

## Application of the Glycemic Index in Endurance Training



### *Introduction*

Endurance athletes train their bodies in preparation to work and perform for hours without rest. Athletes that run long distances, cycle cross-country, row, swim (distance events such as triathlons), or cross-country ski, to name a few events, strive to perform at faster paces and longer distances. Controlling every aspect of an athlete's body during training and events in a healthful manner can prove to be an important factor in success. . Usually the world-champion endurance athletes are extremely successful at doing just that by making sure they do all the little things

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right before competition. Endurance athletes have been experimenting with different extremes of carbohydrate loading, both pre-event and days prior to an event. Much research is conducted to reveal the secrets of carbohydrate consumption and supplementation when maximal endurance performance is desired. Although originally applied to diabetics' nutritional needs, the glycemic index is being experimented with endurance athletes in recent years. Endurance athletes supplement drinks and whole foods before and during events and training to provide carbohydrates in large quantities. Carbohydrates are mostly thought to be beneficial to endurance events as they provide basic and complex forms of energy. This is where the glycemic index is put under the spotlight of researchers, trainers, and athletes.

### *The Glycemic Index*

Introduced in 1981, the glycemic index is thought to be important in predicting response in blood glucose prior to consumption of food (Jenkins et al., 1981). The glycemic index is a fairly simple way of determining the glucose response after the consumption of food, as it relates the blood glucose responses of foods with the response to pure glucose. Pure glucose has a glycemic index of 100, which is the comparative number in the glycemic index. This means that if a certain food has a glycemic index of 50 and a person eats enough of that food to consume 10 grams of carbohydrates, then the blood glucose level would be 50% of the level it would be if the person consumed 10g of pure glucose. Generally, foods that have a glycemic index of 55 or less are considered low glycemic foods; foods that have an

index of 70 or higher are considered high glycemic foods; and an index of 56 to 69 indicates medium glycemic foods. Some research shows foods having a low glycemic index are thought to be superior to foods having a high glycemic index because they take longer to get digested in the gastrointestinal tract and therefore supply the body with useable carbohydrates longer (DeMarco et al., 1999). This is where athletes believe that these low glycemic index foods can give them an advantage by supplying their muscles with glucose longer, rather than a quick spike in energy. Many researchers have made hypothesis and set out to test these ideas in order to find any truth behind these claims. **Table 1** shows various carbohydrate rich foods and the corresponding glycemic index data (Jenkins et al., 1981).

**Table 1.** Food items with their corresponding glycemic indices.

Food Item	Glycemic Index	Food Item	Glycemic Index
Spaghetti (whole meal)	42 +/- 4	Spaghetti (white)	50 +/- 8
Rice (brown)	66 +/- 5	Rice (white)	72 +/- 9
Bread (white)	69 +/- 5	Bread (whole meal)	72 +/- 6
Beans (kidney)	29 +/- 8	Peas (chick)	36 +/- 5
Potato (instant)	80 +/- 13	Potato (sweet)	48 +/- 6
Potato (new)	70 +/- 8	Banana	62 +/- 9
Honey	87 +/- 8	Yogurt	36 +/- 4



### *Hypoglycemia*

Athletes of all types of endurance sports must avoid hypoglycemia to perform adequately, effectively, and safely. Hypoglycemia is the state of low or extremely low blood sugar level. Occurring as body stores of glucose/glycogen reach low levels, hypoglycemia means carbohydrates are hardly supplying any energy to the body. Theoretically, a meal with a reduced GI will result in a slower release of glucose from the gut to the circulating blood, increase glucose availability late in the exercise period, and thus delay the development of hypoglycemia (Kirwan et al., 1998). Kirwan et al. provides the theory that an athlete should benefit during prolonged exercise from the consumption of lower glycemic index food prior to events. Endurance athlete would benefit from a gradual, prolonged supply of available carbohydrates during long events, especially towards the end of events.

### *Absorption Rates*

The main thought behind the exercise advantages of the lower glycemic index foods is the slower digestion rate and therefore the slower absorption rate of the carbohydrates. Lower absorption rates of glucose are theorized to minimize a spike in blood glucose response. Low glycemic foods take more than three hours to digest and absorb into the blood stream, and the increased sympathetic nervous system function which occurs during physical activity and endurance events causes vasoconstriction and most likely further reduces the rate of absorption of monosaccharides from low glycemic index carbohydrates (Wee et al., 1999). The slow digestion and absorption rate of low glycemic index foods may hinder its energy provision with the amount of time it can take to reach the muscles of the performing athlete during the event. If carbohydrates take too long to absorb into the bloodstream of performing athletes, the supply could be so minute that there may not even be a benefit. Essentially, a slower digesting carbohydrate or meal would provide a more gradual supply of carbohydrate energy to the blood, and therefore provide a more consistent energy source for the working muscles. **Figure 2** (DeMarco et al, 1999) shows the insulin levels following the consumption of HGI and LGI meals.

