

Frequently Asked Questions about Carbohydrates and Type 2 Diabetes

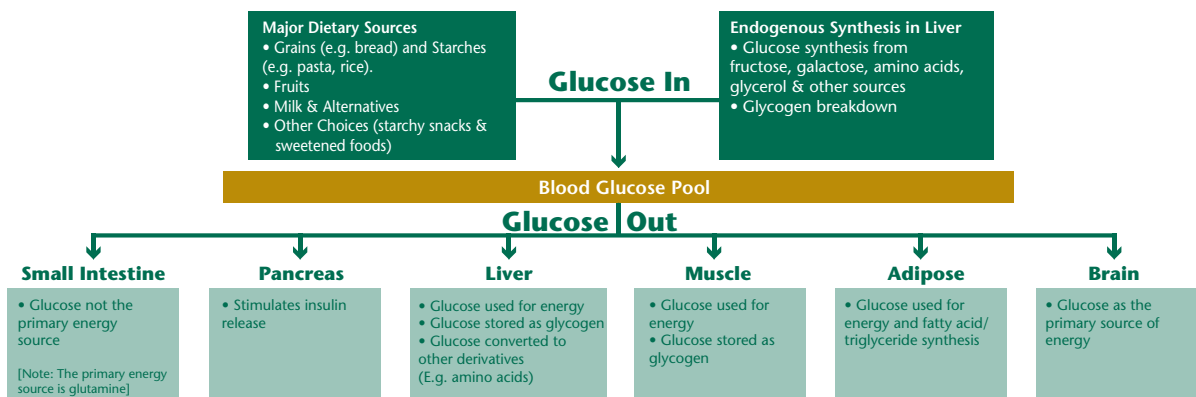
Key points:

- Sugars do not directly cause diabetes. Among the risk factors for Type 2 Diabetes, overweight/obesity is the most significant.
- People with Type 2 Diabetes can consume up to 10% of total Calories from added sugars¹.
- Foods with 'reduced in sugar' and 'No sugar added' claims are not always a better choice.
- People with diabetes should consume consistent amounts of carbohydrate throughout the day, with a minimum of 130 grams per day.

Introduction

Carbohydrate metabolism in relation to glycemic control is one of the most important topics for people with diabetes. Glucose from both dietary and endogenous sources supports essential functions of major organs in the body (Figure 1). Individuals with multiple modifiable and/or non-modifiable risk factors may be at greater risk of developing insulin resistance, resulting in altered glucose utilization (Table 1) and eventually leading to clinically prominent metabolic disturbances (i.e., hyperglycemia, hyperinsulinemia, hyperlipidemia). This resource will provide answers to questions frequently heard by health care professionals regarding carbohydrate and sugars for people with Type 2 Diabetes.

Figure 1: Utilization of glucose by major organs in people with a normal insulin response².



Do sugars cause Type 2 Diabetes?

No, scientific evidence has not identified sugars as a direct cause of diabetes. A systematic review of predominantly prospective cohort studies examined the association between total sugars, sucrose or fructose intake and Type 2 Diabetes incidence and showed inconclusive results⁵. Of the six studies reporting either sucrose intake or total sugars intake, none found a positive association with Type 2 Diabetes incidence⁵.

Similar conclusions were made in a meta-analysis of prospective cohort studies focusing on fructose containing sugars (fructose, sucrose and high fructose corn syrup) where no significant difference in diabetes incidence was found between the highest and lowest quantiles for consumption⁶.

Among the risk factors for Type 2 Diabetes, overweight/obesity is the most significant². Excess weight gain can be caused by chronically exceeding daily caloric needs through the overconsumption of energy from all macronutrients. Sugars contribute to overall carbohydrate and caloric intake, but scientific evidence has not found that sugars contribute to weight gain any differently than other energy sources. Meta-analyses of randomized controlled trials have consistently shown that when sugars were consumed in isocaloric exchange for other carbohydrates, no weight gain was observed in subjects with Type 2 Diabetes^{7,8}.

Table 1: Changes in different organs under insulin resistance^{3,4}.

