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## Sugar and Diabetes

### Position Statement

Diabetes Canada recommends Canadians:

- Limit their intake of free sugars<sup>1</sup> to less than 10% of total daily calorie (energy) intake. This is approximately 50 grams (12 teaspoons) of free sugars consumption per day based on a 2000-calorie diet<sup>2</sup>.
- Limit intake of sugar sweetened beverages (SSB) and drink water in their place.
- Promote the intake of whole foods and reduce the intake of free sugars throughout life for overall health.

Diabetes Canada recommends that federal, provincial/territorial, and municipal governments:

- The Government of Canada introduce a tax on SSBs and use the revenues generated to promote the health of Canadians.
- The Government of Canada ensures clear nutrition labelling for packaged foods including the amount of free sugars on the Nutrition Facts Table.
- Federal, provincial, and territorial governments immediately operationalize the World Health

Organization (WHO) set of recommendations to prevent the marketing of foods and beverages to children.

- A Federal, Provincial, and Territorial Working Group on Food and Beverage Marketing to Children is convened to develop, implement and monitor policies to restrict food and beverage marketing to children.
- Federal, provincial, and territorial governments support improved access to and affordability of nutritious foods in all regions.
- The Government of Canada implement legislation to require labeling of free sugars on menu labels in restaurants so Canadians can make more informed choices about the foods they eat.
- Recreational events, schools, recreation facilities, and government spaces not offer SSBs for purchase.
- Recreational events, schools, recreation facilities, and government spaces provide free water for consumption.
- Retailers and food manufacturers voluntarily cease marketing food and beverages to children until legislation is enacted.

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<sup>1</sup> Free sugars are those sugars that are removed from their original source and added to foods as a sweetener or as a preservative.

<sup>2</sup> As per the WHO Sugars Intake Guideline, Canadians may benefit from limiting free sugar intake to less than 5% of total daily calorie intake based on a 2,000-calorie diet per day (approximately 26 g or 6 teaspoons).



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Diabetes Canada, recognizing its responsibility as a health leader and employer will:

- Remove SSBs at Diabetes Canada events.
- Offer free water at all Diabetes Canada events and venues.
- Continue to encourage Canadians to limit consumption of SSBs.
- Encourage Canadians to limit consumption of foods high in free sugars in preference to whole natural foods.
- Serve foods that are healthy and nutritious at Diabetes Canada events.
- Expand and promote food preparation programs to encourage consumption of whole foods throughout the community.
- Work with partners with similar values and goals to promote health and health policies to create healthy food environments in Canada.
- Not partner with companies whose products are harmful to health and/or linked to the development or risk of diabetes, consistent with Diabetes Canada's corporate partnership policy.
- Promote additional research on the direct impact of free sugars consumption on diabetes and other chronic conditions.

### **Why is the Consumption of Sugars Important to Diabetes Canada?**

This position statement is based on a review of the evidence published between 1995-2015 about the role of free sugars in the diet of people living with diabetes and those at risk for type 2 diabetes. Recommendations for

intake of sugars by adults and children are provided. This statement can inform policy-makers and program managers in their assessment of consumption of free sugars within their jurisdictions and influence a reduction of consumption, as necessary, through a range of public health and public policy interventions.

Diabetes Canada developed the present evidence-informed recommendations using a systematic and deliberative approach. The steps in this process included:

- Identification of priority questions and outcomes;
- Retrieval of the evidence;
- Assessment and synthesis of the evidence;
- Formulation of recommendations;
- Review and input from experts; and
- Planning for communication, dissemination, implementation, evaluation and updating of the recommendations.

### **Diabetes**

From 2000 to 2010, the prevalence of diabetes in Canada doubled from 1.3 million to 2.5 million people (1). Today, more than one in four Canadians — or over ten million people — lives with diabetes or prediabetes; if nothing is done, by 2020, it will be almost one in three. Diabetes will cost an estimated \$14 billion in 2015. The Canadian economy and all Canadians are paying the cost of treating diabetes-related complications.



Diabetes is a condition characterized by an elevation in blood glucose (blood sugar) levels due to either a lack of insulin or a reduced effectiveness of one's own insulin. People with diabetes need to manage their glucose level in an effort to achieve their target blood glucose<sup>3</sup>. Diabetes is a leading cause of blindness, end-stage renal disease, heart disease, stroke, and non-traumatic amputation in Canadian adults (2).

