS 2.2 – Nutrient Intakes from Food: Provincial, Regional and National Summary Data Tables Volumes 1-3[3]. 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 group can be assumed to represent the proportion with inadequate, adequate, or excessive energy intake, respectively, relative to energy expenditure[4]. The BMI categories established by the International Obesity Task Force were used to interpret the BMI data collected as part of CCHS 2.2[5]. Based on these categories, the data indicated that for boys, 31.1% of 9-13 year-olds and 30.8% of 14-17 year-olds were overweight or obese; for girls 28.0% of 9-13 year-olds and 25.6% of 14-17 year-olds were overweight or obese. The remaining adolescents fell into the neither overweight nor obese category, with girls aged 14-17 years showing the highest prevalence of neither overweight nor obese at 74.4% and boys aged 9-13 years showing the lowest prevalence of neither overweight nor obese at 68.9%. Thus, one may assume, based on the CCHS 2.2 findings, that approximately three in ten adolescents had energy intakes in excess of their requirements. 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

Table 1 illustrates the proportion of Canadian adolescents with macronutrient intakes below, within, or above the Acceptable Macronutrient Distribution Ranges

Canada

Table 1. Proportion of Canadian adolescents 9-18 years with macronutrient intakes below, within or above the Acceptable Macronutrient Distribution Ranges (AMDR) (2004)

Macronutrients	% adolescents below AMDR		% adolescents within AMDR		% adolescents above AMDR		Dietary Reference Intake
	Boys	Girls	Boys	Girls	Boys	Girls	AMDR (% of total energy intake)
Total fat							
9-13 years	F	6.5 [E]	**86.3**	**81.4**	10.8 [E]	12.1 [E]	**25-35%**
14-18 years	F	F	**84.4**	**82.6**	13.4 [E]	12.9 [E]	
Protein							
9-13 years	<3	F	**99.1**	**97.8**	0.0	0.0	**10-30%**
14-18 years	<3	3.9 [E]	**98.8**	**96.1**	<3	0.0	
Carbohydrates							
9-13 years	<3	<3	**99.0**	**96.4**	<3	F	**45-65%**
14-18 years	F	F	**95.5**	**97.1**	<3	<3	

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.

(AMDR). The data show that more than 95% of all adolescents consumed protein and carbohydrates within the recommended ranges. In addition, over 80% of adolescents consumed fat in amounts within the AMDR for total fat.

Saturated, Monounsaturated and Polyunsaturated Fats

An examination of the different types of fat in adolescent diets showed that saturated fat contributed ~10% of adolescents' total energy intake, while polyunsaturated fat and monounsaturated fat respectively contributed ~5% and ~12% of adolescents' total energy intake. 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[6]. Notably, the modeling exercise for the development of Canada's Food Guide yielded a food intake pattern that would meet adolescents' nutrient requirements with an average saturated fat content of 7.0-7.9% total energy[7]. Therefore it seems possible to lower adolescents' saturated fat intake without compromising nutrient adequacy by following Canada's Food Guide.

A low prevalence of inadequate intakes of the polyunsaturated fatty acid α-linolenic acid (omega-3) is assumed as the median intake of this nutrient among adolescents exceeded the Adequate Intakes (AI) established for these age and gender groups. The median intakes observed in the adolescent groups were as follows: for girls 9-13 years (1.38 g/d) and 13-18 years (1.67 g/d); for boys, 9-13 years (1.73 g/d) and 13-18 years (2.17 g/d). The median intake of linoleic acid (omega-6) fell below the AI in all adolescent age and gender groups. 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[6]. 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 adolescents' 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[6]. 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 adolescents' diets fell within this range at a ratio of 8:1.

