

Complexities of consumer understanding of the glycaemic index concept and practical guidelines for incorporation in diets

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The glycaemic index (GI) concept has been widely debated during the past two decades. Controversies still reign among health professionals regarding the practical application of the concept despite numerous reports on the health benefits associated with low-GI diets. Those opposed to the practical implementation of the GI concept argue that the use of technical terminology and numerical figures, limited food choices and potential misconceptions about unrestricted amounts of low-GI foods that may result in concomitant high fat intake, may confuse the consumer and will distract from other important dietary advice. Conversely, proponents of the GI concept state that consumers find the GI to be simple, logical and helpful and acknowledge that by expanding the range of foods they may include in their diets the GI concept is a major step forward for people with diabetes mellitus. Complexities of consumer understanding of the GI concept are discussed and suggestions are made to incorporate high- and low-GI foods in the context of current dietary guidelines and client education. If health professionals apply the GI concept in a practical way and explain the concept in a clear, uncomplicated manner, current dietary advice will be supported (and not opposed), resulting in short- and long-term health benefits for consumers.

The glycaemic index (GI) was originally envisaged as a tool for the dietary management of type 1 diabetes mellitus¹ and, 4 years later, dyslipidaemia.² Foods with a low GI produce a lower peak in postprandial glucose response and lesser overall blood glucose responses during the first 2 hours after consumption compared with foods with a high GI. The principle is that a slower rate of carbohydrate absorption from low-GI foods results in a lower rise in blood glucose. Scores of disagreements about the clinical utility of the GI method followed in the literature. Some of the main issues were that published GI values did not always concur because of different methodologies used to determine the GIs of individual foods,³ and that differences between the GI values of different foods are lost once these foods are consumed in a mixed meal.⁴ Critics^{5,6} further suggest that the GI concept adds further restrictions to the dietary management of diseases and question whether the effects of the GI are of sufficient magnitude to be clinically useful. Official organisations such as the British⁷ and American Diabetes Associations⁸ therefore continue to group carbohydrates according to their chemical and physical properties. The 2001 Position Statement of the American Diabetes Association⁹ states that first priority should be given to the amount of carbohydrate rather than the source of carbohydrate.

Despite the ongoing debate, a vast amount of evidence suggests that low-GI diets not only favour improved glycaemic control¹⁰⁻¹² but may also be effective in the treatment of obesity and the prevention of type 2 diabetes mellitus and cardiovascular disease,¹³ and therefore represent the optimal diet for the metabolic syndrome.¹⁴ The GI concept was endorsed in the Joint Food and Agriculture Organization/World Health Organization (FAO/WHO) report¹⁵ that reviewed the available research evidence regarding the importance of carbohydrates in human nutrition. Other expert groups including the European Dietetic Association¹⁶ and the Canadian Diabetes Association¹⁷ also endorse the GI concept in their dietary guidelines. In Australia, the most advanced country in terms of knowledge of the GI of foods,¹⁸ health professionals have developed official dietary guidelines for healthy consumers as well as a GI trademark certification programme for food labelling.¹⁹ Diabetes centres all over Australia and New Zealand use the GI concept in practical dietary advice to patients.²⁰ Locally, the GI concept is acknowledged in the South African Food-Based Dietary Guidelines²¹ referring to the beneficial effects of low-GI foods in the context of preventing chronic diseases. The inclusion of high-GI foods as the preferred choice in specific circumstances such as restoring glycogen stores after exercise is also highlighted in these guidelines.²¹ The GI concept has also been introduced to the lay public in

South Africa via short articles in popular magazines, numerous books and public seminars.

The GI concept is perceived by many scientists as prudent, in view of the strong substantiation of evidence suggesting health benefits and absence of adverse effects. However, from the literature it is clear that the consumer is confronted with many complexities in the practical utilisation of the concept. This article discusses these complexities and, in view of these dilemmas, suggests practical guidelines and teaching aids for incorporating the GI concept in diets.

Does the GI concept oppose current dietary guidelines?

