Journal of
Research in Diabetes & Metabolism

Editorial

Diabetes Diet: Is Glycemic Index Still Relevant in Medical Nutrition Therapy? - ∂

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Submitted: 20 November 2015; **Approved:** 28 December 2015; **Published:** 31 December 2015

Citation this article: Naser KA, Wimalawansa SJ. Diabetes Diet: Is Glycemic Index Still Relevant in Medical Nutrition Therapy? J Res Diabetes Metab. 2015;1(1): 001-004.

Carbohydrates typically is a major energy source in the human diet. However, over consumption or ingesting easily absorbable carbohydrates/sugars lead to increases in unhealthy blood glucose levels, insulin resistance and development of type 2 diabetes (T2D) and obesity. During the last three decades, the incidence of T2D and obesity have been gradually increasing, worldwide [1-3]. As an attempt to control these two disorders, healthcare workers try to manipulate the quality, quantity, and variety of carbohydrates in the diet in diabetic patients. However, many patients and health professionals do not seem to appreciate the complexities of carbohydrates in food, and a verity of issues related to glycemic control in patients with diabetes. In this editorial, we reviewed the appropriateness of continuing to use the Glycemic Index (GI) in diabetic diets, with reference to the management of medical nutrition advice and therapy in patients with diabetes.

Glycemic response (GR) is defined as the extent to which any test meal raises blood glucose. Glycemic response is affected by many factors, including the glucose tolerance status of the subject. Glycemic response is also affected by the amount and type of carbohydrate ingested in a meal, the digestibility of the carbohydrate (e.g, indigestible carbohydrates in food, such as fructo-oligosaccharides do not raise blood glucose), the Glycemic Index (GI) of the available carbohydrate, and the amount and type of fiber, fat, and protein [4,5].

Glycemic Index

The GI was first introduced in 1981 by Jenkins and colleagues [6] to provide objective advice on carbohydrates to patients with diabetes. The index replaced the theory of carbohydrate exchange. Jenkins and colleagues provided broader information on the GI for carbohydrates (shown in Table 1 in ascending order). [From Jenkins et al, 1981 [6].]

Nevertheless, the applicability and acceptance of the GI by the wider community have become controversial. The original study on glycemic index by Jenkins and colleagues did not consider available carbohydrate in formulating the GI. Thus the major drawbacks of the GI are that it measures the impact of individual foods, rather than a mixed meal, and does not necessarily consider the amount eaten or foods in the context of an overall diet. Nevertheless, the GI, an easy to administer, practical tool was introduced as a replacement for food exchange tables that were used in medical nutrition therapy for diabetes at that time. The GI is well accepted in some countries, including Australia and UK, but is used less in the United States [7].

Glycemic load

The GI measures the effects of carbohydrates with respect to their ability to increase blood glucose and compares it with blood glucose response to either white bread or glucose. Glycemic load (GL) was introduced in 1997, which measures the blood glucose response to a specific weight of a given food. Thus, GL provides a measure of total glycemic response to a certain food or a meal. GL is calculated by multiplying the amount of carbohydrate contained in a serving (weight in grams or volume in milliliters) by the GI value of that food divided by 100. Some believe that GL is more meaningful in managing patients with diabetes than is GI [8]. Figure 1 explains the modes of derivations of GI, GL, and the Glycemic Glucose Equivalent (GGE).

Many still believe that GI as the sole factor that determines the glycemic response. In many countries, including the United States, food items are often labelled as "low glycemic index," "diabetic food," "diabetes friendly," and so forth, as if GI is the only factor that will influence the glycemic response (GR). Patients and health professionals give importance to GI rather than using a holistic approach of glycemic response.

The American Diabetes Association advises patients that, for most people with diabetes, the first tool for managing blood glucose is carbohydrate counting. Nevertheless, the type of carbohydrate significantly affects the blood glucose level, so using the GI together with carbohydrate counting seems helpful in "fine-tuning" blood glucose management. Therefore, the use of GI in combination with carbohydrate counting is likely to provide additional benefits for

