

The Glycemic Index Educator's Handbook

Glycemic Index Education Portal Development Team

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The Glycemic Index Educator's Handbook

Introduction

This resource is designed to accompany Diabetes Canada's Glycemic Index Food Guide (GI Food Guide) and will support educators who choose to use Glycemic Index (GI) education as part of their practice. The GI Food Guide has been developed to support current standard care for the prevention and treatment of diabetes as per the Diabetes Canada Clinical Practice Guidelines (Diabetes Canada CPG). It is recommended that it be used with or after use of:

- Diabetes Canada CPG (and educational tools)
 - [The Plate Method](#) (two- and three-dimensional versions available)
 - [Just The Basics](#)
 - [My Action Plan](#)
 - [Self-Management Support](#)
- *Eating Well with Canada's Food Guide* (CFG) or Diabetes Food Guide (DFG)
- three-dimensional food models (optional, but an asset)

Educators who understand behaviour change theory and seek ongoing training opportunities in motivational communication techniques have more success in supporting patients in setting and achieving goals (1, 2).

The goal of the GI Food Guide is to provide nutrition educators with evidence-based educational material that can be used in various practice settings. It has been designed to support patients as they incorporate GI education (knowledge and related skills) into their daily routines. More specifically, the GI Food Guide has been designed to help Canadians use lower GI foods to achieve, maintain, or improve their glycemic control.

The objectives of the GI Educator's Handbook are:

1. To provide the following knowledge:
 - A definition of GI
 - An overview of relevant anatomy and physiology ("slow absorption model")
 - A definition of low, medium, and high GI foods (including examples)
 - An overview of the benefits of low GI foods
 - An overview of the impact of common food processing techniques on GI
2. To support development and practice of the following skills:
 - Communication of GI and related concepts
 - Facilitation of low GI food substitution (including food selection, preparation and meal planning)
3. To address commonly asked questions about GI (concurrently busting some GI mythology).

Note: *Throughout this document, you will be provided with a number of reflective exercises. Example responses/answers have been provided in the appendix (page 12).*

What is Glycemic Index, Glycaemic Index or GI?

The GI is a value obtained when the incremental area under the blood glucose response curve (iAUC), after consumption of 50 g of available carbohydrate (carbohydrate excluding dietary fibre) from a (test) food, is compared with the iAUC obtained after consumption of 50 g of available carbohydrate from a reference food, such as anhydrous (water free) glucose or white bread (3, 4).

The GI is a scale that ranks a carbohydrate containing food or drink by how much it raises blood glucose levels after it is consumed (compared to pure glucose). This GI value is expressed out of 100 or as a per cent (although units are not typically included with GI values in peer reviewed and popular literature) (3, 4). Only foods that contain available carbohydrate can have a GI. For example: Barley has a GI of 35, while poultry does not have a GI. The following GI categories are used in Canada when teaching GI to patients: low GI (≤ 55); medium GI (56 to 69) and high GI (≥ 70) (1, 3, 4).

Some GI researchers use white bread as a reference food, while others use glucose. GI values are more commonly expressed on the glucose scale. White bread yields higher GI values than glucose. To address this, the official international method for measuring GI was developed in 2010 by the *International Organization for Standardization/ISO* (3). This method notes that GI values should be expressed on the glucose scale. A conversion factor of 0.71 is used to convert from the higher bread scale (GI of white bread =100) values to the glucose scale values (GI of white bread =71).

Studies have shown that a lower GI diet may help you feel fuller longer (increase satiety), achieve a healthy weight, and decrease risk of cardiovascular disease (e.g. lower your cholesterol), stroke, type 2 diabetes and diabetes complications, certain cancers (e.g. digestive tract, ovarian, breast), acne, and gallstones (4-17). The strongest evidence for GI utility is in people at risk for or living with diabetes. Evidence in support of using the low GI dietary pattern to manage glycemic control in people living with diabetes (both type 1 and type 2) is considered strong enough for

inclusion in the current *Diabetes Canada 2018 Clinical Practice Guidelines for the Prevention and Management of Diabetes in Canada* (Diabetes Canada CPG) (Grade B, Level 2) and to serve as the basis of nutrition education programs in other countries (e.g. Australia) (1, 5-28). Moreover, evidence shows side effects and symptoms are usually not reported when participants consume a low GI dietary pattern. These data indicate that this dietary pattern is, at the very least, not harmful and the risk of side effect(s) is comparable to control or standard care (when GI is not included in standard care) (1, 8, 12). Below is a supporting statement from Diabetes Canada CPG:

