



DIETARY REFERENCE INTAKES FOR SUGARS

INTRODUCTION

Dietary Reference Intakes (DRIs) are a set of nutrient intake recommendations for healthy people, published by the U.S. Institute of Medicine in collaboration with Health Canada. The DRIs will be used in Canada to assess nutrient intakes and ensure that the Nutrition Recommendations for Canadians and Canada's Food Guide to Healthy Eating are scientifically sound. A summary of the carbohydrate and sugars recommendations from the DRI macronutrient report¹ and estimates of current intakes of added sugars in Canada are provided in the present article.

DRIs FOR CARBOHYDRATES

DEFINITIONS

Carbohydrates: In the DRI report, "carbohydrates" refer to all digestible carbohydrates including sugars (mono- and disaccharides), oligosaccharides, starches, and sugar alcohols. Non-digestible carbohydrates (dietary fibre) are not included as part of total carbohydrate.

Sugars: Sugars are separated into "added sugars" and "naturally occurring sugars". "Added sugars" are defined as all "sugars and syrups that are added to foods during processing or preparation." Added sugars "do not include naturally occurring sugars such as lactose in milk or fructose in fruits." It was noted that "added sugars are not chemically different from naturally occurring sugars."

TOTAL CARBOHYDRATE

Amount Required for the Brain: The average amount of carbohydrate (primarily sugars and starches) required to provide the brain with an adequate supply of glucose was determined to be 100 g/day for individuals one year of age or older. Almost all people in the population will meet their requirements with 130 g/day. Amounts are higher during pregnancy and lactation. These amounts can come from any combination of sugars and starches.

Acceptable Range for Optimal Health: The amount required for the brain does not reflect the amount that should be consumed for optimal health.

Acceptable ranges of intakes for the macronutrients were determined to reflect the amounts required to reduce the risk of chronic disease while providing adequate intakes of essential nutrients. The ranges

for adults are 45-65% of energy for carbohydrate, 20-35% for fat, and 10-35% for protein. Consuming fat and carbohydrate within these ranges was judged to be consistent with lower risks of obesity, coronary heart disease, and diabetes.

Upper Level: A Tolerable Upper Intake Level (UL) is defined for many nutrients. The UL is the highest average daily nutrient intake level likely to pose no risk of health problems for almost all healthy people. Chronic intakes above the UL may increase the risk of adverse health effects. However, a UL was not set for any of the macronutrients, including carbohydrate, given the lack of definitive data available.

SUGARS

The DRI report reviewed all available evidence on the effects of total and added sugars on chronic disease risk and micronutrient intakes. With respect to chronic disease risk, the report concluded that there was insufficient evidence to set a UL for total or added sugars "based on the data available on dental caries, behaviour, cancer, risk of obesity and risk of hyperlipidemia." Regarding sugars and micronutrient intakes, it was concluded that, "it is not possible to determine a defined intake level at which inadequate micronutrient deficiencies can occur", and "at very low or very high intakes, unusual eating habits most likely exist" that contribute to low micronutrient intakes. Thus, no defined level of intake of total or added sugars was found to be associated with an increased risk of health problems in the general population.

SUGARS AND HEALTH

BEHAVIOUR

It was concluded in the DRI report that "altered behaviour cannot be used as an adverse effect for setting a UL for sugar." It was noted that, "a meta-analysis of 23 studies conducted over a 12-year period concluded that sugar intake does not affect either behaviour or cognitive performance in children."

CANCER

No UL was set in relation to cancer because "the data on sugar intake and cancer are limited and insufficient", based on a review of evidence on the effects of sugars on cancers of the lung, breast, prostate, and colon.

DENTAL CARIES

It was concluded that, “because of the various factors that can contribute to dental caries, it is not possible to determine an intake level of sugar at which increased risk of dental caries can occur.” It was noted that, “it is difficult to rationalize the role of sugar and dental caries as a simple cause-and-effect relationship. Caries occurrence is influenced by frequency of meals and snacks, oral hygiene (tooth-brushing frequency), water fluoridation, fluoride supplementation, and fluoride toothpaste.”

