

# glucose management

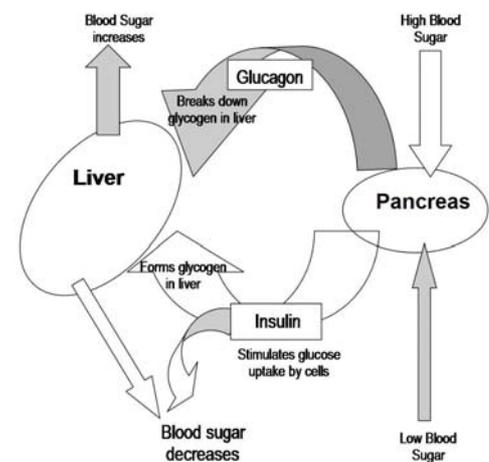
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Carbohydrates are made up of glucose molecules. One main function of glucose is to provide energy (for example it is the sole fuel for the brain). This dependency on glucose requires that we eat carbohydrates regularly and that our body uses glucose efficiently. In situations of blood glucose imbalance (dysglycaemia, reactive hypoglycaemia, insulin resistance or diabetes) physical energy and function is affected as well as mental function – this could be expressed as poor concentration, poor memory, irritability and depression.

## Blood glucose metabolism

The body's response to an increase in blood sugar is to secrete a hormone called *insulin* from the pancreas. The function of insulin is to send glucose into the cells where it is metabolised to produce energy. The excess is stored as glycogen in the muscle and liver cells or it converted to fat and stored in adipose tissues around the body. The result of this process is a decline in blood sugar. When blood sugar levels fall below normal, the pancreas releases a second hormone called *glucagon*, which has the opposite effect of insulin. Glucagon promotes the conversion of glycogen from the liver and muscle cells back to glucose for energy and encourages the burning of fat.

It is the carbohydrates we chose and the amount we eat that commonly cause conditions of glucose imbalance. Left unchecked, the result may be insulin resistance (Syndrome X), diabetes, obesity and/or heart disease.



## Blood glucose imbalances

**Diabetes mellitus** - is a failure to properly metabolise glucose due to either reduced secretion of insulin from the pancreas, or more commonly, from insulin resistance. This results in dangerously elevated blood glucose levels.

**Insulin resistance** – is an inability of the cells to respond to insulin. As a result, the body releases more insulin in an attempt to elicit a response. In this case there is both high glucose **and** insulin in the blood stream.

**Reactive Hypoglycaemia** – occurs when there is an exaggerated insulin response to a rise in blood glucose. As a result there is a dramatic drop in blood glucose, causing physical and mental symptoms, including irritability and sugar cravings. Blood glucose travels a volatile roller-coaster throughout the day.

## Choosing carbohydrates according to the Glycaemic Index (GI)

The rates at which different carbohydrates are broken down into glucose have been measured using a scale that is known as the Glycaemic Index (GI). The GI is a direct measure of the effect a carbohydrate has on your blood glucose levels. Carbohydrates that breakdown into glucose quickly during digestion will be absorbed into the blood stream quickly and therefore have a HIGH GI. Carbohydrates that breakdown slowly, releasing glucose gradually into the blood stream, have LOW GI's. In short, a low GI carbohydrate will help keep blood sugar levels more stable and sustained, and energy levels consistent. A high GI carbohydrate will cause a surge in blood glucose, triggering off a stressed response from the pancreas. This can contribute to the conditions described previously.

The GI scale is measured from 1 to 100 with glucose being given the score of 100. Foods with a score of 0-55 are considered low, 55 to 70 is considered moderate and above 70 high. In general it is best to consume the majority of your carbohydrates from the 0- 50 range whilst avoiding those with a score of above 70. If you consume foods with a score of between 50 and 70, try to combine them with a low scoring carbohydrate to even out the overall score. For example bananas have a high score, whereas oats and skimmed milk have a low score. If you combined all three at your breakfast you would bring down the overall score and still be able to enjoy the odd banana.

