

Case Report

The Specific Impact of Fructose on the Development of Type 2 Diabetes Mellitus in Pediatric Patients

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Abstract

Added fructose in particular i.e., as a constituent of added sucrose or as the main component of high-fructose sweeteners may pose the greatest problem for the development of obesity, T2DM, T2DM-related metabolic abnormalities in pediatric populations and CVD later in life. In contrary, whole foods that contain fructose i.e., fruits and vegetables pose no problem for health and are protective against the above metabolic disorders. Several dietary guidelines appropriately recommend consuming whole foods over foods with added sugars or sugary drinks (SSBs). For instance, in his 2016 Sugar Position Statement, the Canadian Diabetes Association (CDA) recommends reducing free sugar intake to a specific level of 10% of total calories intake i.e., to the level shown to improve glucose tolerance in humans and to decrease the prevalence of T2DM in both adults and pediatric patients. This level is also associated with an improvement of the metabolic complications that often precede and accompany T2DM. Reducing the intake of added sugars and fructose could translate in reduced T2DM-related morbidity and premature mortality. Finally, for our adolescent the recommendation that you as the HCP should give to the parents are no SSBs either fructose or not and to replace these beverages with water, % fruit juice (no added sugar) in limited amount (4 to 6 ounces per day), vegetable juice or milk and to limit the intake of free sugar to the CDA recommendations. However, there is no risk to consume the recommended amount of five servings and more of fruits and vegetables per day despite the presence of fructose in these foods.

Introduction

Recent public health interest has focused on fructose as having a unique role in the pathogenesis of cardiometabolic diseases including obesity, T2DM and others [1-2]. However, because we rarely consume fructose in isolation, the major source of fructose in the diet comes from fructose-containing sugars, sucrose and high fructose corn syrup, in sugar-sweetened beverages (SSBs) and foods [2]. The intake of SSBs is now known to be linked to an increased risk of obesity and T2DM in various populations including pediatric population and the risk of developing CVD later in life. The underlying mechanisms is not completely known but include incomplete compensation for liquid calorie, adverse glycemic effects, and increased hepatic metabolism of fructose leading to an increased lipogenesis from the liver which results in a higher production of uric acid, and accumulation of visceral and ectopic fat [2]. In this mini review, with the use of a case report, we summarize the evidence evaluating the impact of added sugars, SSBs, and fructose on the risk of obesity, T2DM, and its associated CVD. We also discuss strategies to reduce the intake of fructose-containing sugar in order to answer questions raised by many parents and HCPs dealing with pediatric and adult patients suffering from obesity and T2DM.

Case report

During a subsequent visit, the parents came to the clinic for questions about the diet of her daughter Janet. Because she is obese and recently diagnosed with T2DM, the parents are concerned about the risk of losing control of her T2DM. They said that they should

pay attention to the amount of fat, sugars and calories that Janet should ingest every day. On the other hand, they were a little confused regarding sugar: some people say that some sugar are to be avoided, including those added in the juice and food as well as those that are included in the soft drinks. On the other hand, it seems that there are no problems to consume diet drinks since they contains no calories and should be good to help Janet with her weight problem. Among the following, which one would you recommend to the parents?

- avoid all foods containing fructose.
- there is no risk to eat foods with sugar as long as it's not fructose.
- there is no risk associated with "diet" drink.
- the use of sweeteners (artificial sugars) is a good choice.
- neither is true.

All these answers are wrong.

Answer: e

Explanations

- Avoid all foods containing fructose.**

Fructose is the most frequent sugar used as sweetener in drinks like soft drinks, and energy drinks which are the single greatest source of calories and added sugars in the US diet, accounting for nearly half of all added sugar intake [3]. Fructose is also found in sucrose or common table sugar, which is a disaccharide composed of one glucose molecule and one fructose molecule linked via an α 1-4 glycoside bond, and is obtained from either sugar cane or beets. Fructose and

glucose are also both found as naturally occurring monosaccharides that exists in fruit, honey and some vegetables [2].

Sweeteners such as high fructose corn syrup (HFCS), produced from corn starch through industrial processing contain free fructose and free glucose in relatively equal proportions and have progressively replaced use of sugar due to its low cost. The most frequent forms of HFCS contain either 42 % (HFCS-42) or 55 % (HFCS-55) fructose, along with glucose and water. HFCS-55 has the sweetness equivalent of sucrose and is widely used to flavor carbonated soft drinks. HFCS-42 is somewhat less sweet and is mainly used in processed foods including canned foods (e.g., soups, fruits), cereals, baked goods, desserts, sweetened dairy products, condiments, fruit-flavored noncarbonated beverages, candies, and many fast food items.

