FACT SHEET

The Glycaemic Index and Sports Performance

The Glycaemic Index – what is it?

There are thousands of different carbohydrate-rich foods and recipes that can help us to meet the carbohydrate intake goals of healthy eating, as well as fuelling up for sport and exercise. We used to think of carbohydrate foods as being either 'simple' or 'complex' choices. Foods high in sugars were considered 'simple' carbohydrates. It was assumed they would be quickly digested, causing a rapid increase in blood sugar (glucose) levels shortly after their intake. On the other hand, it was thought foods high in starches were 'complex', being digested and absorbed into the blood more slowly, causing a flatter and sustained blood glucose response.

Over the last 30 years, research into food and blood glucose response has completely changed our carbohydrate classification system. We have learned that it is impossible to predict the impact on blood glucose levels by certain foods. Instead we must feed carbohydrate foods to people and measure the actual response. Around the world, laboratories have undertaken tests with real foods and real people to check the effect of different carbohydrate foods on blood glucose levels. The blood glucose response to eating 50 g of carbohydrate from each test food is compared with the response from 50 g portions of glucose. These figures are converted into a percentage or index, known as the Glycaemic Index or GI. Carbohydrate-rich foods with a GI greater than 70 are considered to be high GI foods, those with a GI of less than 55 are considered low GI foods, and those which fall in between are considered to be moderate or intermediate GI foods. (See Figure One)

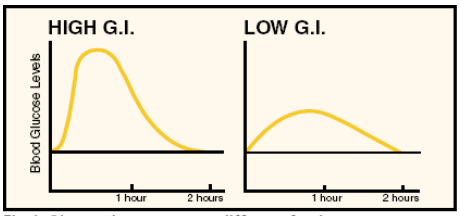

Fig 1: Glycaemic response to different foods.

Australian researchers Jenny Brand Miller and Kaye Foster-Powell have been instrumental in the international publication of the GI of common carbohydrate foods (see Table 1). Some 'simple' carbohydrate foods have a low GI, while some 'complex' carbohydrate foods have a high GI. It is clear that we need actual measurements rather than guesswork to be sure of the glucose response to our food intake. The GI can be applied to mixed meals by taking a weighted mean of the GI of the carbohydrate rich foods that make up the meal.

Why is GI information useful?

The GI is a valuable nutrition education tool in a number of areas of clinical nutrition. Manipulating food choice to lower the GI of the diet has been shown to improve blood glucose control in diabetes and to reduce high blood lipid levels. There may also be benefits for weight control since low GI carbohydrate-rich foods have been shown to suppress the appetite.

Table 1.

Examples of the Glycaemic Index of carbohydrate-rich foods		
Food		**GI (glucose = 100)**
High GI	Instant mashed potato	86
	White rice (medium grain)	83
	Jelly beans	80
	Sports drink	78
	Wholemeal bread	78
	Cornflakes	77
	Watermelon	72
Moderate GI	Weetbix	69
	Soft drink	68
	One-minute oats	66
	Rice (high amylose - eg. Doongara)	66
	Muffins (cake style)	62
	Boiled potato	56
Low GI	Pasta	51
	Orange	51
	Icecream	50
	Banana	50
	Honey (red gum)	46
	Porridge (from traditional oats)	42
	Kidney beans	36
	Mixed grain bread	34
	Flavoured yoghurt	33
	All Bran	30
	Milk	20
Source: http://www.glycemicindex.com/		

Manipulating the GI of meals may be useful in sports nutrition to optimise carbohydrate availability for exercise. This is particularly useful for sports or activities involving prolonged, moderate intensity exercise. Although specific recommendations for the GI of pre-, during and post-exercise carbohydrate choices have become part of some sports nutrition advice and guidelines, further investigation of the evidence is needed.

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GI and the pre-exercise meal

Eating a high carbohydrate meal or snack within the four hour period before exercise improves endurance or performance during prolonged, moderate-intensity exercise. This helps to provide additional carbohydrate fuel late in exercise by topping up liver and muscle glycogen stores, or by gradually releasing carbohydrate from the gut during the activity. However, a potential disadvantage of carbohydrate intake before exercise is that the resultant rise in blood insulin levels suppresses the use of fat as an energy supply. This makes the muscle rely more on carbohydrate for fuel, typically causing a drop in blood glucose levels during the first 30 minutes of exercise. It may also cause glycogen to be used up quicker. Luckily, in most situations, this blood glucose decline is self-corrected and no ill-effects occur.