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## Factors affecting the GI

- **Amount of cooking:** Starches in food swell when cooked. The starch grains in a baked potato swell to bursting point, whereas the starch grains in brown rice remain relatively unchanged. The former has a high GI, the latter a moderate GI.
- **Type of starch** - amylopectin and amylose are both starches found in carbohydrate. The amount and ratio of these two in a food will make the difference between a fast break down and slow break down. For example wheat, corn and rice are high in amylopectin making them fast releasing whereas barley, rye and quinoa are higher in amylose making them slower releasing. Basmati and Doongara rice is higher in amylose and is therefore lower in GI compared to normal white rice.
- **Processing:** When grains are rolled, ground, smashed or pre-cooked (ie. instant), the protective (and harder to digest) outer jacket is removed exposing the soft easily digested starch. Whole oats have a lower GI than instant or quick-cook oats.
- **Fibre:** Fibre acts as a bulking agent slowing down glucose absorption. Some foods naturally have higher amounts of fibre – (eg. beans and legumes). It is therefore better to eat whole foods such as brown rice and wholegrain breads rather than their white, refined alternatives. It also means that whole fruit with its higher fibre content is better than a fresh juice without pulp. Always dilute fresh juices with water and maybe add back some pulp.
- **Protein:** Protein will lower the GI of a meal by slowing down digestion and gastric emptying time. Protein also has a higher satiety level meaning you will be kept satisfied for longer. Aim to make up at least 1/3 of your meal from protein.
- **Fat:** Fat also reduces gastric emptying time and as a result slows down the absorption of glucose from the meal. It is essential to consume the right kind of fats from raw nuts and seeds, fish, avocado and cold pressed oils.
- **Acidity:** Acidity of a food or meals containing acid will slow gastric emptying time. A simple tip is to add vinaigrette dressing to salad or vegetables.

## Glycaemic Load (GL) (see table on page 4)

The latest development in blood glucose regulation techniques comes in the form of the Glycaemic Load (GL). The GL provides information where the GI is lacking by also taking into consideration *the amount of carbohydrates per serving*. For example, the carbohydrate in watermelon is high GI but the carbohydrate level is low so the resulting GL is low. On the other hand, pasta (which has a lower GI than watermelon) has a very high carbohydrate content which results in a high GL. Therefore understanding the GL appears to be a more accurate way to judge your carbohydrates.

### Formula for the Glycaemic Load

$$\frac{GI}{100} \times \text{Carbohydrates per serve (g)}$$

#### For example:

Watermelon  
6 grams of carbohydrate per 120 g serve and a GI of 72 (High GI)

$$\frac{72}{100} \times 6 \text{ g} = \text{GL } 4.32 = \text{low GL}$$

Cup of cooked pasta  
GI of 71 (High) and 40 g of carbohydrates giving it a GL of 28 (High).

#### GL reference range:

10 or less	= low
11 to 19 inclusive	= medium
20 or more	= high

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Breakfast	Lunch	Snack	Dinner
1 slice rye toast 1 grilled tomato 2 poached eggs	Bean, salmon, goats feta and mixed vegetable salad	Low fat natural yoghurt with ½ banana and 1 Tbsp LSA	Poached or baked fish, Steamed vegetables with a fresh parsley sauce
1 slice sourdough toast with avocado, spinach and smoked salmon	Grilled marinated chicken or tofu, with mixed salad	1 small tin of tuna Cloudy apple juice with soda	Pork or tofu and vegetable stir fry with ½ cup brown rice and cashew nuts
1 cup high protein natural muesli, mixed berries, 1 Tbsp flax meal, 1 Tbsp natural yoghurt	1 slice Burgen bread, marinated chicken breast, mixed salad (Open Sandwich)	1 boiled egg Low GI fruit Diluted carrot or tomato Juice	Mixed bean and seed burgers Steamed vegetables Tomato salsa
1 cup porridge oats ½ banana low fat milk	Salad Nicoise made with tuna, boiled egg, tomato, green beans & olives	High fibre Ryvita with avocado and smoked salmon or tomato	Vegetarian bean chilli with 1 serve Quinoa
Fruit salad made from - ½ pink grapefruit, ½x apple, ½ peach, 1 plum, 2 Tbsp LSA, 2 Tbsp natural yoghurt	Brown rice (½ cup), chickpea, capsicum, tomato, parsley and tuna salad with vinaigrette dressing	Celery and zucchini sticks with hummus or baba ganuj	Spinach, tomato, mozzarella, basil frittata / bake served with steamed snow peas and butternut squash