Longitudinal data over the past 40 years have shown a close relation between the rise in added sugar and obesity and T2DM epidemics in the US [4]. For now, there is no study in children to answer this question. On the other hand, according to a recent study performed in adults [5] consuming drinks sweetened with fructose and or glucose can increase abdominal fat and the levels of bad cholesterol, i.e., the low-density [LDL-C] cholesterol, two consequences related to an increased risk of CVD [6]. The study in question involved 32 adult subjects overweight or obese who had been asked to consume 25% of their total daily calorie needs by drinking a sweet drink with fructose or glucose, for 10 weeks. The two groups gained substantially the same amount of weight. However, the researchers found that fructose seemed to have more negative effects on the body weight. Indeed, people who drank sweetened drinks with fructose had higher levels of LDL-C, had a lower sensitivity to insulin and the highest rates of abdominal fat, which are known risk factors for CVD [6-7]. This confirms that excessive consumption of fructose, usually from SSBs can be unhealthy.

To ensure to avoid fructose, it is recommended that the consumers take time to read food labels when shopping to see if fructose is part of the ingredients. This will help them avoid fructose. It is also recommended to choose water, 100% fruit juice (no added sugar), vegetable juice or milk rather than the fructose-containing beverages. On the other hand, do not consider fructose as only being a dangerous sugar. Fruits and vegetables are the main natural source of fructose. Most of the fruits contain about 10 g of fructose. If fructose is toxic in high doses, people consuming large quantities of fruits would have undesirable effects, which is not the case. In addition, studies reported an inverse association between fruit consumption and body weight or the metabolic risks discussed above [8].

The absence of adverse effects associated with the consumption of fruits and vegetables in large quantities is related to a slower rate of digestibility for fruits and vegetables compared to drinks and processed foods sweetened with fructose. In addition, the presence of soluble fiber, and the cell structure of fruit and vegetables contribute to reduce the rate of absorption of fructose at the level of the digestive tract. We can add that the content in nutrients and antioxidants from fruits and vegetables protects against the inflammatory effect of fructose at the hepatic level and against the resistance to insulin at the systemic level. In other words, the small amounts of fructose consumed in vegetables and fruits are healthy for the body [8]. Therefore, there is no risk to

consume the recommended amount of five servings and more of fruits and vegetables per day despite the presence of fructose in these foods.

The metabolism of fructose differs from that of glucose in two major ways. First, there is nearly complete hepatic extraction of fructose and second, there are different enzymatic reactions in the initial steps of the metabolism of fructose and glucose. Fructose is absorbed from the gut into the portal vein and is metabolized in the liver where it is converted into fructose-1-phosphate by the enzyme fructokinase [2]. Because these processes are not dependent on insulin, fructose is metabolized without requiring insulin secretion and without increasing plasma glucose. Of particular note, unlike glucose, fructose can bypass the main rate limiting step of glycolysis at the level of the enzyme phosphofructokinase, allowing it to act as a substrate for hepatic *de novo* lipogenesis resulting in an increased production of lipids [2]. The massive uptake and phosphorylation of fructose in the liver can also deplete intracellular ATP leading to an increase in uric acid production, which has been shown to induce metabolic complications [2]. These differences in hepatic metabolism can lead to a variety of different short- and long-term cardiometabolic effects of fructose compared with glucose.

(b) there is no risk to eat foods with sugar as long as it's not fructose.

There are strong evidences indicating that SSB consumption is associated with an increased risk of T2DM through effects on adiposity and independently through other metabolic effects. A recent meta-analysis of 8 prospective cohort studies evaluating SSB intake and the risk of T2DM was performed (13). This study was based on 310,819 participants and 15,043 cases, individuals in the highest category of SSB intake composed of 1–2 servings per day. These individuals had a 26% greater risk of developing T2DM compared to those in the lowest category (none or less than one serving per month).