The overwhelming majority of studies show that eating carbohydrate before exercise has a positive (or neutral) impact on performance. However, a small percentage of athletes or exercisers seem be sensitive to the effect, suffering severe or premature fatigue. This appears to be more likely when carbohydrate is eaten during the hour prior to exercise. Such concern led to experiments with low GI carbohydrates in the pre-event meal.

In an early study of the GI of pre-exercise meals, a low GI pre-exercise meal was shown to have less impact on blood glucose and free fatty acid concentrations during exercise than a high GI pre-exercise meal of equal carbohydrate content. Most importantly, the low GI meal appeared to sustain carbohydrate availability and increase the endurance of cyclists undertaking moderate intensity exercise. The results of this study have been widely publicised. However, follow-up studies have not always shown benefits from choosing low GI pre-exercise meals, especially when the study protocol measured performance in terms of a time trial, rather than a 'time to exhaustion' outcome.

Most importantly, we need to remember that pre-exercise meals are not the only opportunity for endurance athletes or exercise participants to fuel up for their activities. Sports nutrition guidelines for prolonged exercise recommend that carbohydrate be consumed regularly throughout the activity. This is a very successful way to enhance endurance and performance. A recent study examined pre-exercise meals of varying GI with carbohydrate intake during exercise, and showed that the metabolic effects of the pre-exercise meal were largely overridden by the impact of a sports drink during the event. Therefore, the evidence does not show that low GI meals provide a universal benefit as a pre-exercise meal choice.

It is also important to consider the fibre content of the pre-event meal. Whilst some athletes have stomachs that can tolerate anything, others are prone to loose bowel motions and the extra fibre load, often found in low GI foods, can be enough to tip them over the edge. A sports dietitian can help advise on what food is best for each individual.

GI and carbohydrate intake during exercise

Taking carbohydrate during prolonged exercise provides an extra source of fuel, improving exercise capacity and performance. A range of carbohydrate-rich foods and drinks and a variety of feeding schedules have been successfully used by athletes to achieve these benefits both in laboratory studies and in the field.

Although it is intuitive that carbohydrate sources consumed during exercise should be easily digested and absorbed to provide a rapid supply of energy, the GI of these foods and drinks has not been systematically studied. In practice, athletes choose carbohydrate sources, including commercial sports drinks and bars that would be expected to produce a moderate to high glycaemic response.

GI and post-exercise nutrition

Post-exercise recovery of muscle glycogen stores is a major challenge for athletes with busy competition and training schedules. Since glycogen storage is influenced by both insulin and a rapid supply of glucose to the blood, it has been proposed that high GI carbohydrate foods might enhance post-exercise refuelling of muscle glycogen. Although few studies have investigated this idea thoroughly, the evidence shows that high GI carbohydrate choices result in higher muscle glycogen storage than by low GI foods. Whether this effect is due to higher glucose and insulin responses has not been confirmed.

Summary and practical recommendations

The Glycaemic Index has already been incorporated by some educators into dietary advice for athletes. However, some caution is needed in making recommendations:

1. The Glycaemic Index was not intended to provide a complete ranking of the virtues of carbohydrate-rich foods. Remember other characteristics of food that are important – such as the total nutritional content of a food, cost, taste, practicality, and gastric comfort. Choose meals and snacks according to the goals and needs of each situation.

2. Be aware that some individuals or situations may benefit from the choice of a low GI pre-event meal. These include athletes who show an exaggerated and detrimental response to the intake of carbohydrate-rich foods prior to exercise or events where it isn't practical to consume significant amounts of carbohydrate during the session. In these cases, a low GI carbohydrate-rich meal may enhance performance by better maintaining carbohydrate availability throughout the event.

3. Carbohydrate intake during exercise minimises the metabolic impact of the pre-exercise meal. Therefore, feel free to choose a pre-event menu from carbohydrate foods and drinks that are practical, enjoyable and based on previous successful experiences.

4. In endurance sports or activities, consume carbohydrate regularly throughout the event, aiming for a target of 30-60 grams per hour. Choose carbohydrate choices of moderate to high GI (most sports drinks and popular exercise snacks fit this description). Practice in training to fine-tune your tactics.

5. Enhance post-exercise refuelling or carbohydrate loading by consuming adequate amounts of carbohydrate (1 g per kg body weight immediately after exercise, and a total of 7-10 g carbohydrate per kg body weight per day). While low GI carbohydrate-rich foods can contribute to total carbohydrate intake, it makes sense to focus on carbohydrate-rich foods and drinks with a moderate to high GI.

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