## Top Tips

- Using the GI list provided, familiarise yourself with a few key ingredients and foods that form a regular part of your diet.
- Chose carbohydrates with GL values of 0 - 10 most frequently and 11-19 occasionally. Foods with a GL of 20 or above should be avoided or consumed with a low GL carbohydrate, protein and good oil.
- When making a blind choice, avoid anything processed and look for grain products that are high in fibre.
- Foods with an acidic value or taste tend to have a lower GL, for example, sourdough bread, and acidic fruits and vegetables.
- Below ground vegetables or vegetables which are sweet and sticky when cooked will often have a high GL (although not always). For example potatoes and sweet potatoes have a high GL compared to broccoli or other greens.
- When planning meals – always include 1/3 protein and 2/3 low GL carbohydrate and essential fats (from oily fish, avocado, nuts, seeds, olive oil).
- Allow some fat each day. Preferably from vegetable and fish sources.

## In Summary

GL values are useful but they're available on a limited basis, and don't take into account any valuable vitamins and minerals found in a particular food. To be healthy, get sufficient nutrients and fibre, and avoid a blood sugar "spike" adopt the following rules:

- Choose a wide variety of non-starchy vegetables (5-7 serves daily)
- Replace refined foods with whole grain products
- Eat fruits and starchy vegetables with high protein or high fibre foods
- Use healthy fats – nuts, seeds, grains, fish, and liquid oils (olive, sesame, soybean, flax)
- Lose weight (if you're overweight) and exercise regularly
- Manage stress

(For more information see Nutrimericine's *New Food Pyramid* and *Healthy Eating Suggestions* Clinical Protocol Handouts)

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**GI/GL Example table**

	LOW GI 1-55	MED GI 56-59	HI GI 70-100
<b>LOW GL 1-10</b>	All-bran cereal (8,42) Apples (6,38) Carrots (3,47) Chick peas (8,28) Grapes (8,46) Kidney beans (7,28) Oranges (5,42) Peaches (5,42) Peanuts (1,14) Pears (4,38) Pinto beans (10,39) Red lentils (5,26) Strawberries (1,40) Sweet corn (9,54)	Beets (5,64) Rock Melon (4,65) Pineapple (7,59) Sucrose (table sugar) (7,68)	Popcorn (8,72) Watermelon (4,72) Whole wheat flour bread (9,71) White wheat flour bread (10,70)
<b>MED GL 11-19</b>	Apple juice (11,40) Bananas (12,52) Buckwheat (16,54) Fettucine (18,40) Navy beans (12,38) Orange juice (12,50) Parboiled rice (17,47) Pearled barley (11,25) Sourdough wheat bread (15,54)	New potatoes (12,57) Sweet potatoes (17,61) Wild rice (18,57)	Cheerios (15,74) Shredded wheat (15,75)
<b>HIGH GL 20+</b>	Linguine (23,52) Macaroni (23,47) Spaghetti (20,42)	Couscous (23,65) White rice (23,64)	Baked Russet potatoes (26,85) Cornflakes (21,81)

Table Ref: Mendosa, D; <http://diabetes.about.com/library/mendosagi/ngilists.htm>

For a more complete list of Australian GI and GL levels, see the Database section on Sydney University site <http://www.glycemicindex.com/>