“Replacing high glycemic index carbohydrates with low glycemic index carbohydrates in mixed meals has a clinically significant benefit for glycemic control in people with type 1 and type 2 diabetes.”

Diabetes Canada supports use of a lower GI dietary pattern in the prevention and treatment of diabetes, but recommends that educators reflect on patient interest, ability and need before introducing the topic. GI is intended to be introduced to patients after they have been introduced to serving sizes and food groups.

Nutrition/ diabetes educators have reported that they understand or are familiar with the GI concept, but do not use it in practice because “it is too difficult for patients to understand and apply” (29-31). This said, data on patient-experience with GI education and application does not support this perception (1, 6, 17-18, 27-29, 32). In fact, evidence suggests that patients are satisfied with GI education; both in class and during one-on-one exchanges. After receiving evidence-based GI education and counseling, patients show an increase in GI knowledge and behaviours supportive of lowering dietary GI (4, 6, 9, 12, 17-18, 20, 29, 32). This said, the role of the nutrition educator is an important one. Evidence supports that effective knowledge transfer is supported by educators who critically examine their knowledge and skill and make efforts to maintain and expand it (1, 2, 27, 29, 33-36).

Reflective Practice Exercise 1

Based on your understanding of GI, answer the following three questions, using the lines provided. At the end of this handbook, come back to your responses to assess if your answers have changed.

1. Does dietary protein impact meal GI? For example, would meal GI change if you added one to two servings of low-fat cheese to a sandwich?

2. Does dietary fat impact meal GI? For example, would meal GI change if you added one teaspoon of margarine to two slices of toast?

3. How is meal GI determined?

Glycemic Index Education

High-level evidence on GI clinical utility has been published (5-7, 9, 12, 17-26). Although there are differences in how each study was developed and implemented, common knowledge and skill is effectively transferred in successful GI intervention studies (e.g. how to select and create lower GI meals or snacks) (27). This knowledge, skill, and evidence was used to develop the Diabetes Canada [Glycemic Index Education Portal](#). The remainder of this handbook will highlight this information using the *GI Education Layering Framework for Effective GI Education* (also referred to as the GI Building Blocks Framework).

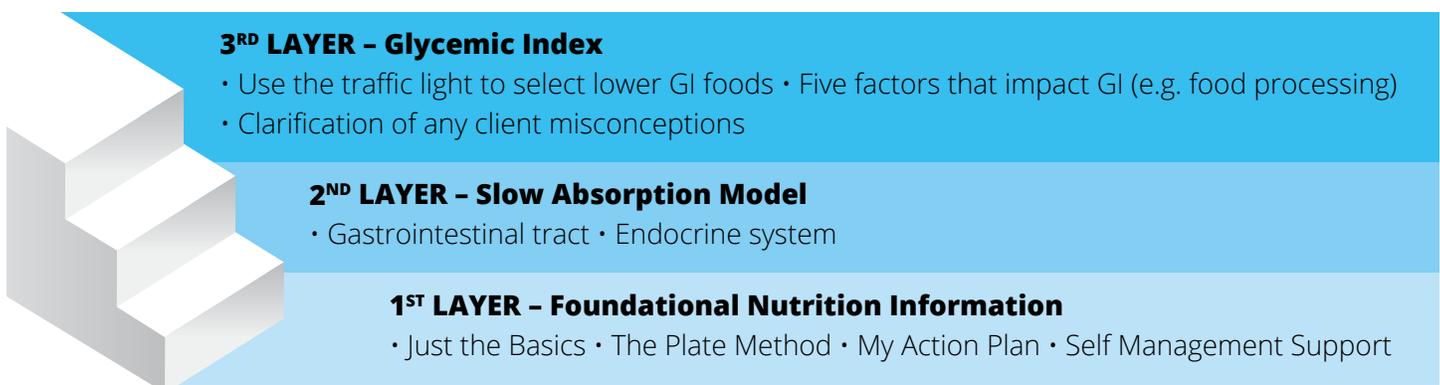
GI education layering (Figure 1) has been shown to be an effective way of presenting introductory GI knowledge and skills to educators and patients (1, 4, 6, 17, 22). Starting with current general nutrition recommendations (first layer – foundational nutrition information), educators can teach or reiterate concepts like dietary reference intakes (e.g. fibre recommendations), serving sizes, meal planning, goal setting, and action planning. The second layer includes an introduction to basic anatomy and physiology, relevant to understanding carbohydrate absorption and metabolism. It is recommended educators stress that foods can be absorbed at different rates and that slowly and quickly absorbed carbohydrates exist, before introducing GI. Pictorial representations of this process can be helpful to facilitate educator-patient exchange (for instance, Figure 2) (27). The third layer is where GI knowledge and skill transfer/ exchange occurs. The traffic light concept is an evidence-based

