A NUTRITIONIST'S VIEW

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Applying the Concepts of Glycemic Index and Glycemic Load to Active Individuals

As you all know, carbohydrate is in the news. Don't get too much! Don't get the wrong kind! Don't get it at the wrong time! These types of headlines in newspapers and sport magazines are confusing for your active clients. There is no doubt that carbohydrates are important for active individuals to provide energy and maintain blood glucose during exercise and to refuel after exercise. However, we now know that different types of carbohydrates bring about dramatically different blood glucose responses. Based upon these responses, carbohydrates can be classified based on their glycemic index (GI) or glycemic load (GL). The concepts of GI and GL were discussed in detail by Stephen Wong, Ph.D., FACSM, and Susan Chung, B.Sc., R.D.N., in their recent *ACSM's Health & Fitness Journal*® article titled "Glycemic Index: An Educational Tool for Health and Fitness Professionals" (1). This column will provide you with a simple format for answering clients' questions regarding different types of carbohydrate foods. First, we will briefly define and explain GI and GL. Then, we will outline how to use the GI with your active clients and what limitations you will encounter.

Glycemic Index

The glycemic response of a food is a measure of the food's ability to raise blood glucose and, thus, insulin. Foods that produce a higher glycemic response are expected to result in a greater increase in muscle glycogen than those that produce a lower glycemic response. This hypothesis was confirmed when L. M. Burke, Ph.D., and colleagues (2) reported that glycogen replacement was 30% higher in well-trained cyclists fed high versus low GI foods for 24 hours after 2 hours of exhaustive exercise. Thus active individuals want to know if they should be modifying their diet based upon the GI of various foods.

The GI is a way of categorizing foods based upon the glycemic response they produce and gives a numeric value to this response so that foods can be compared. The calculation to determine the GI of a food or meal is given here:

- Consume 50 g of a food and compare the blood glucose response within a 2-hour time period.
- Compare this response to that of white bread or glucose. White bread has a GI of 70, whereas glucose has a GI of 100. The GI value for white bread is typically adjusted to 100 and is used as the standard for comparisons.

Calculating Glycemic Index

A number of important factors affect the GI of a food, such as the form of the food (solid versus liquid), presence of fiber, degree of processing or cooking (*e.g.*, more processed foods will typically have a higher GI), the presence of fructose and lactose in the food (both have a lower GI than glucose and are not rapidly converted to glycogen in the muscle), and the quantity of protein and fat in the food. Thus, one cannot easily guess how the body will respond to a particular food or meal without testing it. In general, non-starchy vegetables, fruits, legumes, and nuts usually have a low GI.

Although it is time consuming, the GI can be applied to mixed meals by taking the weighted mean of the GI of the foods that make up the meal. Dr. Wong and Ms. Chung (1) and K. Foster-Powell, Ph.D. (3) provide an extensive listing of foods and their GI values, while a brief list is provided in Table 1.

Glycemic Load

The GI compares foods containing the same amount of carbohydrates and their ability to affect blood glucose levels. The GI does not take into account serving sizes, whereas the GL does. To calculate the GL of a food, you simply multiply the grams of carbohydrate in the food times the serving size in grams divided by 100. Thus, consuming a lot of a high GI food will bring about a greater glycemic response than eating a small amount of a high GI food. For example, both potatoes and carrots are high GI foods, but we typically would only eat 1/2 cup of carrots (one serving), whereas we can easily eat 1 to 2 cups of mashed potatoes (two to four servings). Thus, you would get a much higher GL with the potatoes than the carrots because you are eating more grams of carbohydrate (4, 5).