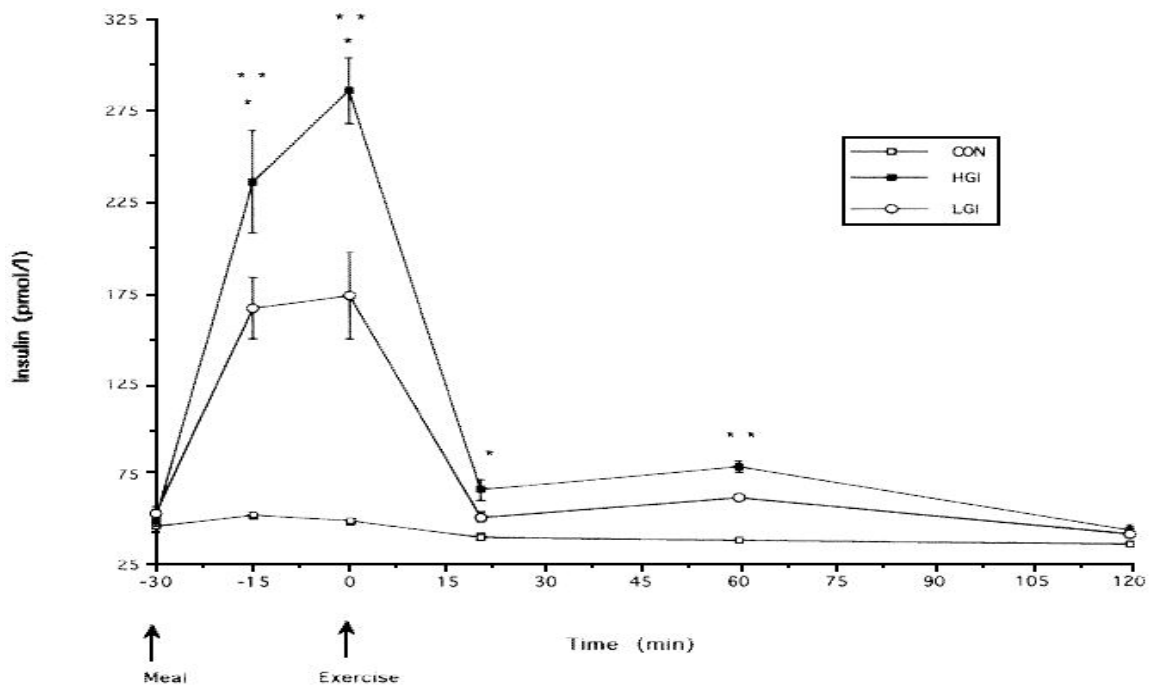


Figure 2.

### *Fiber Content*

The reason low glycemic foods have longer digestion rates and prolonged absorption rates may be due to a higher amount of fiber content. One study holds fiber responsible for causing a differing rate of carbohydrate absorption, as a high glycemic food has lower fiber content than a low glycemic food. A more modest response in blood glucose levels following a feeding of high fiber food is thought to be caused by a “reduced rate of gastric emptying and a reduce rate of intestinal absorption” (DeMarco et al, 1999). DeMarco et al accounts the reduced blood glucose response in the low glycemic food (although LGI response is not shown to be significantly different from the HGI) to the dissimilar amounts of fiber between the two meals. High fiber foods are not always the best choice for pre-event

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consumption however. A lengthy digestion time frame ensues gastric troubles during endurance events and training. Avoiding possible gastric distress during a performance in an endurance activity requires an acceptable time frame prior to the activity.



### *Continued Debate*

Some research shows the benefits of low glycemic foods consumed pre-event versus high glycemic foods. “These results provide support for the hypothesis that a meal with a calculated LGI may confer an advantage over one with a calculated HGI consumed before prolonged strenuous exercise” (DeMarco, et al., 1999). “In conclusion, a significant improvement in maximal exercise performance time, following endurance exercise, was observed when a calculated LGI meal was consumed 30 min before exercise as compared with the consumption of a meal

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calculated to have a HGI" (DeMarco et al, 1999). The results acquired through (DeMarco et al.) research may support the theory stating that meals with a low glycemic index being consumed pre-event can benefit an athlete in early morning competitions. "Increasing the availability of blood glucose exogenously via a slow-releasing source of glucose may supplement endogenous stores adequately enough to enhance performance during maximal exercise" (DeMarco, et al., 1999).