Organ	Change
Small Intestine	↑ Glucose absorption ↑ Fatty acid synthesis and lipoprotein secretion
Pancreas	↑ Glucose-stimulated insulin release
Liver	↑ Glucose influx from blood circulation ↑ Glucose synthesis from various sources ↑ Glucose output to blood circulation ↑ Fatty acid synthesis and lipoprotein secretion
Muscle	↓ Glucose uptake ↓ Glycogen synthesis
Adipose tissue	↓ Glucose uptake ↑ Lipolysis and free fatty acid output
Brain	↓ Glucose uptake and utilization [Alternative energy source: ketone bodies]

Can people with Type 2 Diabetes consume added sugars as part of a healthy diet?

Yes, added sugars in moderation can be included as part of healthy meal plans for people with Type 2 Diabetes. In the 2013 CDA Clinical Practice Guidelines and the 2015 CDA Public Policy Position Statement on Sugars, it is stated that added sugar can be substituted for other carbohydrates in amounts up to 10% of total calories^{1,9}. This level of sucrose intake has been shown to have no deleterious effects on glycemic control or lipid profile¹.

The 2013 CDA Clinical Practice Guidelines and recent meta-analyses also state that fructose, when substituted for other sources of carbohydrate (e.g., starch or sucrose) has no harmful effects on lipid profile, uric acid or body weight¹. In a meta-analysis of randomized controlled trials, small doses of fructose (22.5-36 grams/day) also showed beneficial effects on glycated hemoglobin (HbA1c) and fasting glucose⁸. However, amounts of fructose greater than 50 g (on a 2000 Calories/day diet) or 10% of total Calories may increase triglycerides in people with diabetes. For optimal health, it is therefore recommended that this level not be exceeded¹.

Whenever foods containing added sugars (including sucrose and fructose) are consumed, they should be accounted for as carbohydrate food choices since total non-fibre carbohydrate intake has the greatest effect on blood glucose concentrations, not simply the total sugars or added sugars intake^{1,10}.

Are “Reduced in sugar” or “No sugar added” foods a better choice for people with Type 2 Diabetes?

Not always. Foods and beverages making the claim “Reduced in sugar” or “No sugar added” are often sweetened using non-caloric sweeteners such as aspartame, saccharin and stevia. While these products may provide flexibility in food choices when managing carbohydrate and caloric intake throughout the day, these claims do not indicate that these products are sugar free nor are they necessarily lower in total carbohydrate or Calories. This is because naturally occurring sugars along with starch may still be present (and sometimes in higher quantities to replace the functional role that sugars provided). Market research conducted in Ontario found that of 402 products making a reduced/no added sugars claim, 15% actually had higher Calories, 18% were higher in carbohydrate and 6% were higher in sugars compared to reference products¹¹.

In addition to this potential confusion, sugars claims highlight one single nutrient while people with diabetes have complex nutrition needs to maintain optimal levels of blood glucose, blood pressure and blood lipids¹. Although products with a sugars claim may assist people with diabetes in identifying products lower in sugars, the Nutrition Facts Panel should always be consulted to review the full list of nutritional information, including Calories, carbohydrate (including sugars, starch and fibre), fat and sodium. The CDA Clinical Practice Guidelines present specific dietary and lifestyle recommendations for people with diabetes, which are summarized in Table 2.

REFERENCES

1. Canadian Diabetes Association Clinical Practice Guidelines Expert Committee. (2013). *Canadian Journal of Diabetes*, 37(S1):S1-S212.
2. Szablewski L. (2011). In: *Glucose Homeostasis and Insulin Resistance*. Bentham Science Publisher.
3. Gropper SS, Smith JL. (2013). In: *Advanced nutrition and human metabolism*. 6th Edition. Cengage Learning.
4. Adeli K et al. (2008). *Curr Opin Lipidol* 19, 221-8.
5. Sonestedt E et al. (2011). *Food and Nutrition Research* 56:19104.
6. Tsilas C et al. 2014. In: proceedings of the 32nd International Symposium on Diabetes and Nutrition.
7. Te Morenga L et al. (2012). *British Medical Journal* 346, e7492.
8. Sevenpiper JL et al. (2012). *British Journal of Nutrition* 108, 418-423.
9. Canadian Diabetes Association Public Policy Position Statement on Sugar. (2015) <https://www.diabetes.ca/about-cda/public-policy-position-statements/sugar>
10. Canadian Diabetes Association. 2005. <http://www.diabetes.ca/clinical-practice-education/professional-resources/basic-carbohydrate-counting>.
11. Brisbois TD et al. (2013). *Applied Physiology, Nutrition and Metabolism* 38, 445.
12. Kulkarni KD. (2005). *Clinical Diabetes* 23, 120-122.
13. Naude CE et al. (2014). *PLOS One*, 9.
14. Kelly S et al. (2004). *Cochrane Database Syst Rev* 4, CD004467.
15. Schwingshackl L et al. (2013). *Nutri Metab Cardiovasc Dis* 23(4), 699-706.