There are three common types of diabetes. Type 1 diabetes occurs in people when their beta cells, located in the pancreas, no longer function. Consequently, very little or no insulin is released into the circulation. As a result, glucose builds up in the blood instead of entering the cells to be used as energy. About five to 10 per cent of people with diabetes have type 1 diabetes. Type 1 diabetes generally develops in childhood or adolescence but can develop in adulthood.

Type 2 diabetes occurs when the body cannot properly use the insulin that is released or does not make enough insulin. Glucose builds up in the blood instead of being used as energy. Over 90% of people with diabetes have type 2 diabetes. Type 2 diabetes develops in adulthood most commonly, but children can be affected.

A third type of diabetes, gestational diabetes, is a temporary condition that occurs during pregnancy. It affects up to 18% cent of all pregnancies and increases the risk of

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<sup>3</sup> Goals for target blood glucose are set for individuals depending on age, treatment methods and other co-existing health problems.

developing type 2 diabetes for mother and child in the future (2).

Overweight and obesity are risk factors for the development of prediabetes<sup>4</sup>, type 2 diabetes and gestational diabetes (2). Approximately 60% of adult Canadians (3) and one-third of children and youth aged 5 to 17 years are overweight or obese (4). Children who are obese are at increased risk of remaining overweight or obese as adults (5,6). Type 2 diabetes is being diagnosed earlier than ever before, and more frequently in children (6,7).

Behaviour modification, including dietary management for people at-risk of type 2 diabetes, attempts to reduce the likelihood of progression to diabetes. Dietary management may target weight loss, but also promotes the consumption of healthy foods. For people diagnosed with diabetes, adhering to a healthy diet optimizes glycemic control and reduces the risk of developing complications.

## World Health Organization Sugars Intake Guideline

In 2015 the WHO released guidelines on the intake of free sugars for adults and children (7). These guidelines recommend:

- Reduced intake of free sugars throughout the life-course (strong recommendation);

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<sup>4</sup> Prediabetes occurs when there is impaired fasting glucose, impaired glucose tolerance, or A1C of 6-6.4%; 50% of people with prediabetes will transition to type 2 diabetes.



- In both adults and children, intake of free sugars not exceed 10% of total energy (strong recommendation); and
- Further reduction to below 5% of total energy (conditional recommendation).

The WHO states that the first two recommendations are based on the health risks of free sugars consumption in predisposing those who consume them to overweight and obesity, and dental caries. WHO's third recommendation states that a further reduction of free sugars to below 5% (about 6 teaspoons) of total energy intake per day would provide additional benefits. The limits would apply to all sugars added to food, as well as sugars naturally present in honey, syrups, fruit juices and fruit concentrates.

Diabetes Canada supports these recommendations for Canadians and acknowledges the importance of the outcomes described by the WHO. Diabetes Canada recommends reducing free sugars consumption by the general population to promote dental health and decrease the risk overweight and obesity and subsequent illnesses. Furthermore, for people living with diabetes, limiting sucrose intake to 10% or less of total daily energy is recommended by the 2013 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada. Intake of sucrose >10% of total daily energy may increase blood glucose and triglyceride concentrations in some individuals with type 2 diabetes (3).

## Sugars in our Food Supply

Sugars are ubiquitous in our food supply and are consumed as a naturally-occurring component of many foods including milk, yogurt, fruits, and vegetables. It is also frequently added during food preparation, at the table and during food processing.

Sugars come in many forms. Glucose, fructose, and sucrose are commonly used sugars. Glucose occurs naturally in fruits and plant juices. Most ingested carbohydrates are converted into glucose during digestion and it is the form of sugar that is found in our blood. Fructose is found in fruits, some vegetables, cane sugar, and honey. It is one of the components of table sugar (fructose combined with glucose forms the disaccharide sucrose). It is also consumed as a high-fructose syrup. Sucrose is found in the stems of sugar cane and roots of sugar beet. It also occurs naturally with fructose and glucose in fruits and some roots vegetables such as squash. Maltose is found in certain grains (e.g. barley) and is less sweet than glucose, fructose or sucrose. Lactose is found in milk and other dairy products (8).

Free sugars are those sugars that are removed from their original source and added to foods as a sweetener or as a preservative. There are many different forms of 'free sugars' including cane juice, corn syrup, brown rice syrup, barley malt, agave nectar, and fruit juice concentrate.