Despite the debate about the practical application of the GI concept, there is general consensus in current dietary guidelines for free-living populations and for people with diabetes mellitus (in the Western world) internationally. Experts on the GI acknowledge that macronutrient recommendations remain the primary concern in diabetes nutrition management.^{22,23} Although opponents to the GI concept admit that the concept of simple and complex carbohydrates is not scientific and is outdated, they are against the general practical implementation of the GI.⁹ The recent South African Food-Based Dietary Guidelines, in agreement with current recommendations for diabetes mellitus, advocate dietary variety and a diet high in carbohydrate (with emphasis on increasing intake of cereals and grains) but low in fat content.²⁴ The GI concept should therefore be used alongside and not in opposition to these guidelines. The major sources of carbohydrates in a westernised diet fall within the upper GI range. Most potato products, commonly used bread and breakfast cereals, for example, have high GIs – often higher than the GI of sucrose. In consumer education, emphasis should be placed on substituting these foods with suitable high-fibre, low-GI foods by replacing products made with white flour and potatoes with whole-grain, minimally refined cereal products.²⁵ However, consumers should be educated that the GI of food is not the only factor that will determine whether the food should be included in the diet or not.

It is therefore clear that current dietary guidelines need not be abolished when incorporating the GI in practical advice. The principle of low-, moderate- and high-GI choices could be incorporated into educational tools such as food exchange lists or food pyramids to guide food choices without imposing yet another 'burden' on clients. Dietitians at the International Diabetes Institute in Melbourne, Australia, have developed an education resource where low-GI food choices are highlighted from within the 'Eat most' section of 'The Healthy Food Pyramid'.²³ For example, within the bread section, grainy and pumpernickel breads are highlighted in preference to white bread. Similarly,

different colours or symbols could be used to distinguish between starch-rich foods with high, moderate or low GIs in the food exchange lists. After reviewing the literature extensively, both Roberts²⁶ and Pawlak and co-workers²⁷ concluded that there is substantial scientific evidence that the GI concept is consistent with current dietary guidelines, and these authors advise clinicians to use the concept in the treatment of obesity and other lifestyle diseases. In Table I suggestions are made to incorporate the GI into current dietary advice.

Use of technical terminology

Critics of the clinical utilisation of the GI argue that customers' understanding of the GI concept will be confused by the use of technical terms. Pi-Sunyer²⁸ queries how consumers are to be informed about a food's method of preservation and processing and technical terms like retrogradation. In fact there is no need to use these terms when educating patients. Health professionals who successfully use the GI concept in patient education^{27,29} stress the fact that consumers should not be burdened with technical terms and that technical terminology can be avoided.²⁹ Katanas²⁹ argues that dietitians do not use terms like omega-3 fatty acids or monounsaturated fatty acids in client education. These terms are often replaced with terms like 'healthy', 'unhealthy' or 'better' types of fat. Likewise, the GI can emphasise better carbohydrate choices. Other terms such as 'quick-acting' or 'slow-acting', or 'slow' versus 'moderate' versus 'fast'-acting carbohydrates, may also be used. Similarly, instead of referring to retrograded starch, clients can be informed that reheated cooled potatoes or mealie meal porridge are 'better' choices than warm freshly cooked potatoes or mealie meal porridge.

Moreover, the depth of education should vary, as in all aspects of dietary advice. Technical terminology regarding the GI, glycaemic load (GL), and available carbohydrate may cause confusion. These terms do not need to be mentioned when educating groups of consumers. Depending on the level of education and interest of the individual being counselled, the underlying principles of the GI may be explained to some clients. In South Africa, like many other countries, the prevalence of diabetes is on the increase.³⁰ Mealie meal porridge, the traditional staple food of a large part of the South African population, has a high GI.³¹ Many South Africans may neither desire nor be able to afford to change their staple food. However, advice could be given that reheated cooled mealie meal porridge, or porridge with added dried beans or whole mealie kernels, is a better choice than the warm freshly cooked product.³¹ This may be a simple and easy way of introducing a lower GI food without reference to any technical term. There are also situations where replacement phrases are appropriate. In these

situations specific foods can be encouraged over others, for example long-grain rice instead of short-grain rice.²⁹ Suggestions of how higher-GI foods might be replaced with lower-GI alternatives are made in Table II.

Indeed many food factors, such as the extent to which a starch is processed and gelatinised by home cooking or commercial preparation, may affect the rate of digestion and thus the GI of the starch. Despite the fact that preservation methods may influence the omega-3 fatty acid content of fish, consumers are advised to eat fish at least twice a week in order to increase their omega-3 fatty acid intake. Why then be more technical when advising consumers to ingest certain carbohydrates in preference to others?

