Summary of some nutritional recommendations: [www.diabetes.ca](http://www.diabetes.ca)

Most nutritional recommendations for type 2 diabetics are similar to those for the general Canadian adult population.

**Carbohydrates--some general points**

- **AMDR**: ~ 45-65% of dietary calories as carbohydrate
- **recommended**: ~ 30 g/day dietary fibers (at least 1/3 soluble)
  - Most Canadian adults consume much less
- **about 50 g/day is a minimum to prevent ketosis in many adults**
  - Most adults consume over 200 g/d
  - Some low-carb diets: daily intake as low as 20 g

**Carbohydrate Digestion**

- **mouth**: salivary amylase
- **small intestine**: pancreatic amylase > mono- + disaccharidases
- **liver**
  - monosaccharides from diet → glucose
  - release of glucose to blood
  - store glucose as glycogen
  - convert glucose to fatty acids...stored as fat

**Functions of carbohydrates in body**

- **Energy source**
- **Antiketogenic**
  - prevents high fat mobilization & use as energy source
- **Spare protein breakdown**
  - α gluconeogenesis from amino acids
- **Fiber**: GI function & more...
  - β fat, glucose absorption
  - β gastric emptying rate &
  - stomach distension...β PYY (satiation)
- **Structural & Regulatory roles**
Diabetes mellitus

- Hyperglycemia
  - insufficient production and/or response to insulin
  - initial characteristics of type 1 and type 2 diabetes, respectively
  - over time, insulin production def. also often develops in type 2

- More than half of diabetics are over 55 yrs old
- The great majority are type 2

- Carbohydrate intake too low
- Diabetics with poor glucose control
  - Insufficient Insulin production (type 1, advanced type 2)
  - High resistance to insulin action (type 2)
  - Ketosis is relatively rare in type 2 diabetics

- Large amounts of fatty acids mobilized for energy metabolism (liver)

  Fatty acids are not completely metabolized and intermediates—KETONE BODIES—accumulate, e.g.
  ...can be used by heart, brain for energy

- glycated hemoglobin (A1C)
  - Indicator of glucose control over past weeks
  - Diabetes: A1C > 6.5% (normal, 4-6%)
  - Goal for diabetic adults: < 7%

  Casual plasma glucose measurements not reliable indicators of (pre-) diabetes
Insulin and counter-regulators

- Insulin...typically anabolic/anticatabolic
  - anabolic: glucose to glycogen; AA's to proteins; pyruvate to FA's
  - anticytobolic: inhibits lipolysis; inhibits glycogen and protein breakdown
- Counter-regulators: cortisol, glucagon, adrenaline, noradrenaline, growth hormone
- Opposite effects on lipases (LPL and HSL), plasma glucose, glycogen formation, protein metabolism

Type 1 diabetes
- Usually juvenile onset...but can also start in adulthood
  - destruction of pancreas beta-cell islets (autoimmune)
  - genetic risk factors...possible involvement of nutritional risk factors under investigation...Idiopathic
- If untreated...keto-acidosis...death
- Treatment...insulin injections

Type 2 diabetes
- Usually adult onset...but can also start in childhood/adolescence
  - Initially resistance to action of insulin produced by pancreas
  - Lipolysis: increased circulatory FA's further impair insulin secretion
  - Risk factors: obesity, inactivity, genetics
    - Majority of type 2 diabetics are obese/overweight....
      metabolic syndrome (hyperglycemia, hypertension, atherogenic dyslipidemia, chronic inflammation, thrombosis...visceral obesity is common)
Co-morbidities

- Complications (often occur even with treatments)
  - due to poor glucose balance during treatment
  - rate & extent of progression depend on effectiveness of glucose control

- retinal degeneration...

- heart disease & hypertension
  - CVD major cause of death

- kidney disease
  - high-protein diets may be problematic

- others: e.g., neuropathy, increased fetal growth, ...
  long-term diabetes: main reason for limb amputation, kidney transplants, blindness...