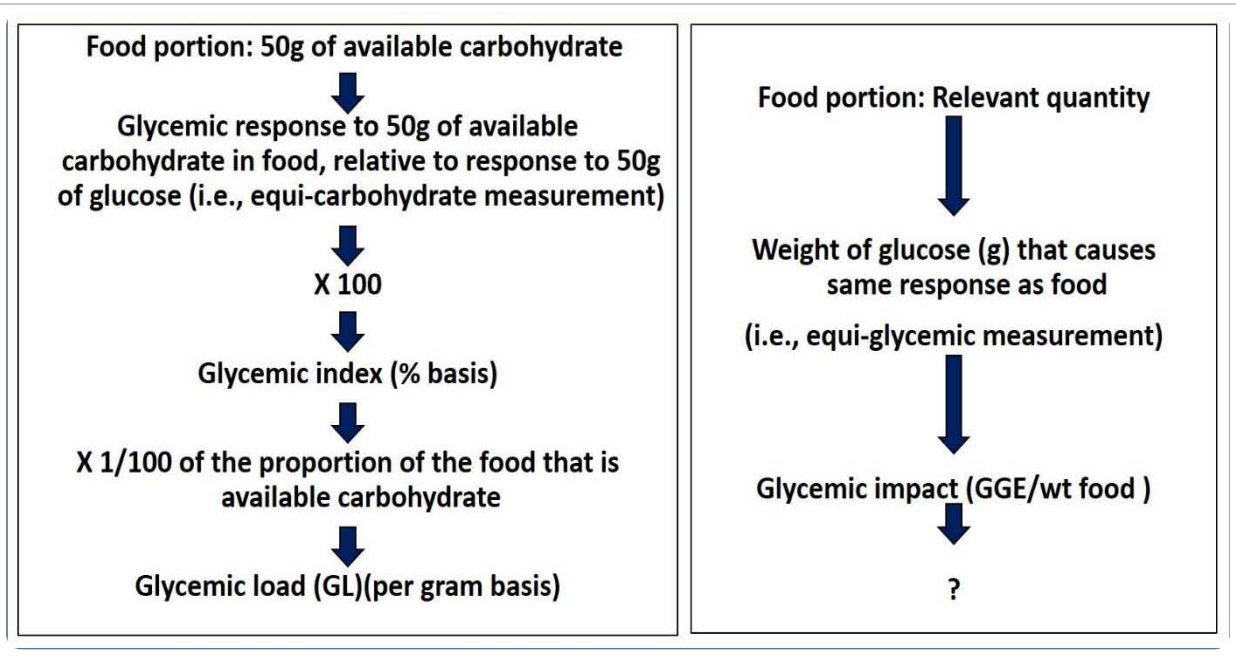

Figure 1: Comparison of Glycemic index (GI), Glycemic load (GL) and Glycemic glucose equivalents (GGE) [Adapted from Monro, J.A. and Shaw, M. (2008) (9)].

Table 1: Glycemic Indexes of commonly used food.	
Carbohydrate	**GI ± SD**
Legumes	31 ± 3
Dairy products	35 ± 1
Fruit	50 ± 5
Biscuits	60 ± 3
Cereals	60 ± 3
Breakfast cereals	65 ± 5
Vegetables	65 ± 14
Sugars	71 ± 20
Root vegetables	72 ± 6

Table 2: Variables affecting the Glycemic Index.	
Inter-carbohydrate variables	**Intra-carbohydrate variables**
Available carbohydrate	Amount of water used in cooking
Amount of intrinsic fiber in the carbohydrate	Duration of cooking and type of cooking
Quantity	Addition of fiber, protein, and fat
	Person-to-person variation

patients in achieving blood glucose goals, especially for those who are willing to put extra effort into monitoring their food choices [10].

However, many factors other than caloric count affect the glycemic response following a carbohydrate meal. Table 2 provides factors that would affect theglycemic response of carbohydrates.

Available carbohydrate

If three different carbohydrates having 50 g of total carbohydrates per 100 g of food are ingested, variable amounts of a percentage percentage of total carbohydrate ingested will be absorbed. Depending on the type of carbohydrate and the availability of fiber contents in the food ingested, the percentage absorbed will vary. The percentage that is absorbed from total carbohydrate is generally identified as the "available carbohydrate." However, food labels indicate the total carbohydrate in a given food. When patients try to count their carbohydrate content, food labels are likely to give misleading information.

Effects of other food and vegetables on carbohydrates absorption and the glycemic response in a mixed meal

Most of the studies on carbohydrates have been done using pure carbohydrate meals, rather than complex, mixed meals such as patients would generally eat. Others have shown that dietary fat and protein reduced the glycemic response of carbohydrates in a mixed meal [11]. It has been shown that adding green vegetables could reduces the glycemic response of a particular carbohydrate. For example, the GI could be reduced by as much as 40% by addition of vegetables to a carbohydrate meal [4]. This is an important factor when it comes to differences in GI between similar carbohydrates.