The WHO defines 'free sugars' as sugars and syrups added to foods during processing or



preparation (7). This definition is inclusive of all sugars added to foods during cooking (or processing), such as honey, syrups, fruit purees, and juices that are added to a food. This definition does not include sugars found naturally in white milk, vegetables, and fruit. These sugar-containing foods also contain vitamins, minerals, and fibre which provide health benefits. These naturally occurring forms of sugar are referred to as bound sugar and are considered part of a healthy diet (9). The body metabolizes naturally occurring and added sugars in the same way however, digestion and absorption of free sugars may be faster as they are not bound into the food matrix. Foods that have high amounts of free sugars tend to offer less nutritional value. Foods with no free sugars tend to be higher in beneficial nutrients than those high in free sugars. Many people consume sugars with no knowledge of its presence in the food that they consume.

It has been estimated that Canadians eat 110 grams of sugars per day (26 teaspoons or 21 per cent of total energy intake, based on a 2,000 calorie-a-day diet) (10). This included sugars from all sources including milk products, vegetables, and fruit as well as free sugars. This estimate varied across sub-groups. People with diabetes were estimated to consume 73 grams of sugar (18 teaspoons) per day. Teenage boys between 14 to 18 years consumed 172 grams daily (41 teaspoons). Almost half of the average daily sugar intake of children from 1 to 8 years old and adolescents from 9 to 18 years old came from beverages, specifically milk (20% and 14%, respectively) fruit juice (15% and 9%

respectively), regular soft drinks (4% and 14% respectively), and fruit drinks (6% and 7% respectively). Milk was the primary source of sugar among children aged 1 to 8, but in those age 9 to 18, regular soft drinks ranked first. Beverages accounted for 35% of adults' daily sugar intake (10). Notably these data are from 2004, and consumption may have changed since then.

### **What are the Effects of Sugar Consumption on the Risk of Developing Diabetes?**

Numerous clinical trials, cohort studies, and meta-analyses have been performed to describe the impact of consumption of sugars on weight gain, as well as risk for and development of diabetes (11-27). Te Morenga et al. recently performed a systematic review and meta-analysis (2013) for the WHO and estimated that adults who reduced intake of dietary sugars decreased 0.80 kg body weight among randomized controlled trials (26). The same systematic review and meta-analysis, however, did not show a body weight decrease in the randomized controlled trials of children. Conversely, an increase intake of sugars was associated with an increase of 0.75 kg of body weight in both adults and children. A reduced intake of free sugars was associated with weight loss and increased intake of sugars was associated with weight gain in European adults in the EPIC-InterAct cohort study (12). Other researchers have performed systematic reviews and meta-analyses and calculated pooled estimates showing a statistically significant positive relationship between increased consumption



of calories in the form of sugars and weight gain. In the absence of weight gain seen in calorie matched trial comparisons, the relationship between weight gain and consumption of sugars appear to be mediated through an increase in calorie consumption (28-30).

A meta-analysis by Sonestedt (31) reviewed the evidence between the intake of total sugars, sucrose or fructose and type 2 diabetes. Nine studies were included, four of which evaluated the association between intake of total sugars, sucrose or fructose and type 2 diabetes. The data were inconclusive after adjusting for weight gain or BMI. Two of three studies found significant positive associations with total fructose intake (17,24). No studies found an association between sucrose or total sugars intake and diabetes and some researchers reported an inverse association. Sievenpiper et al. recently described the association between total sugars, total sucrose, and total fructose in an updated systematic review and meta-analysis of prospective cohort studies including more than 300,000 people. These authors failed to detect an independent risk for diabetes for all of these cases (32).

The link between intake of sugars and fasting plasma glucose, post-prandial glucose and insulin levels was reviewed by Kahn and Sievenpiper (33) and Sonestedt et al. (31). Both groups determined that there is insufficient evidence to link sugars with these proxies of diabetes risk.

In summary, large amounts of free sugars are often found in highly processed, high energy, high calorie foods. Excessive calorie consumption often occurs with these high-free-sugars foods, leading to weight gain. Given the established relationship between type 2 diabetes and overweight and obesity, as well as the relationship between excess calories and weight gain, consumption of sugars must be duly considered by all people trying to manage their weight and their risk for diabetes.

Moderate amounts of sugars can safely be consumed by people with diabetes and those at risk.

### **Sugar-Sweetened Beverages and the Risk of Developing Diabetes**

SSBs include soft drinks along with other sugar-sweetened beverages such as sports drinks, fruit drinks, lemonade, blended coffee drinks, and iced tea. They contain large amounts of readily absorbable sugars and are considered nutrient poor. A single 'serving' of soft drink (i.e. cola) contains approximately 40 grams (about 10 teaspoons) of sugar.