DIABETES

Evidence cited to support the conclusion that no UL should be set for sugars in relation to diabetes included findings that, “two prospective cohort studies showed no risk of diabetes from consuming increased amounts of sugar. Furthermore, a negative association was observed between increased sucrose intake and risk of diabetes.”

HYPERLIPIDEMIA

The conclusion regarding the effects of sugars on hyperlipidemia was that, “there are insufficient data for setting a UL based on increased risk for coronary heart diseases.”

OBESITY

No UL was set in relation to obesity because “there is no clear and consistent association between increased intake of added sugars and body mass index (BMI).” In fact, it was noted that higher intakes of total or added sugars are actually associated with a lower incidence of obesity (see **Figure 1**). The report states that “a negative correlation between total sugar intake and BMI has been consistently reported for children and adults”, and “a negative correlation between added sugar intake and BMI has been observed.”

The consistently observed association between higher intakes of added sugars and lower incidence of obesity may be due to the fact that higher intakes of added sugars are associated with lower intakes of fat², or that those with higher intakes of added sugars have greater energy needs (e.g. greater physical activity). It has also been suggested that this association could be due to overweight individuals reducing sugars intakes after becoming overweight, however, this is unlikely because the association is observed across the entire range of BMIs, in children and adults, and in people who do or do not restrict sugars.²

SUGARS AND MICRONUTRIENT INTAKES

No UL was set for added sugars in relation to micronutrient intakes because it was concluded that, “it is not possible to determine a defined intake level at which inadequate micronutrient deficiencies can occur”, and “at very low or very high intakes, unusual eating habits most likely exist” that contribute to low micronutrient intakes. Nevertheless, “a maximal intake level of 25% or less of energy from added sugars is suggested based on the decreased intake of some micronutrients of American subpopulations exceeding this level.”

The evidence used to set this maximum included an analysis of data from the U.S. National Health and Nutrition Examination Survey, 1988-1994 (23,452 participants). Median intakes of six micronutrients were compared among individuals who consumed different ranges of added sugars as a percentage of energy (i.e. 0-5%, 5-10%, etc. up to >35%). The data in **Table 1** show that very high intakes of added sugars (20 to >35% of energy) were associated with lower micronutrient intakes

FIGURE 1 Association between added sugars and body mass index (BMI) from the *Dietary and Nutritional Survey of British Adults* (Gibson 1996a) (left) and the *Scottish Heart Health and MONICA* studies (Bolton-Smith & Woodward 1994b) (right). A significant negative correlation between added sugars and BMI was observed in both studies. Adapted from DRI report¹.