For example, in rice varieties, the GI of Basmati rice and brown rice are given undue prominence by traders as well as medical community. When over 200 varieties of rice was tested, the GI values were found to be vary different. Even within similar varieties of rice, there is a wide variation in GI. For example, there are varieties of Basmati rice with high and some with low GI values [12]. Promoting a particular rice variety without considering other factors, such as duration of cooking time, water content, and inclusion of other foods such as vegetablesand proteins could be misleading and thus, would not help patients with diabetes.

They may purchase Basmati rice assuming as low GI rice GI but may end up buying a type of Basmati rice with a high GI value. Thus, the principle of glycemic response is more complicated. In addition, the importance of adding vegetables and proteins to carbohydrate meals should be emphasized to patients with diabetes. There are other factors affecting the GI of a carbohydrate diet. For example, in normal subjects as well as patients with diabetes, it has been shown that when a carbohydrate meal is eaten with watery gravy, the glycemic response increases [13,14].

Series of studies were conducted by KAN, using carbohydrate meals made up of flour from brown rice and white rice and compared the GR with and without the addition of curries made from gravy, fish, lentils, and green beans. Higher GR was observed when meals were eaten with gravy. When fish and green beans were added, there was a reduction of approximately 30% to 40% in the GR. This difference nullified the GI advantage of GI observed with brown rice [4]. These data led us to hypothesize that consuming water just before or a quantity of gravy with rice together with meals might increase the GI of a carbohydrate meal. In fact, other studies support the theory that consuming water just before, during, or after a carbohydrate meal, increases the absorption of carbohydrates [14,15]. This theory needs to be scientifically tested.

Biscuits as snacks in diabetes

The original paper on GI by Jenkins and colleagues showed a medium glycemic response to biscuits [6]. However, this study was done with 50 g of carbohydrate, which is not how people eat in dayto-day life. In real life, a subject will eat a few biscuits at a time. Each time, the quantity may not reach the level of 50 g of carbohydrates. If biscuits are given in the quantities normally consumed by patients with diabetes, the glycemic response observed are likely to be different.

Apparent volume of food after cooking

When healthcare workers teach patients about a diabetes diet, that usually depend on food items with approximately 25 g of "available" carbohydrate, which needs to be reflected by the right portion size fora given patient with diabetes. We observed that when a fixed quantity of the same carbohydrate (e.g., wheat flour) is used to cook various food items, such as pasta, noodles, string hoppers and flat bread, the apparent volume of the cooked food varies significantly. When measured the post-cooked volume of a wheat flour-based product and compared it with same quantity of cooked rice, the post-cooked volume of rice is higher, providing a bigger "apparent" volume without change in caloric count. This simple but important phenomenon has not been considered in clinical studies before. It is in part attributable to different quantities of water being absorbed during cooking, the speed of cooking, and different volumes of air space in some food items. This finding has important implications for patients because they serve themselves (e.g., a portion of rice) depending on the apparent volume of the food, rather than the real weight or caloric content. Therefore, to prevent misguiding patients, when a healthcare worker prescribes a diet with GI/GL, consideration of the post-cooked apparent volume of food (portion size) should to be considered.

Carbohydrate counting and DAFNE (dose adjustment for normal eating course and carb counting)

Carbohydrate counting for diabetes is a popular diet method in most Western societies. In DAFNE courses, patients are trained to count their carbohydrate intake at every meal and advised to inject 1

to 3 units of ultra–short-acting insulin for every 10 g of carbohydrates ingested. There is evidence that patients who are carb counting have better glycemic control. However, when carb counting is performed, total carbohydrate is considered, and the available carbohydrate is not considered or calculated. Neither the addition of fat, proteins, and vegetable fiber are taken into account in the glycemic response of that particular food [15].

Therefore, DAFNE courses could be further improved if minor details of carb counting could be included in the teaching. Patients should be systematically taught about other factors that affecting the GR and how they can calculate the amount of available carbohydrates in their diet. Every patient with diabetes may not be motivated or capable to learn the minor details of medical nutrition therapy, going beyond simple carbohydrate counting. However, committed patients who may want to fine-tune their diabetes treatment should be offered additional training in this regards.