A similar association was found in a sub-cohort of 15,374 participants and 11,684 incident cases from the European Prospective Investigation into Cancer and Nutrition (EPIC) study [10] where a one serving per day increase in SSBs was associated with a 22% increased risk of T2DM. A recent meta-analysis of 17 cohort studies found that a one serving per day increase in SSBs was associated with an 18% increased risk of T2DM. Adjusting for BMI reduced this estimate to 13%. Given the similar estimates from studies in the US where HFCS is the primary sweetener and Europe where sucrose is used, there does not appear to be any appreciable difference regarding the impact of sweetener type on risk of T2DM. However, food sources of fructose may make a difference in metabolic effects. Some studies have shown beneficial effects of whole fruit consumption on risk of T2DM [11].

These results indicate that the liquid vs. solid forms of calories from sugars may impact metabolic diseases differently. Fructose in beverages is absorbed more quickly than fructose in whole foods such as fruit and vegetables, which are absorbed more slowly due to their fiber content and slow digestion. As mentioned earlier, the rapid absorption of liquid fructose increases the rate of hepatic extraction of fructose due to an increase in the lipogenesis from the liver which results in a higher production of lipids [2]. This new reality shows that excessive sugar consumption has harmful effects on health beyond his

alleged role in obesity. In other words, too much sugar doesn't just affect growth; it can also make us ill [12-13].

According to a recent study, more the consumption of added sugars is high and steady, more the risk of death from CVD increased [14]. There is also increasing evidence that higher SSB consumption increases CVD risk by contributing to the development of HTN, dyslipidemia, inflammation, coronary heart disease and stroke. In over 88,000 women in the NHS followed for 24 years, it was found that those who consumed 2 servings and more per day of SSBs had a 35% greater risk of CHD (non-fatal myocardial infarction or fatal CHD) compared with infrequent consumers [15]. Additional adjustment for potential mediating factors (including BMI, total energy intake and incident diabetes) attenuated the association, but it remained statistically significant, suggesting that the effect of SSBs may not be entirely mediated by these factors. Similar results were found in the HPFS among 42,883 men [16]. In this study, intake of SSBs was also significantly associated with increased plasma concentrations of inflammatory cytokines [16].

There is also evidence linking intake of SSBs to an increased risk of stroke. Among 84,085 women and 43,371 men in the Harvard cohorts followed for 28 and 22 years respectively, 1 serving and more of SSB per day was associated with 16% increased risk of total stroke compared with none in multivariable adjusted models including BMI [17]. This association was attenuated and no longer statistically significant after adjusting for HTN and T2DM, suggesting that these factors may be mediators. In the multi-ethnic cohort of 2,564 residents in Northern Manhattan followed for a mean of 10 years, daily soft drink consumption was associated with an increased risk of vascular events only in participants free of obesity, T2DM and metabolic syndrome at baseline and adjusted for a number of factors including BMI and HTN [18]. A Japanese cohort of 39,786 men and women followed for 18 years found significant positive associations between SSB intake and total and ischemic stroke in women but not in men in models adjusted for HTN and T2DM [19]. Adjustment for BMI and total energy intake had little effect on estimates, suggesting that these factors are not major mediators.

According to these researchers, we consume too much added sugar. It has been shown that between 2005 and 2010, 70% of adult foods contained at least 10 % of added sugars. Intake of both added sugar and SSBs was associated with an increased risk for CVD mortality in an analysis of NHANES III Linked Morality cohort data [20]. After a median of 14.6 years of follow-up, added sugar intake was associated with a 2-fold greater risk of CVD death comparing extreme quintiles of intake. In contrast, an analysis from the NIH-AARP Diet and Health Study; a prospective cohort of older US adults, found that intake of total fructose but not of added sugar was associated with a modest increase in risk of all-cause mortality in men and women [21]. However, total sugars from beverages, including added sugar were positively associated with risk of all-cause, CVD and other-cause mortality in women while only fructose from beverages was positively associated with risk of all-cause and CVD mortality in men.

In 2015, the WHO released guidelines on the intake of free sugars for adults and children [22]. This guideline strongly recommends to

reduce the intake of free sugars throughout the life-course. In both adults and children, it is strongly recommended that the intake of free sugars should not exceed 10% of total energy intake. Further reduction to below 5% of total energy intake is a conditional recommendation. The WHO states that the first 2 recommendations are based on the health risks of free sugars consumption in predisposing those who consume them to overweight and obesity, and dental caries. The 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.

Another argument going against the fact that not only the fructose is harmful involves the glycemic index (GI). This index is a scale of classification of foods rich in carbohydrates according to the rise in blood sugar compared to a reference element, which is glucose or white bread. Glucose and the most commonly consumed starchy foods have a high GI, while fructose has a low GI. In addition, meta-analyses and systematic reviews have linked diets with high GI in the same undesirable effects as those of fructose, particularly regarding obesity and T2DM [8]. It is wrong to believe that there is no risk to consume foods and drinks with added sugars, as long as it is not fructose.