Is sugar an issue?

Notwithstanding the debate surrounding the GI, general agreement has been reached among most nutritionists and dieticians regarding the place of sugar in the diabetic diet. The GI of sucrose is relatively low at 68 ± 5 (mean of 10 studies using glucose as the standard).³² Several studies have shown that ingestion of 30 g sucrose per day does not compromise carbohydrate or lipid metabolism,³³ and these findings initiated the liberalisation of sugar intake in diabetic

diets over the past decades. The American Diabetes Association issued a strong statement to try to dispel the myth regarding the sugar content of foods being termed simple carbohydrates as opposed to starches being termed complex carbohydrates.⁸ In their most recent (evidence-based) recommendations, the American Diabetes Association regarded the evidence that sucrose does not increase glycaemia to a greater extent than isocaloric amounts of starch as A-level evidence.³⁴ Yet many health professionals still believe that sugar should be avoided in the diabetic diet. Brand Miller and co-workers³⁵ state that theoretically the addition of sucrose will lower the overall GI of the diet if it replaces wheat flour or foods with a high GI. In practice, Brand Miller and Lobbezoo³⁶ demonstrated a decrease in glucose and insulin responses when the starch in a high-GI breakfast cereal was replaced with sucrose. Opponents to the practical application of the GI²⁸ argue that the entire GI issue is complicated by the expectation that adding sugar to a meal would lower the GI and that reported evidence does not support this. A local study³¹ has shown that adding sugar to mabella porridge did lower the GI (from 89 to 77, glucose = 100), but not in soft mealmeal porridge (85 to 89). Why should this debate complicate the GI issue? If sugar is used in the diabetic diet within the context of current dietary guidelines, it need not be an issue at all.

Table I. Suggestions on how the GI may be incorporated into current dietary advice

- Always keep in mind that current dietary guidelines form the basis of any good diet and apply the GI concept alongside these guidelines
- Emphasise that a healthy diet is a diet high in carbohydrate and low in fat
- Change the staple food in the diet to a low-GI alternative (cooled reheated mealmeal porridge, wholegrain and seed breads, wholegrain cereals)
- Include two low-GI foods daily²⁰
or
Include one low-GI food at each meal²⁹
or
Replace 50% of carbohydrates in the diet with low-GI choices²⁹
- Spread carbohydrates throughout the day
- For in-between snacks substitute high-GI foods with low-GI foods
- Adhere to the prescribed amount/portions/exchanges of starch or carbohydrate but make better choices (lower-GI choices)
- Distinguish between low-GI carbohydrates and fatty low-GI carbohydrates. Fatty carbohydrates should be avoided or used as 'sometimes' foods
- No food is good or bad – eating the low-GI way means eating a variety of foods
- High-GI foods do not have to be avoided completely. Some high-GI foods contain important nutrients like vitamins, minerals and phytochemicals. The golden rule is to combine high-GI foods with low-GI foods in the same meal
- Use dry beans, peas and lentils more often; also as a thickening agent in soups, stews, curries
- Use low-oil or oil-free salad dressing containing vinegar to lower the GI of a meal⁴⁴
- Enjoy foods in moderate amounts. Avoid overindulgence in any food
- Low-fibre, low-GI choices include pasta, semolina, high-amylose rice like Basmati
- Sugar may constitute 10% of daily energy (1.5 - 2.5 tablespoons/day⁴⁰)
- Plain low-fat yoghurt or artificially sweetened fat-free yoghurt are good low-GI choices
- Athletes who are too nervous to eat solid foods as a pre-event meal may take low-GI liquid supplements

Mixed meals

Opponents to the practical utility of the GI concept state that differences in GIs between foods are lost once these foods are ingested in a mixed meal.⁴ They also argue that mixed meals contain fat that may greatly alter the GI of the meal. However, in studies in which 8 - 24 g fat was fed in mixed meals containing 38 - 104 g carbohydrate, the added fat had a negligible influence on the predicted glycaemic response.³⁷ According to Jenkins and co-workers,³⁸ large deviations in the dietary macronutrient profile will occur over time, but these differences will be minimised over time. Only in those subjects with substantial differentiations in daily macronutrient intake are changes in the dietary GI likely to be obscured, and in such individuals any meaningful attempt at dietary modification is also likely to be difficult.³⁸

In 1997, the concept of GL was introduced by researchers at Harvard University to quantify the overall glycaemic effect of a portion of food.³² The GL of a typical serving of food is the product of the amount of available carbohydrate in that serving and the GI of the food. Thus, the total dietary GI of mixed diets can be calculated as a weighted average of the GI values of the individual foods with the weights corresponding to each food's carbohydrate content.²⁵

This may be very complex for the consumer, but if higher-GI foods are replaced with lower-GI foods in a meal, consumers do not have to be burdened by this technical task.

