

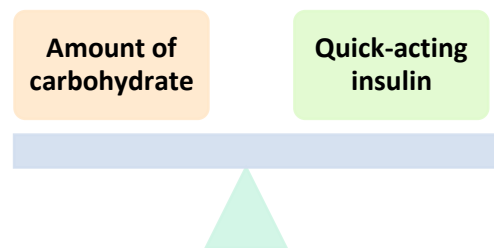
# Resources for People with Type 1 Diabetes

## FLEXIBLE MEAL-TIME INSULIN DOSING AND CARBOHYDRATE COUNTING

### HOW CAN PRACTICING FLEXIBLE MEAL-TIME INSULIN DOSING BENEFIT YOU?

Carbohydrates in your meal are digested and converted to glucose. Therefore, how high your blood glucose level rises after a meal is largely determined by **how much carbohydrates** have been consumed.

Flexible insulin dosing allows you to **adjust the amount of quick-acting insulin to match the amount of carbohydrates** you are planning to eat.



**How will learning flexible meal-time insulin dosing benefit you?** You can eat a wider range of foods with greater flexibility and confidence, while avoiding high or low blood glucose levels after a meal.

### HOW TO GET STARTED?

To practice flexible meal-time insulin dosing, you will need to master the following:

- 1** Identify and count the amount of carbohydrates in your meal
- 2** Know your insulin:carbohydrate ratio
- 3** Dose insulin based on the amount of carbohydrate in your meal and your insulin:carbohydrate ratio

## CARBOHYDRATES

### Types of Macronutrients

The three main macronutrients in a balanced diet are carbohydrates, proteins and fats.

#### Carbohydrates

- These include starch and sugar (natural or added). Carbohydrates have the greatest impact on blood glucose levels
- Examples of carbohydrate-containing food: Bread, potato, rice, noodles, pasta, oats, legumes, beans, milk, sugar, fruits

#### Protein

- Examples of protein-containing food: fish, chicken, egg, tofu, beef, prawn, dairy products
- A moderate amount of protein in a balanced meal has minimal impact on blood glucose levels.
- However, a large amount of protein taken together with carbohydrates can raise blood glucose levels further.

#### Fat

- Examples of fat-containing food: cooking oil, butter, nuts, seeds, deep fried food, baked goods (muffins/cookies/pastry)
- A small amount of fat in a balanced meal will not directly affect blood glucose.
- However, a meal high in fat can delay digestion and make you more resistant to insulin. This results in delayed & prolonged rise in blood glucose levels.

## More On Carbohydrates

Carbohydrates can be further classified into the following types:

### 1. **Sugars**

These are simple carbohydrates which are quickly absorbed and raise blood sugar levels quickly. Examples are sugar-sweetened beverages like sodas and packet drinks and sweets.

### 2. **Starches**

These are complex carbohydrates which become simple sugars after being digested by the body.

**Refined grains** are carbohydrates that have been processed and thus contain less fiber and nutrients. They tend to raise blood sugar levels quickly. Examples are white rice, corns flakes, and food made from white flour such as white bread.

**Wholegrains** are the preferred choice of starches as they are less processed and contain higher amount of fiber. This in turn keeps blood sugar levels more stable. Examples are brown rice, wholegrain bread, and oats.

### 3. **Fibre**

These are complex carbohydrates and cannot be digested by the body. These will not raise blood glucose levels and can also slow down the digestion and absorption of sugars.

Although carbohydrates (sugars and starches) are the main contributors to post-meal glucose rise, avoiding carbohydrates may lead to excessive protein and fat consumption and this can in turn cause weight gain. One should eat a balanced meal according to the healthy plate concept for the best long-term health benefits. Such a diet is also more sustainable in the long-term.

## ADVANCED CARBOHYDRATE COUNTING

You may have been exposed to basic carbohydrate counting using the **carbohydrate exchange system**. This is a system that groups carbohydrate-containing foods based on their carbohydrate content. Each carbohydrate exchange contains the same amount of carbohydrate which is 15g.

**Advanced carbohydrate counting** involves counting your carbohydrate intake more accurately in **grams**. Accurate carbohydrate counting can lead to a more accurate dosing of quick-acting (bolus) insulin and thus better glucose control.

In order to accurately estimate the amount of carbohydrates, you will need the following:

#### 1) **Measurement of the serving size of the food item you are planning to eat**

Measuring can be done by weighing your carbohydrate food, or using household measures like cups, spoons, or a bowl.

For example:

- **1 standard Chinese rice bowl** (300ml) of tightly packed rice contains about 60g of carbohydrate.
- **1 cup of milk** (250ml) contains about 15g of carbohydrate.

## 2) A reference of how much carbohydrates (in grams) per portion size of the food

We have provided information on some commonly eaten foods and their average carbohydrate content for your reference.

If the food items come with nutrition labels, do refer to it for more accurate carbohydrate counting. In addition, you can also refer to online reference databases (see next section).