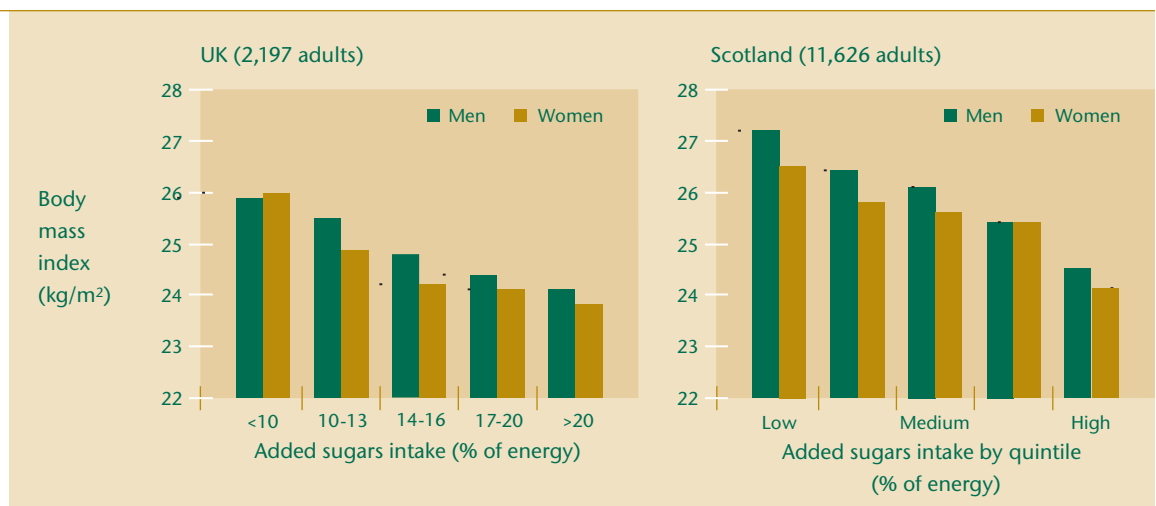


TABLE 1 Range of added sugars intakes (% of energy) associated with low micronutrient intakes, by age and sex^{1,2}

	All	Males	Males	Males	Males	Females	Females	Females	Females
	4-8 ³	9-13	14-18	19-50	51+	9-13	14-18	19-50	51+
Calcium	25-30	25-30	30-35	>35	30-35	NS	>35	30-35	30-35
Magnesium	25-30	NS	NS	20-25	25-30	>35	30-35	30-35	30-35
Vitamin A	30-35	NS	NS	30-35	>35	NS	>35	30-35	NS
Vitamin E	NS ⁴	NS	NS	>35	30-35	>35	>35	20-25	30-35
Iron	30-35	NS	NS	30-35	>35	NS	30-35	30-35	30-35
Zinc	25-30	25-30	NS	20-25	>35	>35	>35	25-30	30-35

¹Ranges of added sugars associated with significantly lower micronutrient intakes than micronutrient intakes associated with intakes of added sugars < 10% of energy; ²Adapted from DRI report¹; ³Age range in years; ⁴NS, not significant: no significant difference between micronutrient intakes in those at the highest range of added sugars intakes compared with those at the lowest range of added sugars (< 10% of energy).

for some micronutrients in some population groups. In other groups, there was no association between high added sugars intakes and low micronutrient intakes (i.e. NS in Table 1). Thus, an association was only found at intakes of added sugars well above current levels (average intakes are approximately 12% of energy in Canada; see Table 2).

Estimates of the prevalence of inadequacy for each of the six micronutrients for each range of added sugars intakes were also provided. These data showed no association between added sugars and nutrient inadequacy for many nutrients and sub-groups. For other groups, there was a trend towards a greater risk of nutrient inadequacy at both very high intakes of added sugars (> 25% of energy), and very low intakes (< 10% of energy) (e.g. zinc; see Figure 2).

INTAKES OF ADDED SUGARS IN CANADA

To put the DRI suggested maximum (< 25% of energy) into perspective, we have calculated intakes of added sugars in Canada. Although there are no national nutrition surveys in Canada, an estimate of actual intakes can be made from disappearance data (sugars available for consumption). Actual intakes are lower than disappearance due to losses in food processing (e.g. bread, wine), wastage, and non-food uses. Based on the assumption that the difference between actual intakes and disappearance in Canada is the same as in the U.S. (based on nutrition surveys² and disappearance³), estimates of mean intakes of added sugars in Canada and the U.S. were made (Table 2). These data suggest that the average intake of added sugars in Canada in

FIGURE 2 Percent of individuals with intakes of zinc below the average requirement (estimate of prevalence of inadequacy) for each range of added sugars intake, by age and sex (m = male; f = female). The suggested maximal intake for added sugars (< 25% of energy) is shown for comparison (dotted line). Adapted from the DRI report¹.