way to support selection of lower GI foods. Partnering this approach with information on factors that impact GI (e.g. food processing) and myth busting (directed by patient interest) has been shown to be particularly supportive (6, 27, 29, 32, 37). By approaching GI education using this step-wise approach, educators can ensure that both carbohydrate quantity and quality are covered comprehensively; avoiding the misperception that GI encourages unhealthy choices.

By layering GI education, educators acknowledge the complexity of medical nutrition therapy/ dietary interventions, highlighting that numerous factors influence food choice. Some red or high GI foods are also high in nutrients and, despite being high GI, can positively impact a patient's dietary intake. For instance, carrots are high GI when compared to other vegetables, but are an excellent source of beta-carotene and other nutrients (38).

Many people are surprised (and sometimes upset) to see vegetables and fruits, like watermelon, in the high GI category. As discussed above, GI is one layer of nutrition education (the third layer). GI is designed to be layered on top of standard care. While carrots are a high GI food, they are also an affordable, convenient, nutritious vegetable fibre (not to mention they are a traditional food for many Canadians). Carrots do not need to be excluded from a healthy diet; however, patients may wish to monitor the portion size of carrots, as they would when using *Eating Well with Canada's Food Guide, Beyond the Basics*, or the *Diabetes Food Guide*.

Figure 1. GI Education Layering (GI Building Blocks Framework)



The GI Traffic Light

The GI Traffic Light (Figure 3) is an evidence-based job aid used to support GI education. This approach to education has been shown to simplify the GI concept by adding a visual component (colour) to the GI categories (low = green, medium = yellow/ amber, and high = red) (27, 39). Although patients typically find the defined

categories useful for illustrating foods that are lower GI, some educators may wish to further sort foods within each GI category (e.g. lower end of medium or yellow). This type of sub-categorization requires that the educator has a sound understanding of how to find and interpret publicly available GI values.

Want to learn more? Resources are available through the Dietitians of Canada Learning on Demand website to support educators. Please search *Glycemic Index Education: Translating Knowledge to Action* when on the Learning on Demand [landing page](#). Publicly available resources are available to support educators in finding and interpreting GI values