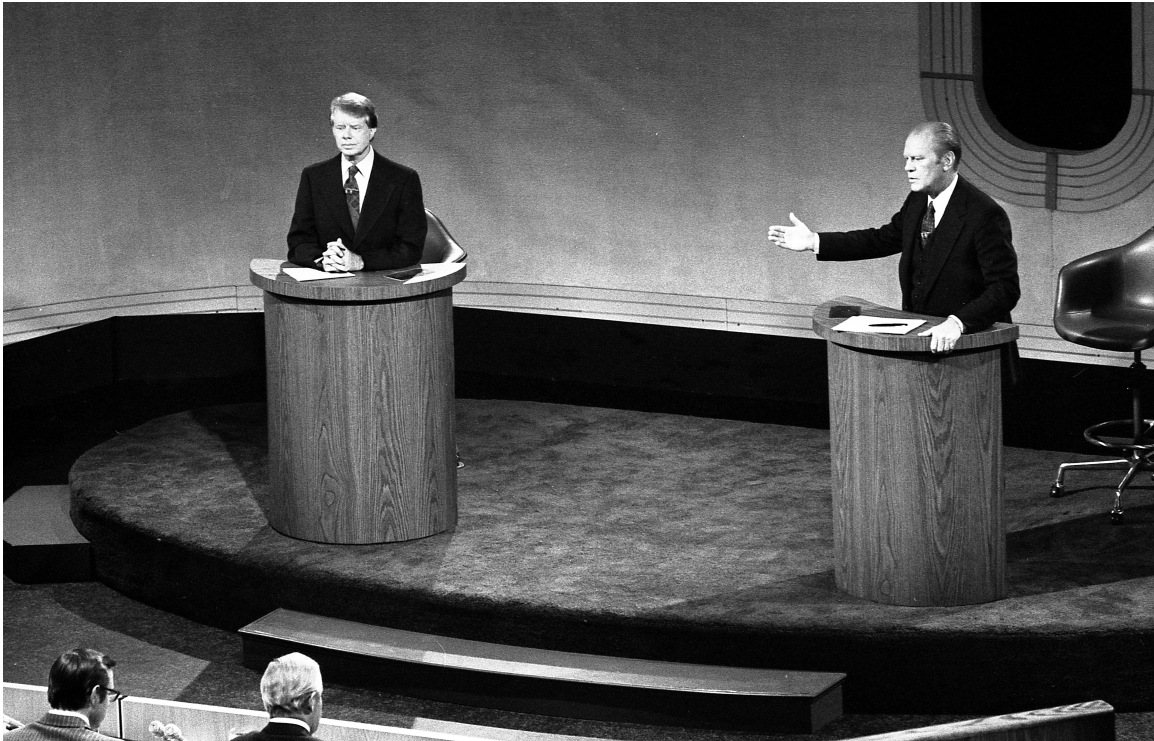
Although previous research shows that low glycemic foods may support elevated performance, other research supports the idea that moderate glycemic index foods can result in elevated performance. "The main finding from our study shows that eating a MOD-GI breakfast cereal 45 minutes before beginning exercise can improve performance time, whereas eating a HI-GI meal is no different from ingesting water" (Kirwan et al., 2001). Such research showing possibly enhanced success with a moderate glycemic index may show that the glycemic index could benefit endurance athletes best when both high glycemic and low glycemic meals are used together.

While some research shows differences between athlete response to low glycemic and high glycemic, much research shows no difference. The dispute between both types of glycemic index is ongoing. "The major finding of this investigation was that when large amounts (~170 g) of CHO were ingested during prolonged (~2.5 h) cycling, there were minimal differences in the metabolic and performance responses to the choice of pre-event meal" (Burke et al., 1998). Research done by Burke et al. does not support the theory that differing glycemic indices, prior to prolonged cycling, have differing effects. Since there is both



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research supporting the theory and research not supporting the theory, much more research needs to be conducted in order to show a trend in results that is consistent.



### *Recommendations for Endurance Athletes*

Pre-event carbohydrate consumption is estimated to resemble 4-5 grams of carbohydrate per kilogram of body mass four hours before the event. Along with one gram of carbohydrate per kilogram of body mass one hour prior. As for consuming low glycemic foods or high glycemic foods, multiple answers are formulated. Research needs to continue to accurately distinguish an advantage between the two. Athletes should stick to what they are comfortable consuming and foods that are familiar to the stomach. Foods lower in fiber are also performance-friendly and prevent food related distress during long events, but if consumed in an

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appropriate time frame (such as a few hours prior to event to allow adequate digestion) an athlete may not experience any discomfort. If an athlete would like to utilize the glycemic index for endurance performance, a combination of both high glycemic and low glycemic meals could be beneficial. A pre-event meal being consumed roughly four hours before an event could consist of the low glycemic foods with high fiber content, and provide a consistent blood glucose level. The carbohydrate consumption one-hour prior could consist of high glycemic foods/drinks in order to provide a spike in blood glucose levels.



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Images:

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