Role of Glycemic Index in Training

The athlete's dietary goal should be to optimize the body's stores of carbohydrates before an exercise session, provide adequate fuel during the session, and replenish those carbohydrate stores during recovery (6, 7). These factors all help to promote and maintain optimum exercise performance. Choosing foods with a low, medium, or high GI can alter the availability of carbohydrates for exercise. A low GI meal has been shown to be an appropriate carbohydrate source before prolonged exercise to promote the availability of sustained carbohydrate. Studies have found that endurance time is prolonged after ingestion of a low versus high GI meal (8–10). Medium and high GI foods are appropriate sources of carbohydrate during a period of prolonged exercise and also after exercise during the recovery period. High GI foods can be used immediately after exercise to improve muscle glycogen synthesis. Table 2 gives examples of when eating various types of GI foods before, during, and after exercise would be appropriate.

Limitations to the Glycemic Index

The GI value of a food isn't the only factor that needs to be considered when selecting what to eat. Other factors such as food preference, training routine, and availability of food also need to be considered. Because individuals respond differently to food, the active individual needs to

Table 1. Glycemic Index of Various Foods

High Glycemic Index Foods (GI > 85)*			
Angel Food Cake	Croissant, doughnuts	English Muffins	Pop Tarts
Hard Candy	Coca Cola (Coke)	Waffles, Pancakes	Special K Cereal
Ice cream	Raisins, Watermelon	White Bread, Bagels	Grapenuts
Honey/Syrups	Cheerios, Cornflakes	Corn Bran Cereal	Corn Chex Cereal
Corn Chips	Cream of Wheat	Soda Crackers	Rice Krispies
Mashed Potatoes	Sport Drinks	Total Cereal	Shredded Wheat
Moderate Glycemic Index Foods (GI = 60–85)*			
Sponge Cake	Pastry	Snickers Bar	Oat Bran Bread
Corn Tortilla	Pita Bread, white	PowerBar, Chocolate	7-Grain Bread
Green peas	Bran Chex Cereal	Oat Bran Cereal	Special K Cereal
Grapes, Banana	Oatmeal, cooked	Ice cream, low fat	Sweet Corn
White Rice (long grain)	Orange/Grapefruit juice	Durum Spaghetti	100% WW Bread
Low Glycemic Index Foods (GI < 60)*			
Ironman Bar, Choc.	Tomato Soup/juice	Rice Bran, Br. rice	Beans (all types)
Milk (whole/skim)	Yogurt (all types)	Apple (whole/juice)	Peanuts/Cashews
9-Grain Bread	Grapefruit/Oranges	Peaches, Pears (fresh)	All Bran Cereal

*White bread was used as the reference food (GI = 100). Adapted from (3).

Table 2. Timing of the Use of Low, Medium, and High GI Foods With Sport

Timing	Type of Carbohydrate	Examples
Before exercise: 2–3 hours pre-race of workout	Low GI (*e.g.*, mixed meal made up of low and high GI foods).	Bagel and low fat yogurt; banana and PowerBar; Sports drink and 1/2 turkey sandwich or bean burrito.
During exercise	Medium, High GI sport products	Sports drink; 1/2 PowerBar
Immediately after exercise: 20–40 minutes post-exercise	High GI	2 c. juice or sport drink; fruit-flavored yogurt and graham crackers; chocolate milk or cereal with skim milk; Nutri-Grain Bars; Pop Tarts
Post-exercise follow-up meal	High GI and mixed meals	Pasta w/meat sauce, salad, milk; Sub-sandwich w/meat; Rice/chicken/bean burrito
Recovery time	High GI as needed	Sport drinks; fruit or fruit juice; bagel

find a routine that works best for him or her and practice this routine during training. Although the GI and GL work well in controlled research experiments, there is limited research examining this practice in the field with larger populations of active individuals doing a variety of exercise activities. Finally, carbohydrate isn't the only nutrient that needs to be considered when planning meals for active individuals. In general, meals usually contain more than one food and a variety of nutrients. Sport foods high in carbohydrates are a quick way to get the needed carbohydrates during and immediately following exercise. However, the overall diet needs to focus on the appropriate balance between carbohydrates, protein, and fat and eating nutrient rich foods high in vitamins, minerals, and fiber.

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