Figure 3. The Glycemic Index Traffic Light



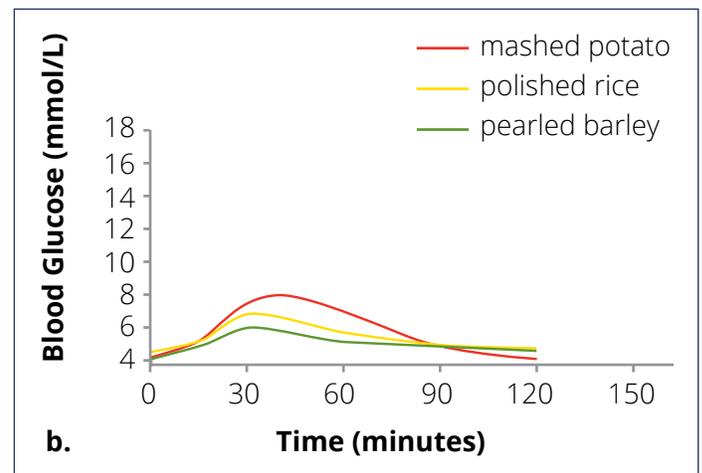
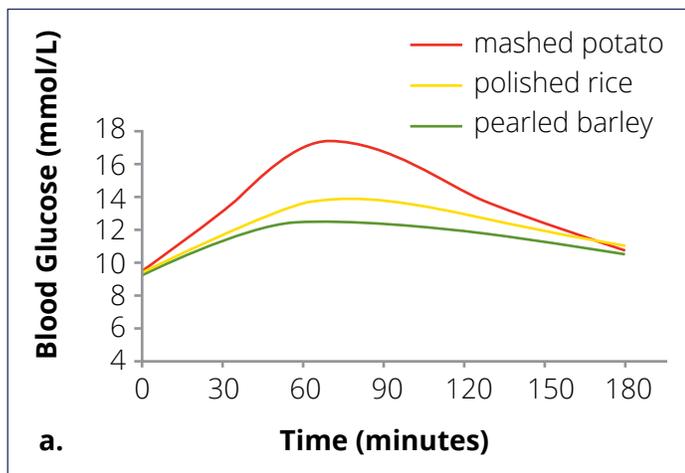
The GI Traffic Light and the Blood Glucose Curve

The GI Traffic Light is a versatile job aid and used in various nutrition education initiatives with success (6, 27, 32, 39). Figure 4 illustrates an additional way this concept and imagery can be used to support patients at risk for or living with diabetes. Figure 4a

shows postprandial blood glucose of people living with diabetes after they eat a high, medium, or low GI food/ meal. Figure 4b shows postprandial blood glucose of people living with normoglycemia after they eat a high, medium, or low GI food/ meal.

Figure 4. Postprandial Blood Glucose Response After Consumption of High, Medium, and Low Glycemic Index Foods: a. Type 2 Diabetes, b. Normoglycemia

Adapted from: Lan-Pidhainy & Wolever. *Eur J Clin Nutr* 2011;65:727-34.



Slabber (2005) recommends that “retrogradation” be described to patients using terms like “sticky” or “gel-like”.

“When red potatoes are cooked (or warmed up), the carbohydrate (or starch) in them becomes easily available to our body. When they are cooled after cooking, the starch becomes sticky or gel-like, slowing down digestion and lowering the GI of the food.” (27)

Example 1: Potatoes

Some potatoes (e.g. white and red potatoes) that are cooked and eaten warm have a high GI. Cooling cooked potato converts some of the rapidly digested starch into slowly digested starch. When these potatoes are cooled, the GI is lowered (4, 27, 39, 43-46). Red potatoes, commonly used for potato salads, are high GI when eaten warm (e.g. baked). Cooling cooked red potatoes causes the gelatinized starch to retrograde, resulting in a 40% lower blood glucose response and a lower GI (medium GI) (4, 27, 39, 43-46).

Example 2: Pasta

In some instances, overcooked (very soft) pasta (12+ minutes cooking time) will have a higher GI in comparison to al dente (firm) pasta (~10 minutes cooking time), which has a lower GI (typically low GI) (4, 27, 39, 47-50). This difference in GI is due to the gelatinization of starch, which is initiated during cooking. The longer the pasta cooks, the more the starch granules swell up with water, disrupting the starch structure and making starch more accessible to digestive enzymes. This can be explained to patients as the body having to work less to digest and absorb nutrients. Since al dente pasta requires more work from the body during digestion, the digestion rate is slower and, therefore, the GI is lower (refer back to Figure 2) (4, 27, 39, 47-50).

2. Processing and Packaging

Factory processing of grains and starches can result in convenient packaging and quicker cooking products. This can impact GI (4, 38-39, 47-49, 51-54). It is important for educators to understand how processing and packaging impact GI and be able to explain it to patients.