### Grains, Cereals & Breads

Food Item	Portion Size (Weight of food)	CHO (g)	CHO exchange (1 exchange = 15g of carbohydrate)
<b>Rice (white or brown), cooked, tightly packed</b>	1 rice bowl (200g)	60g	4
<b>Porridge</b>	1 rice bowl (260g)	30g	2
<b>Beehoon, plain, cooked</b>	1 rice bowl (180g)	45g	3
<b>Kway teow, plain, cooked</b>	1 rice bowl (150g)	42g	3
<b>Noodles, egg, cooked</b>	1 cup (160g)	38g	2.5
<b>Spaghetti, plain, boiled</b>	1 cup (140g)	43g	3
<b>Cornflakes</b>	1 cup (30g)	26g	2
<b>Oat, rolled, raw</b>	½ cup (45g)	27g	2
<b>Chapati</b>	1 piece (45g)	21g	1.5
<b>Plain Thosai, small</b>	1 piece (45g)	18g	1
<b>Idli</b>	1 piece (75g)	16g	1
<b>Bread, wholemeal</b>	1 slice (30g)	12g	1
<b>Cream crackers</b>	3 pieces (23g)	14g	1

### Starchy Vegetables

Food Item	Portion Size (Weight of food)	CHO (g)	CHO exchange
<b>Potato, raw, with skin</b>	1 whole, medium (150g)	20g	1
<b>Mashed potato</b>	½ cup (120g)	19	1
<b>Sweet potato, raw, peeled</b>	1 piece (65g)	12g	1
<b>Pumpkin, boiled</b>	1 cup (245g)	9g	0.5
<b>Corn on cob, raw</b>	1 whole (300g)	32g	2

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### Legumes

Food Item	Portion Size (Weight of food)	CHO (g)	CHO exchange
Baked Beans, canned	½ cup (125g)	22g	1.5
Sambar, dhal curry	1 cup (285g)	21g	1
Chickpeas, boiled	1/3 cup (50g)	14g	1
Red kidney beans, raw	½ cup (90g)	56g	4

### Milk & Dairy

Food Item	Portion Size (Weight of food)	CHO (g)	CHO exchange
Milk, plain, low fat or skim	1 cup (250ml)	13g	1
Low fat natural yoghurt	1 small tub (200g)	12g	1

### Common Hawker Centre Food

Food Item	Portion Size (Weight of food)	CHO (g)	CHO exchange
Chicken Rice, with steamed chicken	1 portion (330g)	73g	5
Nasi Lemak with fried chicken wing	1 plate (412g)	109g	7
Nasi Briyani with chicken	1 plate (377g)	102g	7
Lontong with Sayur Lodeh	1 plate (775g)	64g	4
Claypot Rice	1 plate (597g)	93g	6
Seafood Fried Rice	1 plate (428g)	125g	8
Century Egg Porridge	1 soup bowl (512g)	34g	2
Ban Mian Soup	1 portion (648g)	38g	2.5
Sliced Fish Beehoon Soup (no evaporated milk)	1 soup bowl (686g)	48g	3
Mee Rebus	1 plate (571g)	82g	6
Mee Siam	1 plate (655g)	92g	6
Beehoon Soto	1 soup bowl (900g)	31g	2
Chicken Macaroni Soup	1 soup bowl (480g)	30g	2
Ang Ku Kueh with Peanut filling	1 piece (68g)	26g	2
Deep Fried Carrot Cake	1 piece (130g)	27g	2
Chee Cheong Fun, plain, with sauce	2 rolls (202g)	51g	3
Curry Puff, potato	1 piece (107g)	37g	2.5
Vadai with kacang Hitam	1 piece (60g)	10g	1
Vegetable Samosa	1 piece (75g)	22g	1.5
Gado Gado	1 plate (421g)	44g	3

Source: HPB Energy & Nutrient Composition of Food” <https://focos.hpb.gov.sg/eservices/ENCF/>

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### ONLINE RESOURCES FOR CARBOHYDRATE COUNTING

There are many online references for carbohydrate content available. Some of them can be assessed online via a website, and others on a smartphone app. One which contains local foods will be more helpful.

It is good to double-check and cross-reference the information from multiple sources to ensure accuracy. Different database or apps may provide slightly different values, so cross-referencing can help you get a more reliable estimate.

When using these resources, **do pay attention to the portion sizes!** Make sure to estimate the carbohydrate amount based on the serving size that you are intending to eat.

Here are some resources to get you started:

Resource	Format
<b>HPB Energy and Nutrient Composition of Food</b> <a href="https://focos.hpb.gov.sg/eservices/ENCF">https://focos.hpb.gov.sg/eservices/ENCF</a>	Website
<b>Nbuddy</b>	Smartphone app
<b>My Fitness Pal</b>	Website, smartphone app


### INSULIN:CARBOHYDRATE RATIO (ICR)

The **insulin:carbohydrate ratio** or **ICR** refers to how many grams of carbohydrate are covered by one unit of quick-acting insulin.

#### *For example*

A person with an **insulin:carbohydrate ratio of 1:10** will administer **1 unit** of quick-acting insulin for every **10g of carbohydrate** he intends to consume.