Almiron-Roig and colleagues suggest that liquids have relatively weak satiating effects, in part due to faster consumption and the greater chewing effort and longer oral exposure for semi-solids and solids which have been associated with higher satiety. Sensory and cognitive processes (e.g. odour, texture, and the perceptions of solid food versus a drink) have physiological responses affecting their satiating properties (34). SSBs



are high in sugar and calories but are in liquid form so they may be less satiating than isocaloric solid or semi-solid foods; thus, intake of SSBs may result in over-consumption of calories.

Many researchers have investigated the impact of SSBs and the incidence of diabetes. In the past, controlled trials, cohort studies, systematic reviews and meta-analyses of controlled trials in people with and without diabetes have shown mixed results (35,36). However, there is now substantial credible evidence for an association between SSB consumption and type 2 diabetes risk. Preliminary data supports the increased risk of gestational diabetes and consumption of SSBs (37).

Most recently, a meta-analysis by Wang and colleagues estimated that the increased risk of diabetes associated with high of SSBs is 1.30 times that for low consumption (95%CI 1.12-1.39) (36). This risk persisted after adjusting for BMI. Evidence from the European Prospective Investigation into Cancer (EPIC)-InterAct study funded by the European Union, that included eight European countries, across 26 research centres also showed that in adjusted models, one 336 g (12 oz) sugar-sweetened soft drink daily was associated with hazard ratio (HR) for type 2 diabetes of 1.22 (95%CI 1.09-1.38). After further adjustment for energy intake and BMI, the association of sugar-sweetened soft drinks with type 2 diabetes persisted (HR 1.18, 95%CI 1.06-1.32) (12). Malik et al (30) and Sonestedt et al. (31) have also reported similar findings in their reviews.

Chen et al. reported results from the Nurses Health Study II that evaluated the impact of SSBs on gestational diabetes. This large prospective study found that cola was significantly and positively associated with GDM risk, after adjustment of known risk factors for GDM including age, family history of diabetes, parity, physical activity, smoking status, alcohol intake, BMI, and Western dietary pattern. Compared with women who consumed <1 serving/month, those who consumed  $\geq 5$  servings/week of sugar-sweetened cola had a 22% greater GDM risk. No statistically significant elevation in risk was observed for other SSBs and diet beverages (37).

Imamura and colleagues recently prospectively examined the association between consumption of SSBs and type 2 diabetes and estimated the population attributable fraction in the United States and United Kingdom (38). Higher consumption of SSBs were associated with a greater incidence of type 2 diabetes by 18% and 13% per serving per day before and after adjustment of adiposity respectively.

In summary, based on high quality observational evidence of the adverse association between high SSB consumption and risk of type 2 diabetes and potentially gestational diabetes, it is prudent that we take action to reduce SSB intake.



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## Sugars, Diabetes and the Food Environment

Reducing intake of sugars is a healthy choice from many perspectives. From the societal perspective, it would have many health benefits, including preventing and reducing dental caries, reducing obesity, and preventing weight gain, with a favourable impact on other illnesses, such as diabetes, heart disease, and stroke. From a diabetes perspective alone, reduction of free sugars, specifically SSBs, may have an independent influence on type 2 diabetes risk and gestational diabetes risk. All this said, dietary changes must occur within a societal context.

### Sugars in the Food Supply

The packaged foods available today are sweeter than before. According to Basu et al., sugar supply has risen across the globe from an average of 218 kilocalories per person per day in 1960 to over 280 kilocalories per person per day by 2013. Assuming a food wastage rate of 30%, these consumed calories exceed the recommended daily upper limit of 150 kilocalories per man and 100 kilocalories per woman by the American Heart Association. Much of this is in the form of high fructose corn syrup within SSBs; however, added sugar is found throughout the food supply (27).

### Food Insecurity

Development of programs, policies, subsidies and strategies that enhance food security –

available, affordable, culturally appropriate food – are needed. Although there are several definitions of food security, the Food and Agriculture Organization of the United Nations currently uses the following description: "food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious foods which meets their dietary needs and food preferences for an active and healthy life" (39). The term "food desert" is used to describe an area that has limited access to healthy, nutritious food. For example, people living in some neighbourhoods have easier access to fast food and nutrient poor foods rather than healthy whole foods (40). Thus, people consume foods that are not healthful for reasons beyond their personal preference. These reasons may include, for example: food distribution, poverty, food skills, cultural context, marketing unhealthy foods, and social norms.