Use of numerical figures

One of the major misuses of the GI concept relates to the expression as numerical figures that may adversely affect food choices. Clients may, for example, view all foods with a low GI as suitable and include low-GI foods with a high fat content, such as chocolate, freely. Moreover, they may avoid foods with high GIs that contain important nutrients and phytochemicals such as potatoes, enriched mealie meal porridge and carrots. Unfortunately, many health professionals regard the numerical lists of GI values as the primary factor in determining a food's suitability in dietary management.²³ In truth, the actual GI figure or number is not the most important consideration. Rather, consumers should be educated that the ranking – i.e. whether the food has a low, moderate or high GI – holds the real key to correctly applying the GI concept in dietary advice. Providing consumers with lists of numbers for GIs may be confusing and complicating dietary education. A range for low-, medium- and high-GI foods, rather than specific values, best describes the

Table II. Substituting lower-GI foods for high-GI foods

Higher-GI foods	Lower-GI alternatives
Bread	
Whole-wheat, brown or white	Bread with lots of whole grains, seed loaf and seed buns
Mealiemeal porridge	Cooled reheated mealiemeal porridge <i>and/or</i> add dried beans, lentils, and chickpeas to porridge <i>and/or</i> add any vegetables to meal
Breakfast cereals	
Puffed cereals, Weetbix (including sugar free)	All Bran, Raisin Bran, High Fibre Bran, Oat Bran
Shredded wheat	Raw muesli
Biscuits and crackers	
Plain biscuits and crackers	Biscuits (low fat) with oats or oat bran, dried fruit, whole grains
Rice cakes	
Rice	
Sticky white or brown rice	Basmati rice, crushed wheat ('stampkoring'), corn, green mealies, sweetcorn, lentils
Samp	Add dried beans or lentils
Potato	Sweet potato, pasta, baked beans
Muffins/scones	
White or brown	Muffins or scones (low fat) made with oat bran, oats, fruit, dried fruit
Fruit	
Watermelon	Citrus fruits: oranges, lemons, naartjies, grapefruit
Tropical fruits: paw-paw, mangos, litchis, melons, bananas	Apples, pears, apricots, peaches, plums, kiwi, sultanas, cherries, grapes
Note: the riper the banana the higher the GI	Note: the more tart/sharp/acid the fruit the lower the GI

glycaemic response to foods and should be used by health professionals in client education.

Limited food choices

One of the concerns of the American Diabetes Association⁸ and some health professionals^{39,40} concerning the practical utility of the GI is that a low-GI diet limits food choices and places another burden on individuals with diabetes. However, a recent large, long-term prospective study in children with type 1 diabetes⁴¹ showed that those who were given flexible low-GI dietary advice did not lower dietary quality or food choices compared with children who received more traditional measured carbohydrate dietary advice. Beebe³⁹ argues that only over 600 foods have been assigned a GI value, whereas her patients are exposed to more than 7 000 food items in a supermarket in a developed country. Although a wider variety of low-GI products may be needed to implement a low-GI diet and suitable alternatives are not always available, health professionals can utilise the current range of foods listed within the low-, medium- and high-GI ranges as a valuable tool in client education. The food industry should regard the development of lower-GI starch substitutes as a challenge, especially in view of the current draft labelling legislation, which advocates the use of standardised methodology for the determination of the GI of carbohydrate-rich foods.