If he intends to consume 30g of carbohydrates, then  $30 \div 10 = 3$  **units** of quick-acting insulin should be administered before the meal.



**1:10g**

**3 units** = **15g CHO** + **15g CHO**

**Total: 30g CHO**

Each individual has a different ICR. You can work with your healthcare team to estimate the correct ICR for you. Your ICR may also be different at different times of the day.

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## PUTTING INSULIN:CARBOHYDRATE RATIO (ICR) AND CARBOHYDRATE COUNTING TOGETHER

If your ICR is correct and you have counted your carbohydrates for the meal accurately, you should observe that your blood glucose levels will not rise by more than 3 to 4 mmol/L after a meal. It should also come back down to pre-meal target values about 5 hours after your meal (Figure 1).

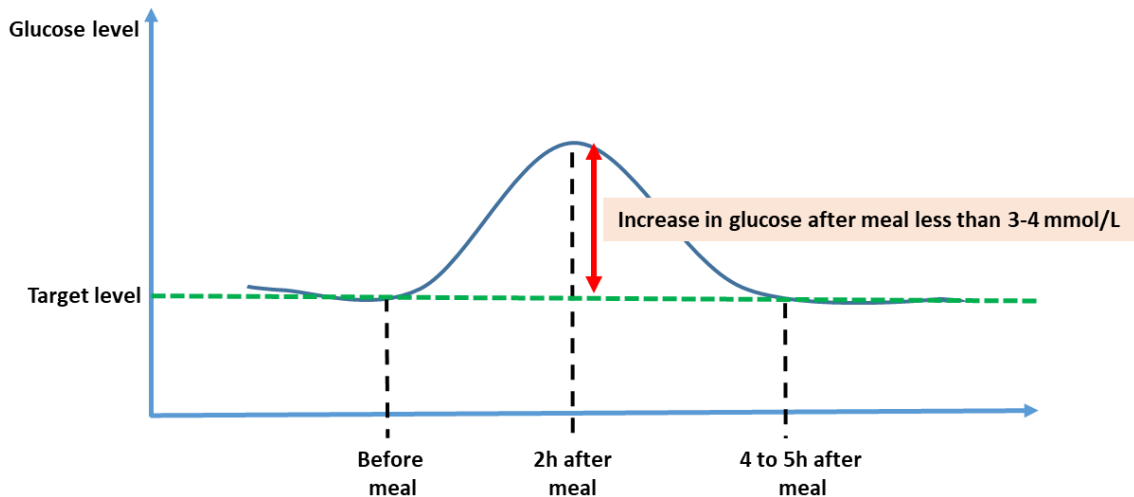


Figure 1. Increase in blood glucose after meal is less than 3-4 mmol/L

You can check if your ICR is correct under the guidance of your healthcare team.

If you find that your glucose readings consistently exceeding the above thresholds, then you may have given insufficient insulin, or underestimated the amount of carbohydrates in the meal.

## WHAT OTHER FOOD-RELATED FACTORS AFFECT POST-MEAL BLOOD GLUCOSE LEVELS?

Although the amount of carbohydrates is the main factor affecting post-meal glucose levels, there are other food-related factors that can affect the how quickly the glucose levels will rise after the meal.

The **glycemic index (GI)** of a food measures how quickly the food will cause the blood glucose to rise. The higher the GI, the faster blood glucose levels are expected to rise.

Factor	How it affects the post-meal glucose reading
<p><b>Type of carbohydrate (simple/refined vs complex)</b></p>	<p>Simple sugars and refined carbohydrates have a higher glycemic index (GI) and are more quickly absorbed than complex carbohydrates which are richer in fibre.</p> <p>If your blood glucose levels rise rapidly after the meal, but returns back to the target range after the meal, this could be because the carbohydrates are being rapidly absorbed.</p> <p>You can reduce the rapidity of glucose spikes after a meal by replacing simple or refined carbohydrates in the meal with complex carbohydrates or carbohydrates rich in fibre.</p> <p><b>For example:</b> Choose brown rice (lower GI) instead of white rice (higher GI)</p>
<p><b>How the carbohydrate is prepared</b></p>	<p>Different cooking methods for e.g., boiling, frying, baking and roasting can affect glycemic index of the food by changing how quickly the starch will be broken down and sugars released.</p> <p>Other food preparation factors / processing methods i.e. long cooking duration, juicing, mashing or grinding could all potentially increase the glycemic index of the food and cause blood sugars to rise more quickly.</p> <p><b>For example:</b> Al dente pasta has lower GI compared to well-cooked soft pasta.</p>
<p><b>What the carbohydrate is eaten with</b></p>	<p>Taking carbohydrates in a balanced meal together with moderate amounts of protein, fat or fiber will lower the glycemic index and cause blood sugar to rise more slowly compare to just eating the carbohydrate alone.</p> <p>Do take note that if a large amount of protein and/or fat is taken with carbohydrates, this can lead to a delayed and prolonged rise in blood glucose levels. If you notice this pattern on glucose monitoring, your healthcare care team will be able to share with you some strategies on how to cope with this.</p>