Example 1: Oats

Instant oatmeal and quick oats (e.g. Quaker® Quick Oats) have a medium GI (38, 39, 52, 55). The factory processing of instant oats results in the starch of the oats being more readily digested, resulting in a higher blood glucose response and a higher GI. While quick oats have a medium GI, oats that are minimally processed, like oat bran and steel-cut oats, have a low GI (39, 47, 52, 55).

Example 2: Legumes

Both canned and dried (cooked) legumes are classified as low GI, however, dried legumes generally have a lower GI than canned. This difference can be as large as 40 GI units. This is likely due to higher levels of lectins and phytates, which inhibit amylytic digestion and reduce glucose response and starch gelatinization (39, 49, 56, 57).

Some educators use “the baby bird analogy” when describing the digestion of highly processed high GI foods to their patients. Some mother birds regurgitate food for their babies, which (in some cases) can be thought of as partially breaking down the food for her babies before feeding them. The process of digestion has already started before the baby bird puts the food in its mouth; similar to what happens with highly processed grains (58).

3. Maturity of Food During Harvest and Consumption

Time of harvest or consumption may affect the GI of a food. Conditions and timing of harvest impacts the structural and functional properties of the starch of the food (e.g. root vegetables). Ripening of fruit also impacts the structural properties of the fruit. Foods harvested or consumed earlier typically have a lower GI than those harvested late or consumed when more ripe (59-61). Two inexpensive foods commonly consumed in Canada that provide an example of this phenomenon are potatoes and bananas.

Example 1: Potatoes

Potatoes harvested early tend to have a lower GI than those harvested at maturity. The difference in GI is due to the higher amount of amylopectin in younger potatoes than mature potatoes (4, 39, 59, 62).

Example 2: Bananas

As a banana ripens, its starch converts to sucrose (4, 63). As the level of sucrose in a banana increases, so does its GI. Over time, the GI of a banana increases from low (green to yellow in colour) to high (yellow to brown in colour) (64-66).

4. Variety

Different varieties or types of food (such as parboiled versus short grain rice) have different starch structures, which can affect GI (51-52, 54, 59, 63-64).

Example: Rice

Different varieties of rice have different GIs. This is thought to be due to the higher amylose content. Amylose is a polysaccharide. It is one of the two components of starch, making up approximately 20 to 30% of the structure. The other component is amylopectin, which makes up 70 to 80% of the structure (51-52, 54, 63-64). Amylose has a tightly packed structure and is, therefore, more resistant to digestion than other starch molecules. An example of a rice with higher amylose content is long grain rice (23 to 25% amylose) while an example of rice with lower amylose is short grain white rice (12.8 to 14% amylose) (51-52, 54, 59, 63-64).

Rice can also vary by processing, but the effects of processing vary by variety (e.g. parboiled rice is low GI versus short grain white rice which is high GI) (39).

5. Geographic Location

Geographic location of food production and processing may affect the GI of a food for the following reasons:

1. Nutrient composition of a food may differ between climates (e.g. tropical versus temperate).

Example: Carrots

Carrots produced in Perth, Australia are grown in a warm, sunny climate and have a GI of 39, while carrots produced in Canada have adapted to long, cool growing seasons and have a GI of 92 (39). The [GI Food Guide](#) provides GI values of food tested in Canada whenever possible.

2. Ingredients and processing methods of food products can vary between countries.

Example: Breakfast cereals

A cereal in Canada has different ingredients than a comparable cereal in Australia (i.e. same name brand, but different GI) (4, 39).