In other words, there is a real risk to consume added sugar. We cannot repeat enough the importance of taking the time to read food labels when shopping to avoid buying products that contain added sugars. We therefore recommend to this patient and her family to choose foods and drinks that contain no added sugar. It is also recommended to avoid the addition of sugar table in drinks, cereals and to reduce the consumption of processed meals (prepared or frozen) that often contain a lot of added sugar and salt.

(c) There is no risk associated with drinking "diet" drink.

For the moment, there is no study in children to answer this question. On the other hand, recent evidence show that in overweight or obese adults who drink diet drinks tend to consume more food and calories from solid foods (non-liquid), especially during snacks, that those who drink SSBs [23]. In general, the diet drinks can be seen as part of a weight-control strategy. Indeed, it is wise to believe that they could contribute to weight loss because they contain fewer or no calories. However, we should not forget that the physical mechanisms for maintaining weight are very subtle and complex.

To better understand the relationship between the consumption of diet drinks and caloric intake, the researchers looked at almost 24 000 adults of 20 years of age and older and noted the drinks and foods consumed over a period of 24 hours. They found that 11% of adults with a healthy body weight, 19 % of overweight adults and 22 % of obese adults drank diet drinks. The number of calories consumed during that 24 hour period by overweight or obese adults who drank diet drinks was similar in terms of number of calories.

On the other hand, adults with a weight surplus or obese people who drank diet drinks tended to ingest more calories in the form of solid food. Indeed, they have consumed 88 and 194 more calories

from solid foods per day, respectively, than similar adult who drank soft drinks. Notably, obese adults who consumed diet drinks ate much more during snacks than those who were exposed to sugary drinks. Those who drank diet drinks consumed 131 calories per day from salty snacks compared to 243 calories from sugary snacks, compared to 107 and 213, respectively, for obese adults who drank sugary drinks.

One of the main reasons for these results is that the consumption of artificial sweeteners present at high doses in diet drinks, is associated with greater activation of the centers of rewards at the brain level, thereby increasing feelings of pleasure a person experiences during the ingestion of sweetened foods [7]. In other words, the consumption of diet drinks artificially sweetened can alter the activity of the receptors responsible for the control of sugar in the brain, causing disturbances in the control of appetite. This results in an increase of food consumption, representing a potential risk of weight gain. Similarly, the increase in the consumption of calories from sweetened snacks rather than salty snacks is compatible with this concept and suggests diet drinks sweetened with natural or artificial sweeteners drinks encourage some form of dependence on sugars [7, 23].

The results of the study from Bleich and colleagues suggest that overweight or obese adults seeking to lose or maintain their weight loss and having already replaced sugary drinks for diet drinks, should look carefully at other solid components of their diet, especially sweet snacks, which would allow them to identify food to change in their diet [23]. Therefore, it is wrong to believe that there is no risk to diet drinks. We do not recommend to totally eliminating diet drinks from the youth diet because they can help control weight due to their low calorie levels especially if they contain no added sugar. However, based on the results presented in the adult, it is also recommended to young people, especially those who are overweight or obese and who drink diet drinks, to become aware of the calories from solid foods, particularly sugary foods, in order to prevent weight gain or facilitate weight loss. It is recommended that patient pay special attention to the choice and content of snacks to ensure that the total and wanted energy intake be respected, even if they consume diet drinks.

It was found that replacement of 1 serving per day of SSBs with one serving of water was associated with 0.49 kg less weight gain over each 4-year period [24]. In the NHS II, substituting water for SSBs was also associated with a significantly lower risk of T2DM [25]. Therefore, this represent a good strategy for our 14 year-old patient, but, unfortunately, I do not think that this strategy will be sustainable at long-term. One hundred percent fruit juice could be perceived as a healthy alternative to SSBs, since juices contain some vitamins and other nutrients. However, fruit juices also contain a relatively high number of calories from natural sugars, with likely greater amounts of fructose. A positive association seems also to exist between the consumption of fruit juice and greater weight gain and T2DM, although some conflicting evidence exists. Nonetheless, based on the current evidence it has been recommended that daily intake of 100 % fruit juices be limited to 4–6 ounces per day [26–28].