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 26 g/d for girls 9-18 y, 31 g/d and 38 g/d for boys 9-13 and 14-18 respectively. Results showed that girls 9-18 y had median fibre intakes (14.0 g/d) below the AI. The CCHS 2.2 also found that boys 9-18 y had median fibre intakes below the AIs with intakes of 16.3 g/d and 18.2 g/d for the 9-13 and 14-18 y respectively. Thus, no assessment of adequacy can be made (Appendix C). 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 adolescents in CCHS 2.2 only reflect naturally occurring dietary fibre intake. Therefore, the total fibre intakes of adolescents 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

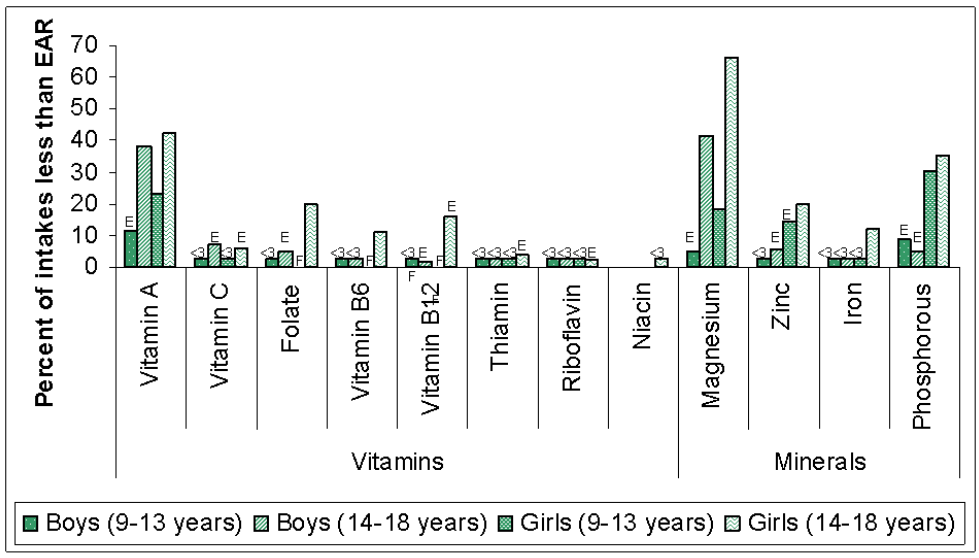
Vitamins and Minerals with an Estimated Average Requirement

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[7]. Applying this threshold to CCHS 2.2 data, a low prevalence of inadequate intakes among adolescent boys was seen for most micronutrients. In boys 9-13 years-old, the prevalence of inadequacy was less than ten percent for all nutrients (except vitamin A, at 11.6%). In boys 14-18 years-old, the prevalence of inadequacy was less than ten percent for all nutrients except vitamin A (38.3%) and magnesium (41.5%). For some nutrients, a greater prevalence of inadequate intakes was seen among girls 9-13 years-old with the prevalence of inadequacy for vitamin A, magnesium, zinc, and phosphorus intakes ranging between 10-30%. The intakes of older adolescent girls (14-18 years-old) were the most problematic. In this group, the prevalence of inadequate intakes of vitamin B6, vitamin B12, folate, zinc, and iron ranged between 10-25%; the prevalence of inadequate magnesium intake was 66.3%, phosphorus 35.2%, and vitamin A 42.2%. Figure 1 shows the nutrients with the highest prevalence of inadequacy among adolescents are vitamin A, magnesium, and phosphorus.

Vitamins and Minerals with an Adequate Intake

The AI for vitamin D for adolescents aged 9-18 years is 5 µg/d. The median vitamin D intakes of boys 9-13-years-old (6.6 µg/d) and 14-18 years-old (7.2 µg/d), and of girls 9-13 years-old (5.2 µg/d) were greater than the AI for vitamin D. Therefore, among adolescents in these groups there was a low prevalence of inadequate intakes of vitamin D. The median vitamin D intakes of girls 14-18 years-old (4.4 µg/d) fell below the AI, thus nothing can be concluded about the adequacy of vitamin D intake within this group (Appendix C). Similarly, although adolescents' median intake of both calcium and potassium fell below the AIs of 1300 mg/d and 4500-4700 mg/d, respectively, it cannot be assumed that their intake of these nutrients is inadequate.