Eight Frequently Asked Questions About GI

1. Does a diet low in GI contradict current nutrition recommendations?

No. Diabetes Canada recommends using GI education, based on each patient's interest and ability, as a supplement to current general (layer 1) dietary recommendations (1, 4, 29, 68). Despite this, critics of GI continue to note (in popular and scientific arenas) a low GI diet encourages increased use of foods high in fat and sugar and promotes increased energy consumption (4, 29, 69-70). Upon comprehensive review of peer-reviewed literature, it becomes clear that this criticism is unfounded and that low GI foods can be eaten as part of a diet based on current dietary recommendations (1, 4-5, 7, 24-27, 29, 32, 71-76). For instance, Grant et al. (2011) used the *GI Education Layering Framework for Effective GI Education* to obtain

improved glycemic control in women with gestational diabetes (and impaired glucose tolerance) while not impacting energy and macronutrient intake. Moreover, Frost et al. (1996) facilitated adherence to current dietary recommendations using supplementary low GI education. In this study, participants on the low GI diet consumed less dietary fat and more fibre. A more comprehensive review of this topic can be done by reviewing the citations included above and exploring evidence-based resources like:

- PEN: Practice-based Evidence in Nutrition®
- Dietitians of Canada Learning on Demand [Glycemic Index Education: Translating Knowledge to Action](#)
- University of Sydney's [online resources](#)

2. Is GI too difficult for patients to learn and apply?

There are insufficient data available to make the claim that GI is too difficult for patients to learn and apply. Interestingly, the majority of the data used to back this claim is based upon the perceptions and opinions of health-care professionals and scientists rather than those of patients (4, 29-32, 69-70, 71-76). Studies examining the use of GI education with patients living with type 1, type 2, and gestational diabetes show that patients are able to lower the overall GI of their diets when GI education is presented in an evidence-based and patient-centered manner (e.g. GI education layering). Data from these studies also support increased participant self-efficacy, GI knowledge, and (in some cases) behaviour change; all with low incidence of clinically relevant side effects (4-5, 27, 29-32, 77-88).

To encourage efficient GI knowledge translation, clinicians must efficiently translate scientific terminology and/or concepts and use phraseology appropriate to the patient's knowledge and skill level. Slabber (2005) noted that GI terminology is not more difficult than teaching other concepts included in standard medical nutrition therapy. For instance, as mentioned above, low and high GI can be explained using terms like "slow- and fast-acting carbohydrate". "Retrogradation" can be explained using the following phrasing: "When cooked (red) potatoes are cooled in the fridge, the starch in them becomes sticky and gel-like."

Research on GI utility from the user perspective is ongoing. In fact, this very handbook and the *GI Food Guide* came out of research and efforts to increase support for those interested in learning more about and using GI education (both educators and patients).

3. How does GI apply to mixed meals?

GI is a characteristic of a carbohydrate containing food or drink. Foods that do not contain carbohydrates do not have a GI (e.g. baked chicken breast). It is recommended that the GI of a single food be measured and the GI for mixed meals (a meal that contains carbohydrate, protein, and fat) be

calculated using the GI values of the ingredients of the mixed meal (3-4, 85). In a mixed meal, the GI of individual foods does not change and is not affected by the presence of fat or protein. This has been demonstrated by multiple studies (3-6, 29, 85-89). In order to understand GI in a mixed meals scenario, it is important to understand the difference between glycemic response versus GI (see question 4 below). If you want to learn how to calculate meal GI, please refer to [*Carbohydrates in Human Nutrition: Report of a Joint FAO/WHO Expert Consultation*](#) (open source) or Dietitians of Canada Learning on Demand [*Glycemic Index Education: Translating Knowledge to Action*](#).

4. What is the difference between GI and glycemic response?

Glycemic response is the change of blood glucose after consumption of food and drink. Glycemic response is impacted by the quantity of food and drink consumed, GI of food or meal, and addition or subtraction of protein or fat in a meal (4). Therefore, you can lower your glycemic response by substituting a high GI food with a lower GI food or by adding lean protein or healthy fat to snacks and meals. Carbohydrate containing foods may have an assigned GI value, while humans have a glycemic response (4, 90-91). Characteristics of GI and glycemic response are outlined in Table 1:

Table 1: Glycemic Index Versus Glycemic Response

Adapted from: Dietitians of Canada Learning on Demand
Glycemic Index Education: Translating Knowledge to Action

GI	Glycemic Response
Property of a food	Impact of food on blood glucose
Measures quality of carbohydrate	Determined by the quality AND quantity of carbohydrate
Not affected by quantity of carbohydrate, or the presence of protein and fat	Affected by amount of carbohydrate consumed. Can be lowered by presence of protein and fat.