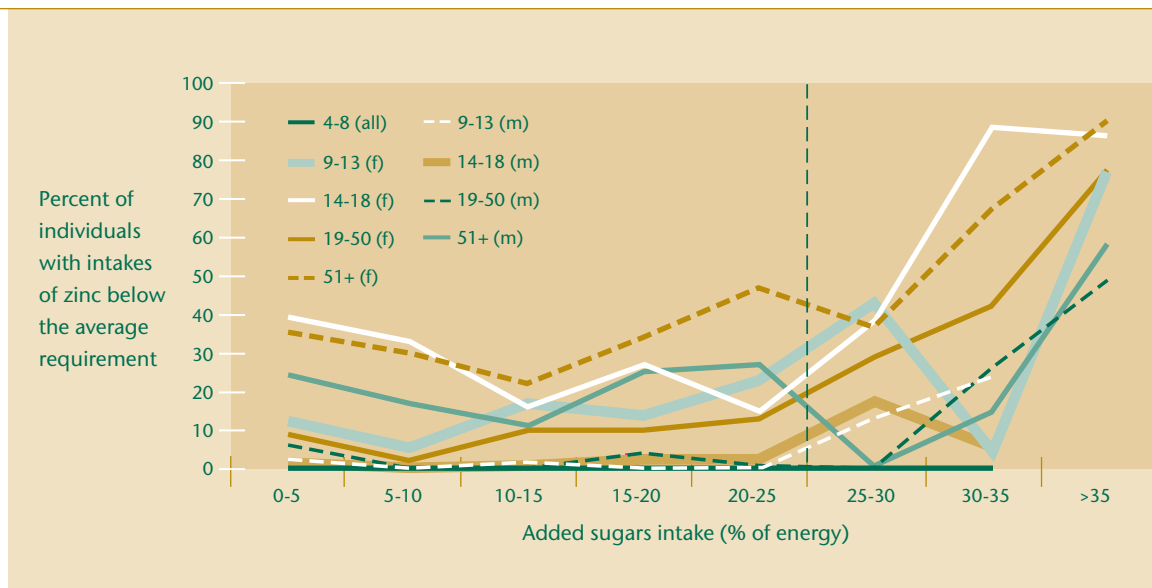


TABLE 2 Estimated mean intakes of added sugars by all individuals aged two and older^{1,2}

Canada	1994	1995	1996	1997	1998	1999	2000	2001
Intake per person per day (g)	61.5	60.0	60.1	61.7	64.7	61.3	62.0	60.5
Percent of energy ³	12.3	12.0	12.0	12.3	12.9	12.3	12.4	12.1
United States	1994	1995	1996	1997	1998	1999	2000	2001
Intake per person per day (g)	79.0	79.9	81.1	82.6	83.2	84.7	83.0	81.8
Percent of energy ³	15.8	16.0	16.2	16.5	16.6	16.9	16.6	16.4

¹ Includes refined sugar, high fructose corn syrup, glucose syrup, dextrose, honey and edible syrups; ² Estimated by the Canadian Sugar Institute based on U.S. Continuing Survey of Food Intakes by Individuals 1994-1996³ and sugars disappearance in Canada and the U.S.⁴; ³ Assumes mean of 2,000 kcal/day (U.S. mean = 2,007 kcal/day³).

2001 was approximately 12% of energy. Intakes are lower in Canada than the U.S. because of lower disappearance in Canada (about 75% of U.S.), partly due to lower soft drink consumption.

An estimate of the proportion of the population that consumes > 25% of energy from added sugars can also be made. Assuming that variability in intakes of added sugars is similar to the variability in protein, carbohydrate and fat intakes (provided in the DRI report), it can be estimated that in 2001 the 1st percentile of intakes of added sugars in Canada ranged from 6.7 to 8.5% of energy, and the 99th percentile ranged from 15.7 to 17.6% of energy (i.e. 99% of the population consumed less than 15.7 to 17.6% of energy from added sugars).

SUMMARY

1. The conclusion of the DRI report was that there is no evidence available to set a UL for total or added sugars. Thus, no specific level of intake of total or added sugars was found to be associated with an increased risk of adverse health effects related to behaviour, cancer, dental caries, diabetes, hyperlipidemia, or obesity.
2. Very high and very low intakes of added sugars are associated with lower micronutrient intakes.
3. Intakes of added sugars in Canada are estimated to be within a range consistent with adequate micronutrient intakes, and well below 25% of energy (mean = 12.1%; 99th percentile = 15.7 to 17.6%).

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