Despite the relative wealth within Canada compared to other countries in the world (41):

- Approximately 5% of Canadian children and 8% of Canadian adults lived in food insecure households from 2007 to 2012;
- In 2011–2012, 8.3% of Canadian households experienced food insecurity;
- Nunavut had the highest rate of food insecurity (36.7%); over four times the Canadian average (8.3%) in 2011–2012; and
- Individuals in food-insufficient households were also more likely to report diabetes, heart disease, high blood pressure and food allergies.



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## Childhood Obesity

In 2007, the Standing Committee on Health of the Parliament of Canada issued its report (42) on childhood obesity. They stated that:

- "The Committee shares the fears of many experts who predict that today's children will be the first generation for some time to have poorer health outcomes and a shorter life expectancy than their parents."
- "Children are consuming too many calories. This was attributed to increased portions, increased intake of fatty and processed foods as well as greater consumption of sugary drinks. The link between obesity and the increased consumption of sweetened drinks is particularly disturbing. It has been estimated that sugary drinks may be responsible for as much as one pound per month weight gain in adolescents."
- The Committee shares the concerns about the potential association between food advertising to children "and increased childhood overweight and obesity."

Since then, Potvin-Kent described that children's exposure to food and beverage advertising has increased since the implementation of the Canadian Children's Food and Beverage Advertising Initiative, a voluntary effort by the self-regulatory industry group Advertising Standards Canada (43). The authors conclude that the current self-regulatory system is failing to protect children from food marketing high in fat, sugar and

sodium on television. Government regulation needs to be considered.

## Taxation on SSBs

Internationally, some governments have used policy levers to influence SSB consumption. Mexico, France, regions in the U.S. (e.g. Berkeley, California and Vermont) and Europe, have applied taxes on sugar sweetened beverages as a means to deter consumption and redirect revenues toward health promoting initiatives. Preliminary results from the Mexico experience, which added a 10% tax to non-dairy and non-alcoholic drinks with added sugar, demonstrated a 6% decline in purchases in 2014 compared to pre-tax trends. These results were observed across socioeconomic groups and occurred in tandem with an increase in water consumption (44).

## Nutrition Labelling

Recently, the Government of Canada proposed changes to the Nutrition Facts Table that are a first step in helping Canadians understand the foods they consume. Diabetes Canada further recommends that nutrition labels should transparently list the quantity of all sugars that have been added to the food product. The amount should include free sugars (including added monosaccharides and disaccharides as well as sugars naturally present in, for example, honey, syrups and fruit juices) as these sugars should be considered in the choice to consume a food product. This added information to the label will help consumers make more informed



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choices about the foods they eat and the sugars they consume.

## **Marketing to Children**

Children's exposure to food and beverage advertising influences consumption patterns. The current self-regulatory system is failing to protect children from being exposed to marketing of food high in fat, sugar and sodium (43). Government regulation across Canada need to be expanded to emulate Quebec's Consumer Protection Act (1980), and regularly updated to include new mediums through which foods and beverages are advertised to children.

## **Healthy Foods and Beverages in Public Places**

Improving the nutritional quality of foods and beverages in public places is a low-cost public health strategy that can help to change social norms and create healthier food and beverage environments. This can help to model and reinforce healthy eating in other spaces and at home. Most public spaces have health promoting services (gyms, sports activities, wellness programs) that are undermined and contradicted by the sale of unhealthy foods.

## **Food Security**

The food industry must also play a role though reformulating products to reduce their content of sugars. Offering a wide range of products including those lower in sugars is

an important component of a comprehensive approach. Refraining from marketing to children and removing SSBs from recreational facilities and events are important first steps.

## **Conclusion**

Urgent action is needed now on several fronts to reduce consumption of sugars and thereby lessen the burden of obesity and diabetes in Canada.

All levels of government, from federal to municipal, as well as patient and community groups and individual champions are important catalysts for change and should therefore be involved in reducing consumption of sugars.

Diabetes Canada is committed to helping Canadians make healthy food choices. Reduction of free sugars consumption should not result in an over-consumption of other unhealthy foods. Diabetes Canada will continue to promote health education, food skills and healthy public policy to support Canadians.

There is an opportunity to lower the risk of type 2 diabetes and gestational diabetes. This requires a long-term commitment from many stakeholders at many levels. Population based interventions, including education, improved food distribution along with policies, such as SSB taxation and healthy food procurement by public institutions will together promote healthier food consumption, reduced intake of free sugars and better health.



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Last Updated: January 2020