(d) the use of sweeteners (artificial sugars) is a good choice

It is often proposed to address the problems associated with the overconsumption of sugar by using artificial sweeteners such as

saccharin, acesulfame, aspartame, neotame, stevia (which is a natural plant extract) and others as they contain no calories. On the other hand, these synthetic substances are hundreds to thousands of times sweeter than sucrose and cause an intense feeling of pleasure in the brain with minimal concentrations of artificial sweetener [7]. As suggested by the term “diet”, under which these products are marketed, the food and drinks with artificial sweeteners are supposed to produce a sweet taste comparable to their counterparts containing sugar, but with fewer calories, contributing to weight loss.

Short term clinical trials provide evidence to that effect. For example, an increase in weight and blood pressure and inflammatory markers were observed in obese adults who consumed on average 600 Kcal/d of sucrose, mainly in the form of SSBs, for 10 weeks, compared to a control group using artificial sweeteners [7]. Therefore, it is possible to believe that the use of these artificial sweeteners can have a beneficial effect on weight control. However, the physical mechanisms for maintaining weight are subtle and complex. Now, it is increasingly obvious that the lack of calories from artificial sweeteners would be replaced, over time, with calories from other sources. Thus, this compensation could have an impact on weight control and on health [7]. In addition, increased stimulation of brain receptors by a frequent consumption of these powerful artificial sweeteners can cause taste preferences to sugars which will persist creating an increased tolerance to sugars.

Therefore, people who regularly use these artificial sweeteners can find not sweetened enough some foods such as fruits, vegetables, legumes and other. As these foods have become less attractive, so less consumed, the quality of the diet is reduced, thus contributing to a risk of weight gain. One of the concerns is that the repeated use of these artificial sweeteners can disrupt hormonal ways and neurobehavioral compartments, thus causing a preference for sweet foods, a change in the feeling of hunger, which would affect the control of appetite and, indirectly, the control the weight. Therefore, it is wrong to believe that the use of sweeteners (artificial sugars) is a good choice. Despite the lack of study on the consequences of the sweeteners among young people, it would be preferable that these parents do not give these artificial sweeteners to her 14 year old daughter.

(e) neither is true.

All these answers are false. As discussed by Goran [29–30], children and teens today grow up in a much sweeter nutritional environment than previous generations. A good use of sugary drinks and sugary solids contained in snacks and meals became an important daily task for parents in the education of children and adolescents. Indeed, more than 70% of the foods contain sugar, and the consumption of soft drinks has increased fivefold since 1950.

It is also important to note that the consumption level of sugar is particularly high in vulnerable segments of the population who are more susceptible to obesity, as well as in young people with a low socio-economic status such as ethnic minorities, the obese and other groups. The latest research on this topic has demonstrated a strong link of evidence between the sugar contain in food, particularly fructose and the risk of hepatic steatosis, which has more than doubled in children in the last 10 years [31–32]. Increased consumption of fructose in

adolescents was proved to be associated with CVD risks later in life secondary to an increase in abdominal fat [33].

A recent study of Stanhope and his collaborators describes how the metabolism of fructose is associated with a good number of adverse metabolic effects [34]. These effects are likely to be increased during growth and development because fructose promotes differentiation of adipose tissue during growth. In support of this concept, the article of Disse and colleagues shows that children with a disorder of absorption of fructose have lower levels of obesity [35]. Although not definitive, this finding supports the concept of a more damaging effect of fructose on obesity during growth. This concept is also based on the Morgan [36] meta-analysis which shows that the consumption of fructose can contribute to the increase in the prevalence of pediatric obesity, while the limitation of SSBs which include the majority of fructose intake can help to reduce the prevalence of obesity among young people and help to improve their metabolic profile [37].

This imbalance to a greater amount of fructose in the diet has other implications for the growth and development of children and adolescents [29-30]. For example, the consumption of milk, which has declined in favor of SSBs; the milk is now more expensive than SSBs. This has consequences on the daily fructose consumption because milk contains no fructose, while SSBs, is very rich in fructose. For example, a serving of 12 fluid ounces (350 ml) of soft drinks contains 23 g of fructose. Two of these portions would be sufficient to reach 90% of the acceptable level of the daily consumption of fructose for youth, without even taking into account the fructose consumed from other natural sources (fruits and vegetables) and found in the other foods [38].