Figure 1. Prevalence of inadequacy for nutrients with an Estimated Average Requirement (EAR) in Canadian adolescents 9-18 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.

With regard to the mineral sodium, the median intake of male and female adolescents exceeded the AI of 1500 mg/d. Furthermore, more than 80% of female adolescents and 97% of males had intakes above the Tolerable Upper Intake Level (UL) for sodium of 2300 mg/d – the level of intake beyond which the potential risk of adverse effects increases. Among girls, the median sodium intake was 2885 mg/d and 2962 mg/d for 9-13 and 14-18 year-olds, respectively; among boys the median sodium intake was 3510 mg/d and 4151 mg/d for 9-13 and 14-18 year-olds, respectively.

Table 2. Assessment of adequacy for nutrients with an Adequate Intake (AI) in Canadian adolescents 9-18 years (2004)

Age	Vitamin D	Calcium	Potassium	Sodium
Boys				
9-13	Low prevalence of inadequate intake*	<AI	<AI	High prevalence of excessive intakes; increased risk of adverse health effects
14-18		<AI	<AI	
Girls				
9-13		<AI	<AI	
14-18	<AI	<AI	<AI	

<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 incidence of overweight and obesity suggests approximately three in ten adolescents had energy intakes in excess of their energy expenditure.
- The diets of Canadian adolescents 9-18 years of age provided acceptable proportions of energy from protein, carbohydrate and fat.
- With respect to the contribution of the different types of fat in the adolescents' diet, it appears that adolescents' intake of saturated fat could be decreased without compromising nutrient adequacy by following Canada's Food Guide.
- The diets of Canadian adolescents had adequate amounts of most nutrients. The nutrients with the highest prevalence of inadequate intakes were: vitamin A (9-13 year-old girls and boys and girls 14 18 years); magnesium (boys and girls 14-18 years-old); and phosphorous (girls 9-18 years-old).
- Median calcium, 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 adolescents may not be meeting their needs. Further analyses on food intake will provide more insight.
- More than 80% of Canadian adolescents had sodium intakes in excess of the UL – the intake level beyond which the risk of adverse health effects increases.

References

1. Committee on Food Marketing and the Diets of Children and Youth. Food Marketing to Children and Youth: Threat or Opportunity? Washington: The National Academies Press; 2006.
2. 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.
3. Health Canada, Statistics Canada. Canadian Community Health Survey, Cycle 2.2, Nutrition (2004) - Nutrient Intakes From Food: Provincial, Regional and National Data Tables. Volumes 1, 2 & 3 Disk. 2009. Ottawa, Health Canada Publications.
Ref Type: Data File
4. Health Canada. Canadian Community Health Survey Cycle 2.2, Nutrition. 2004, A Guide to Accessing and Interpreting the Data. Ottawa: Health Canada Publications; 2006.
5. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. British Medical Journal 2000 May 6;320(1240):1-6.
6. Institute of Medicine. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. Washington: The National Academies Press; 2006.
7. Katamay SW, Esslinger KA, Vigneault M, Johnston JL, Junkins BA, Robbins LG, et al. Eating Well with Canada's Food Guide (2007): Development of the Food Intake Pattern. Nutrition Reviews 2007;65(4):155-66.

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 9-18 years, n = 8,604) 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 adolescents 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].

(1) Health Canada, Statistics Canada. Canadian Community Health Survey, Cycle 2.2, Nutrition (2004) - Nutrient Intakes From Food: Provincial, Regional and National Data Tables Volumes 1, 2 & 3 Disk. 2009. Ottawa, Health Canada Publications.

(2) Health Canada. The Canadian Nutrient File. Nutrition Research Division, editor. [9]. 2001.
Ref Type: Data File

(3) Rao JNK, Wu CFJ, Yu K. Some recent work on resampling methods for complex surveys. Survey Methodology 1992;18(2):209-17.

(4) Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. Statistical Methods in Medical Research 1996;5(3):283-310.

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.

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.