Should people with Type 2 Diabetes consume a low carbohydrate diet?

No. The Canadian Diabetes Association (CDA) recommends consuming carbohydrates throughout the day in consistent amounts at consistent times, with a minimum intake of 130 g to provide sufficient glucose to the brain¹. Carbohydrate counting is a tool available to measure carbohydrate intake at each meal. As a percentage of total daily energy, carbohydrate should not be less than 45% to prevent high intakes of fat and may contribute up to 60% if derived from low glycemic index (GI) and high-fibre foods¹. As each individual will have unique carbohydrate requirements, initial carbohydrate goals should be set based upon individual needs¹².

Despite their popularity, there is much confusion about low carbohydrate diets for Type 2 Diabetes. The CDA 2013 Clinical Practice Guidelines state that low carbohydrate diets (4 - 45% total calories) can lower HbA1c and triglycerides, but have no effect on total cholesterol, high density lipoproteins, low density lipoproteins or bodyweight in short term studies¹. A more recent meta-analysis of randomized controlled trials identified that low carbohydrate diets have no additional benefits on weight loss as compared to an isocaloric and balanced diet (CHO: 45-65% energy, fat: 25-35% energy, protein: 10-20% energy) in terms of weight loss, glycemic control and lipid profile in both the short term (3-6 months) and long term (1-2 years)¹³. Very low carbohydrate diets may not ensure micronutrient and fibre adequacy and long term studies have not yet evaluated the sustainability and nutrient adequacy of these diets¹.

Choosing lower GI carbohydrates in mixed meals may help some individuals with glycemic control. Meta-analyses of controlled feeding trials have shown clinically significant improvements in glycemic control and some cardiovascular risk factors when low GI carbohydrates replace high GI carbohydrates in mixed meals^{14,15}. Individuals with diabetes are encouraged to follow *Eating Well with Canada's Food Guide* while selecting a diet best suited to their individual preferences and treatment goals.

Table 2: Canadian Diabetes Association Dietary and Lifestyle Recommendations¹ Abbreviations: PUFA = Polyunsaturated fatty acids

Dietary Recommendations - Adults with Diabetes	
Nutrient	Amount
Carbohydrates	45-60% of total kcal
Fibre	25-50g or 15-25g/1000kcal
Sugars	<10% total kcal from added sucrose or fructose
Protein	15-20% total kcal
Fat	20-35% total kcal
Saturated Fat	<7% total kcal
Trans Fat	Kept to a minimum
Monounsaturated Fat	Up to 20% total kcal
Long chain Omega-3 PUFA	Up to 10% total kcal
Lifestyle Recommendations	
<ul style="list-style-type: none"> • Participate in 150 minutes/week of aerobic exercise and 2 sessions/week of resistance exercise • Work towards a weight loss of 5-10% 	

SCIENTIFIC ADVISORY COUNCIL

G. Harvey Anderson, PhD
University of Toronto

Huguette Turgeon-O'Brien, PhD, DtP
Laval University

Robert Ross, PhD
Queen's University

David D. Kitts, PhD
University of British Columbia

Nick Bellissimo, PhD
Ryerson University

CANADIAN SUGAR INSTITUTE NUTRITION PROFESSIONALS

Sandra L. Marsden, MHSc, RD
President

Flora Wang, PhD
Manager, Nutrition & Scientific Affairs

Laura Pasut, MSc, MBA, RD
Director, Nutrition

Chiara DiAngelo, MPH, RD
Manager, Nutrition Communications