Despite the diversity of links between increased consumption of SSBs and fructose and obesity among young people, an important conclusion is observed: increased consumption of sugar, particularly fructose, contributes to a profile of altered body fat which would favour an increased risk of metabolic diseases, including T2DM, fatty liver and other [37]. Note a higher level of sugar, especially of dietary fructose induce a metabolic dysfunction, especially among young people who are overweight or obese, compared to young people with normal weight [39]. Youth studies suggest that a reduction in the consumption of SSBs leads to a better weight control among those who are overweight [39].

Despite the mixed conclusions and some gaps in our knowledge about the effects of sugars on obesity and the metabolic risk in pediatric populations, the majority of studies support the current efforts of public health to reduce the total consumption of sugars and fructose in this population [30]. For the reasons given previously, it is a crucial issue among youth because of the underlying effects of added sugar, and fructose on the growth and development of adipose tissue.

The most important is to consider the effects of fructose on the brain and on the appetite control, which are to promote the development of obesity. It is therefore realistic to believe that fructose would have an "obesogenic" effect during the period of development of the youth (30). Since overweight and obesity aggravate the effects of sugar on the metabolic disorders during growth and development, efforts to reduce the sugar consumption should focus on children and

adolescents who are overweight or obese. It is also suggested to focus not only on obesity as a consequence, but also as a metabolic risk factor for T2DM and CVD.

From the information above and the lack of clear regulations governing the content in sugar and fructose of several foods and sugary drinks, it seems very justifiable to recommend the absence of SSBs among our young people with overweight or obesity. Remember that, in fruit and vegetables, the fructose is mixed with fibre, vitamins, minerals and enzymes, making it harmless, which justified retaining the current recommendation of five servings of fruits and vegetables per day and no SSBs.

Conclusion

Intake of added sugar, predominantly sucrose and HFCS from SSBs has increased markedly in the US and Canada in the past decades and constitutes the major source of fructose in the diet. In this perspective, and since we rarely consume fructose in isolation, it is logical to measure the potential cardiometabolic effects of fructose by evaluating its associations with SSBs. Although the consumption of SSBs has decreased moderately in recent years, the intake levels remain high in the US and Canadian populations and are increasing rapidly in developing countries.

Based on the available evidence we can conclude that the consumption of SSBs causes excess weight gain and is associated with increased risk of T2DM in adult and pediatric patients. It also increases risk of CVD and other serious health problems later in life. SSBs are thought to promote weight gain in part due to excess calories and incomplete compensation for liquid calories at subsequent meals. These beverages may also increase T2DM and CVD risk independently through an adverse glycemic response and unique metabolic effects of fructose. Short-term mechanistic studies have shown that excess fructose ingestion can result in additional cardiometabolic effects due to increased hepatic *de novo* lipogenesis, accumulation of visceral adiposity and ectopic fat and production of uric acid [2].

Several public policy and regulatory strategies to reduce intake of SSBs have been in place or are being considered to limit the consumption of SSBs. Implementing and evaluating such policies are important areas for scientists and policymakers. Key areas that warrant future research include examining the effects of different sugars and sugar moieties on health outcomes over a broad range of doses, investigating the health effects of sugar consumed in solid form in comparison to liquid sugar and further elucidating the biological mechanism by which intake of liquid calories induces an incomplete compensatory intake of energy at subsequent meals. There is also a need to identify effective strategies to reduce SSB consumption at the individual and population level. In this regard the Canadian Diabetes Association recommends the following in its Sugar Position Statement for the population and the Government [40].

The Canadian Diabetes Association recommends Canadians:

1. Limit intake of free sugars to a less than 10% of total daily calorie (energy) intake. This is approximately 50g (12 teaspoons) of free sugars consumption per day based on a 2000 calorie diet.

2. Limit intake of sugar sweetened beverages (SSB) and drink water in its place.
3. Promote intake of whole foods and reduce intake of free sugars throughout life for overall health.

The Canadian Diabetes Association recommends that:

1. The Government of Canada introduce a tax on SSBs and use the revenues generated to promote the health of Canadians.
2. The Government of Canada ensures clear nutrition labelling for packaged foods including the amount of free sugars on the Nutrition Facts Table.
3. 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.
4. 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.
5. Federal, Provincial and Territorial governments support improved access to and affordability of nutritious foods in all regions.
6. 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.
7. Recreational events, schools, recreation facilities, and government spaces not offer SSBs for purchase.
8. Recreational events, schools, recreation facilities, and government spaces provide free water for consumption.

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