CONCLUSION

The Glycemic Index (GI) is still relevant to diabetes diet and other dietary modifications. However, the glycemic response (GR) to a meal is complicated by many factors. Therefore, using GI alone to judge a food item may not be the right approach. Moreover, the apparent volume of cooked food; addition of proteins, fats, and vegetable fiber to carbohydrates; cooking methods; and available carbohydrate are also important modifiable factors that should be considered when prescribing a diet. Consuming snacks, especially high GI food like biscuits, even in small quantities (such as two biscuits), could increase the postprandial glucose significantly higher than foods such as yoghurt.

These simple principles need to be considered and taught to patients via a simplified, but a structured method, and the principles should periodically be re-enforced to patients with diabetes. The DAFNE (dietary adjustment for normal eating) and other similar courses could be modified on this basis. In this regard, each country and ethnic or cultural group should investigate their food items for “available carbohydrate,” GI, GL, and GR as a “complex meal,” rather than studying the plain (individual) carbohydrate, or borrowed data from previously published work that have used refined simple carbohydrates.

REFERENCES

1. Wimalaansa SJ. Obesity and type 2 disbees: Preveting complications. Journal of Diabetes, Metabolic Disorders & Control. 2015;2(4):47-50.
2. Smith CY, Bailey KR1, Emerson JA, Nemetz PN, Roger VL, Palumbo PJ, Edwards WD . Contributions of increasing obesity and diabetes to slowing decline in subclinical coronary artery disease. See comment in PubMed Commons below J Am Heart Assoc. 2015; 4.
3. Kushiyama A, Yoshida Y, Kikuchi T, Suzawa N, Yamamoto M, Tanaka K, Okayasu M . Twenty-year trend of increasing obesity in young patients with poorly controlled type 2 diabetes at first diagnosis in urban Japan. See comment in PubMed Commons below J Diabetes Investig. 2013; 4: 540-545.
4. Muthalib A.M. KNKA, R Sivakanesan, Nageeb,B.M. Effects of consumption of traditional Sri Lankan meals on glycaemic response in healthy individuals. Sri Lanka J Diabetes, Endocrine & Metabo. 2014;4:12-6.
5. EFSA. Scientific Opinion on Dietary Reference Values for carbohydrates and dietary fibre. EFSA Journal. 2010;8(3):1462.
6. Jenkins DJ, Wolever TM, Taylor RH, Barker H, Fielden H, Baldwin JM, Bowling AC . Glycemic index of foods: a physiological basis for carbohydrate exchange. See comment in PubMed Commons below Am J Clin Nutr. 1981; 34: 362-366.
7. Wolver TMS. The Glycaemic Index. A physiological classification of dietary carbohydrate. U.K.: CABI publishers; 2006.
8. Venn BJ, Green TJ . Glycemic index and glycemic load: measurement issues and their effect on diet-disease relationships. See comment in PubMed Commons below Eur J Clin Nutr. 2007; 61 Suppl 1: S122-131.
9. Monro JA, Shaw M . Glycemic impact, glycemic glucose equivalents, glycemic index, and glycemic load: definitions, distinctions, and implications. See comment in PubMed Commons below Am J Clin Nutr. 2008; 87: 237S-243S.
10. ADA2014;Pageshttp://www.diabetes.org/food-and-fitness/food/what-can-i-eat/understanding-carbohydrates/glycemic-index-and-diabetes.html?referrer=https://www.google.co.uk/#sthash.M46C67Cb.dpuf.
11. Flint A, Møller BK, Raben A, Pedersen D, Tetens I, Holst JJ, Astrup A . The use of glycaemic index tables to predict glycaemic index of composite breakfast meals. See comment in PubMed Commons below Br J Nutr. 2004; 91: 979-989.
12. Fitzgerald MA, Rahman S, Resurreccion AP, Concepcion J, Daygon V.D, et al Identification of a major genetic determinant of glycaemic index in rice. Rice (N Y). 2011;4:66–74.
13. Crapo PA, Reaven G, Olefsky J . Plasma glucose and insulin responses to orally administered simple and complex carbohydrates. See comment in PubMed Commons below Diabetes. 1976; 25: 741-747.
14. Young KWH W, TMS. Effect of volume and type of beverage consumed with a standard test meal on postprandial blood glucose responses. Nutr Res 1998;18:1857-63.
15. DAFNE Study Group . Training in flexible, intensive insulin management to enable dietary freedom in people with type 1 diabetes: dose adjustment for normal eating (DAFNE) randomised controlled trial. See comment in PubMed Commons below BMJ. 2002; 325: 746.