5. What is glycemic load?

The glycemic load (GL) is a calculation that estimates the glycemic response of a serving of carbohydrate containing food or drink. The GL calculation uses two measures: 1. The GI of the food or drink 2. The amount of available carbohydrate consumed. It is defined as GI multiplied by available carbohydrate (g) divided by 100 (4). GL is a very useful concept in dietary pattern and dietary intervention research (4, 11, 13, 14, 16, 33, 49, 90).

Educators often use GL as a general concept to highlight the importance of serving size or quantity (4). Due to this, it is important to highlight that **GL is not synonymous with serving size** and should not be presented to patients in this manner. Serving size education can be more effectively communicated by layering GI on top of current dietary recommendations.

In practical settings, GL values of foods are commonly calculated without adjusting for energy; if calculated at all. Typically, GL values for foods are summed to obtain the meal GL, and meal GLs are summed to obtain the daily GL value (4, 85).

"If you consider individual foods, adjusting for energy leads to a curious result. The GL of one slice of bread containing 20 grams of carbohydrate and a GI of 71 is 14.2 (using the above equation). Therefore, the GL of two slices of bread is 28.4. BUT, since two slices of bread contain twice as much energy as one slice of bread, adjusting for energy results in one slice of bread having the same GL as two slices. Clearly this is not consistent either with current practice or with the intention of the GL concept. It does leave me wondering what exactly the GL concept means!"
~ Dr. Thomas Wolever (4)

The concepts of quality and quantity are important ones in the context of medical nutrition therapy. Current dietary guidelines (e.g. *Eating Well with Canada's Food Guide*, The Plate Method) and elsewhere provide patients with guidance on serving size and daily intake recommendations. As highlighted above, we recommend using GI (quality) as a concept to supplement these messages to give patients the knowledge and skill to make an informed choice (4).

6. Do individuals with diabetes need to adjust the timing and/or dose of their medication based on the GI rating, even if the carbohydrate content is the same?

Some studies have observed that participants on a low GI diet experience more frequent dosage reduction in anti-hyperglycemic medications compared to those on a high-cereal fibre diet or were less likely to add or increase dosage of antihyperglycemic medications than those following the American Diabetes Association Diet (12). Reducing the GI of your diet, while maintaining a consistent carbohydrate intake, may result in a need to adjust the timing and dose of medication. It is recommended for patients to self-monitor blood glucose during dietary changes and adjust medication dosing and timing accordingly (with support of health-care professional) (1).

7. I have heard that fructose is low GI, but cannot be explained using the slow absorption model. What makes fructose low GI?

It is a common misconception that all sugars have a high GI and all starches have a low GI. In fact, many sugar-containing foods also have a low GI. Examples include many fruits and dairy products. Excessive energy intake from added sugars should be avoided, but it is important to consider more than sugars alone when evaluating food and drink choices (1). As highlighted above, it is important to consider nutritional quality and carbohydrate quantity (first layer) and its GI (carbohydrate quality). Fructose has a very low GI in comparison to other sugars (e.g. glucose). This can be attributed to the difference in absorption and metabolism of these monosaccharides (4, 63). Several studies (reviews and textbooks) have compared the absorption, metabolism and health effects of fructose with glucose; delivered as 25% of energy and as components of a mixed diet. From this work, it has been well established that there is a difference in absorption and hepatic metabolism of fructose and glucose in the liver (4, 93-96).

8. According to the *International Organization for Standardization (or ISO)*, how are low carbohydrate foods (like green vegetables) GI tested?