Management of diabetes

- main objective...keep glucose levels as close to normal as possible

- other important objectives...control dyslipidemia (and cardiovascular risk factors incl. hypertension)

Common recommendations:

- ↑ exercise (consider hypoglyc., tissue damage, etc)
- ↓ fat intake (esp. SFA; ↑ w-3)
- weight loss

- ↓ GL? esp. simple sugars

Treatment of type 2 diabetes

- diet program
  - often the first treatment step (typically to promote weight loss & decrease cvr risk factors)
  - effects of wt. loss on gluc. control: within approx. 3 months
  - if after ~3 mo results not satisfactory, OHA added
  - if after ~3 mo with OHA + diet....not satisfi..O.C.T. insulin
  - if during these trials, condition deteriorates...insulin
  - dietary and health education (diabetes self-care), cessation of smoking, physical activity...

- oral hypoglycemic agents (OHAs, e.g., metformin)
  - oral combination therapy O.C.T
- after a few decades...many may need insulin for optimal glucose control
Major points regarding dietary management of diabetes...applied to self mgmt

• regular meal patterns
• carbohydrate distrib. over daily meals (e.g., 6 times/d)
• timing of meal patterns with insulin injection (mainly for type 1)
• calorie restriction
  - ↓300-400 kcal—mainly for type 2, obesity
  - ensure adequate energy for children & during pregnancy/lact.
• optimal nutrient levels determined on individual basis
  - few specific set guidelines for everyone
  - % calories from macronut. are not very different from recommendations for general population
• Protein...problem if too high (e.g., kidney stress, esp. amino a. supplem.) or too low (if increased catabolism for gluconeogenesis)...e.g., ~15-20%

Glycemic index (GI) & load (GL)

- General: potential of food to inc. blood glucose
- GI: relative AUC [gluc] after food intake –
  - 50 g digestible carb in food vs. 50 g of standard (glucose or white bread)
  - ≤55 low GI; ≥70 high GI
- GL = (GI)(amount of carb)
  - e.g., GL for one slice of bread = 70, GI x 15, amount of carb/100 = 10.5
    [2 slices = 21]
  - ≤11 low GL; ≥20 high GL

- problems and controversies...
  - e.g., determined for single foods, not the food combinations that are typical of meals (and related interactions of foods);
  - may distract person from other important factors such as caloric, fibre, SFA intake;
  - high variability in GI among people

Some examples of GI:

<table>
<thead>
<tr>
<th>Type of Food</th>
<th>GI Range</th>
<th>Type of Food</th>
<th>GI Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>55 or less</td>
<td>56-69</td>
<td>70 or more</td>
<td></td>
</tr>
<tr>
<td>rough-grain bread</td>
<td></td>
<td>whole-wheat bread</td>
<td></td>
</tr>
<tr>
<td>Converted (parboiled) rice</td>
<td></td>
<td>white bread (highly refined flour)</td>
<td></td>
</tr>
<tr>
<td>legumes</td>
<td></td>
<td>basmati/brown rice</td>
<td></td>
</tr>
<tr>
<td>plain yogurt</td>
<td></td>
<td>short-grain or intant rice</td>
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<tr>
<td>yams</td>
<td></td>
<td>banana</td>
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<tr>
<td>pineapple</td>
<td></td>
<td>watermelon</td>
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<tr>
<td>popcorn</td>
<td></td>
<td>Russet potato</td>
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<tr>
<td>doughnuts</td>
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</table>
**Nutritional self-management of diabetes**

- **Assessment**...& diagnosis
  - e.g., lab data, A1C, lipids, etc; medications; anthropometrics; food/nutrition history & knowledge

- **Intervention**...developing and implementing a strategy & its goals
  - e.g., worksheet for assessment of diet or design of dietary plan:
    - balance & variety; carb. distribution; total & % macronut. calories, esp. fat & SFA/animal products
    - use of common food planning approaches, e.g., carb. counting

- **Monitoring and Evaluation** of results and follow-up
  - e.g., adherence to plan, A1C, plasma [glucose],…
  - If results not adequate: changes to dietary plan, or changes + OHAs, or include insulins.

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**Example of table for dietary assessments and recommendations**

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Breakfast</th>
<th>Snack</th>
<th>Lunch</th>
<th>Snack</th>
<th>Dinner</th>
<th>Snack</th>
<th>Total Serv.</th>
<th>C Carb (g)</th>
<th>P Protein (g)</th>
<th>F Fat (g)</th>
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<tbody>
<tr>
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<td>Carb Count</td>
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</tbody>
</table>

As an example of an assessment, one column and row have been filled.

Total grams: X Y Z

Total kcal: ~<500 ~<1000 ~<2000