Misconceptions about unlimited amounts of low-GI carbohydrate foods in the diet

Some health professionals consider all low-GI foods as appropriate and all high-GI foods as unsuitable and to be avoided. This may well lead to *ad libitum* use of low-GI foods and exclusion of high-GI foods, thus limiting food choices and resulting in a deterioration of dietary quality. Beebe³⁹ states that Americans are eating low-fat foods, but in unlimited quantities. They are replacing fat with carbohydrates, but ignoring total energy intake. This practice implies misuse of the GI concept. Health professionals should strictly avoid suggesting to overweight clients and diabetic patients that low-GI carbohydrates may be eaten in unlimited quantities without overt risk of increasing obesity and/or hyperglycaemia. Portion sizes remain of utmost importance. Moreover, it is premature to recommend to the general population to avoid high-GI foods. However, substituting certain carbohydrates with 'better' choices will not discard any current dietary guidelines. It therefore remains important for health professionals to emphasise that individuals must not overindulge on low-GI foods, that portion sizes are important, and that the GI of food is not the only factor determining whether the food should be included in the diet or not.

Food labelling

Labelling of carbohydrate-rich foods in terms of the GI is in progress in South Africa. One of the complexities of consumer understanding of the GI will be to interpret labels with GI information. Venter and co-workers¹⁸ suggest that a GI symbol programme, similar to the one that has been developed in Australia,⁴² could be designed. Details regarding the manner in which the GI will be presented remain a major combined challenge for the food industry, nutritionists and health professionals while not confusing the consumer. Debating these issues thoroughly is strongly advised before labelling of the GI can be implemented.

Practical advice for incorporating the GI into current dietary advice

The GI is an exciting area of research that cannot be ignored. Health professionals are being challenged to incorporate the concept into current macronutrient recommendations and practical dietary advice for people with diabetes, hypoglycaemia, the metabolic syndrome or obesity, and also for athletes. According to Miller,⁴³ the normal diet of most diabetics has a GI of ~65 (glucose is 100) after standard dietary advice. Measurable clinical gains are associated with diets in which the GI has been reduced by ≥ 11 units, by substituting approximately 50% of the carbohydrates from the high-GI category with low-GI foods.⁴³ This leaves sufficient space in the diet for high-GI staple foods such as bread and mealie meal porridge and other high-GI foods such as potatoes and brown rice which contain important nutrients such as fibre, vitamins, minerals and phytochemicals. Understanding the GI way of eating can make an enormous difference to the diet and lifestyle of people with diabetes. However, health professionals and consumers must first overcome several hurdles. Nutritional advice should be appropriately tailored in a simple and understandable way without misuse of the concept. Cultural and ethnic preferences and traditions should also be considered. Old beliefs should be re-examined, and health professionals must therefore move away from a 'good food', 'bad food' approach. Suggestions of how the GI may be incorporated into current dietary advice are given in Table I.

Educational tools

Frost and co-workers¹¹ have shown that people are able to reduce the GI of their diets significantly following verbal and written communication. As in any other area of dietary education, health professionals can improvise and develop interesting resource materials and

teaching aids to educate consumers about the practical use of the GI. When consumers are confronted with shopping for lower-GI foods, a shopping list containing low-fat low-GI choices can be provided and specific low-GI brands may be highlighted.²³ Entrepreneurial dietitians may launch supermarket tours to educate groups of diabetic patients or obese clients about the GI concept as well as general dietary guidelines. Fig. 1 includes some ideas of how clients and patients can be informed about low-, moderate- and high-GI foods without using technical terms or complicated dietary advice. The GI concept may also be explained in a simpler way to less educated consumers by using pictures of household utensils (Fig. 2) like a bucket of water with large, medium and small holes to illustrate that low-GI foods may 'pass more slowly through the body', thereby accomplishing better glycaemic control.





Tool	High-GI foods	Moderate-GI foods	Low-GI foods
Terminology	Good	Better	Best
	Fast acting	Medium acting	Slow acting
Robot 	Highlight shopping lists or exchange lists with red light foods	Highlight shopping lists or exchange lists with yellow light foods	Highlight shopping lists or exchange lists with green light foods
Graph			

Fig. 1. Ideas for informing clients and patients about the GI.

Household utensil	Bucket with holes	Sieve	Colander	Perforated spoon
				

Fig. 2. Examples of household utensils to teach consumers about the GI concept.

Conclusion

Practical application of the GI concept seems prudent provided that health professionals use scientifically based evidence in their client education and do not abuse the concept. While long-term studies are needed to supply answers to the practical utilisation of the GI, observational analyses supply strong evidence that applying the GI concept in consumer education need not be confusing, as long as the educator keeps an open mind. The golden rule is to incorporate the GI concept alongside current dietary advice and not opposed to it.

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