GI testing is only appropriate when the food in question has physiologically relevant amounts of digestible carbohydrate. For the purposes of this International Standard, the minimum amount is specified as 10 g or more of glycemic carbohydrate per serving. Carbohydrates that have low or no digestibility (e.g. polydextrose, resistant starch, some sugar alcohols) are not counted in the specified carbohydrate portion used in GI testing (3, 4). Typically, it is recommended that 25 g be used for low carbohydrate foods during GI testing (50 g being the “norm”). Data from Wolever and Bolognesi (1996) and Lee and Wolever (1998) support that the relative responses of foods are the same at different levels of available carbohydrate intake when between 25 and 100 g. This said, caution should be taken when

carbohydrates identified as “low carbohydrate”, “low-digestibility carbohydrates”, or “non-digestible/resistant starch” are being discussed with patients in the context of GI, as these foods are often not suitable for GI testing given that consuming sufficient amounts for testing would cause gastrointestinal discomfort. This is why many green vegetables do not have a GI (4). That said, some educators will label green vegetables “green” or “go” to highlight them as nutrient dense foods that illicit a low glycemic response (often referred to as “free foods”). That said, the traffic light can be used in this case by thinking of free vegetables as “green” or “go”. This is illustrated in the [Glycemic Index Flip Cards](#).

Your Questions:

If you have questions that have not been answered in this resource, you can email guidelines@diabetes.ca. Also, keep an eye out for future glycemic index webinars and learning opportunities.

Appendix

Possible Responses for Reflective Practice Exercise 1

*Written (and shared with consent) by physicians and allied health-care professionals

1. Does dietary protein impact meal GI? For example, would meal GI change if you added one to two servings of low-fat cheese to a sandwich?

No. Dietary protein does not significantly impact meal GI. In the example provided, low-fat cheese is added to a sandwich. Adding this cheese will increase dietary protein and carbohydrate in the meal (and potentially increase dietary fat slightly). The carbohydrate will impact the meal GI, but the protein (and fat) will not.

2. Does dietary fat impact meal GI? For example, would meal GI change if you added one teaspoon of margarine to two slices of toast?

No. Dietary fat does not significantly impact meal GI. In the example provided, one teaspoon of margarine was added to two slices of toast. This addition will increase the fat content of the meal, but not the protein or carbohydrate content.

3. How is meal GI determined?

Steps to calculating meal GI:

Step 1: Make a list of the carbohydrate containing foods that are included in the meal.

Step 2: For each of the foods listed in Step 1, look up a corresponding GI value (Units = %).

Step 3: For each of the foods listed in Step 1, look up the amount of available carbohydrate (Units = grams).

Step 4: Calculate the total available carbohydrate of the meal.

Step 5: Create a ratio of available carbohydrate from each food to the available carbohydrate in the meal. From that, calculate the “proportion of carbohydrate”.

Step 6: For each carbohydrate containing food in the meal, multiply the GI of that food by its “proportion of carbohydrate”.

Step 7: Add up all the calculated GI values (for each food) to obtain the meal GI.

For additional support, complete Dietitians of Canada Learning on Demand [Glycemic Index Education: Translating Knowledge to Action](#) and obtain *Calculating Mixed Meal Glycemic Index: A Resource for Educators*.

Possible Responses for Reflective Practice Exercise 2

Figure 2 illustrates the slow absorption model, often used for describing digestion and absorption of carbohydrates (in the gastrointestinal tract) to patients, trainees, and students. In fact, it is a little known fact that the research first conducted on GI provided a foundation for our current understanding of carbohydrate digestion, absorption, and metabolism. On the left, digestion and absorption of high GI carbohydrate is represented. In comparison to the low GI carbohydrate image, it is clear that high GI carbohydrate is absorbed earlier in the intestine and quicker in comparison to lower GI carbohydrate.

Possible Responses for Reflective Practice Exercise 3

The red line represents the postprandial blood glucose response in a patient during the postprandial period after a high GI meal. The red line is significantly steeper and higher in comparison to the lines representing blood glucose after a medium and low GI meal. Also, the red line shows a rapid decline in blood glucose after two hours then undershoots the baseline blood glucose value. The yellow line represents blood glucose after a medium GI meal. The green line represents the postprandial blood glucose response after a low GI meal. In comparison to the response after a high or medium GI food, the green line increases and decreases more gradually (has a lower peak) and does not result in a blood glucose that undershoots the baseline blood glucose value. Evidence suggests patients consuming lower GI foods may feel fuller and have less between-meal cravings than patients consuming higher GI foods.

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