Dr. Perlmutter's

Guide to the Glycemic Index

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Glycemic Index

The glycemic index (GI) is a powerful tool that will help you make better choices in the foods you consume.

One of the most important messages in the Grain Brain Program is to limit your exposure to foods that will significantly raise blood sugar. Elevation of blood sugar ultimately leads to several detrimental processes that wreak havoc in the body and especially in the brain.

When blood sugar levels rise, a chemical change known as glycation increases. Glycation is the binding of sugar to protein, and when that occurs in your body, two damaging processes are enhanced—inflammation and the production of damaging chemicals called free radicals.

Inflammation is familiar to most of us. It's the reason a person's arthritic knee or shoulder is a painful experience. But what may come as a surprise to many people is the new science indicating that inflammation actually plays a sinister role in brain disorders like Parkinson's disease and Alzheimer's.

While pain signals that inflammation is damaging an arthritic joint, the brain itself does not perceive pain because it lacks pain receptors. So when the brain is inflamed, the inflammation goes unnoticed. Again, a cornerstone of some of the most feared degenerative brain disorders is inflammation, and inflammation is enhanced when blood sugar is elevated, leading to glycation. Understanding how the Grain Brain–recommended food choices can reduce inflammation provides powerful leverage to preserve and enhance brain function.

The second worrisome consequence of glycation is the dramatic increase in the production of damaging chemicals called free radicals. Free radicals lead to oxidative damage of our tissues. A familiar example of oxidative damage would be to consider what happens to a piece of iron left out in the weather. Iron oxidizes quite readily, a process we are all familiar with called rusting. This same process is at work right now throughout your entire body, including your brain. Oxidative damage caused by free radicals damages fat, protein, and even your DNA, your code of life. That's why it is critical to do everything possible to reduce oxidative damage.

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To reduce oxidative damage, consume foods rich in antioxidants, chemicals that neutralize free radicals. These foods include colorful vegetables—like broccoli, kale, spinach, and red peppers—and limited amounts of fruits. (While we've been told for years to eat multiple servings of fruit each day, it's important to keep in mind that virtually all of the calories in fruit come from sugars.) But it's perhaps even more important to reduce the production of free radicals in the first place.

Glycation of proteins, which increases as blood sugar rises, can increase the production of damaging free radicals by as much as 50 fold! So understanding how food choices translate into blood sugar elevation is crucial.

Several decades ago, researchers in food sciences and diabetes began exploring the effects of various foods on blood sugar and future risk for developing diabetes, a disease now affecting close to 26 million Americans that has been associated with a two-fold increased risk for the development of Alzheimer's disease. Researchers at the University of Toronto, led by Dr. David J. A. Jenkins, realized that it was important to consider how rapidly and how high blood sugar would rise following the consumption of a particular food. They surmised that glycation, brought on by blood sugar, would be enhanced the longer the blood sugar remained elevated. So well beyond the notion that a particular food would

cause a spike in the blood sugar, the longer the blood sugar remained elevated, the greater the long-term damage. These scientists then developed a ranking system that has allowed us to look at foods in a new and very meaningful way: the glycemic index. The glycemic index not only provides important information as to how high blood sugar will rise but, perhaps more importantly, reveals how long the blood sugar will remain elevated.

The longer the blood sugar remains high, the greater the chance that sugar will bind to protein. And this process, glycation, is what greatly enhances both inflammation and the production of free radicals. And keep in mind that inflammation and free radical production directly damage our most vital tissues and organs.

Doctors now routinely evaluate a marker of glycation as part of a general laboratory assessment. The test most commonly used is called hemoglobin A1c or, more commonly, A1c. As the name implies, this test is a marker of glycation of the protein hemoglobin. Healthcare practitioners use the A1c test to determine a person's average blood sugar over a three- to four-month period. The more the blood sugar levels remain elevated, the higher the A1c. But beyond simply as a marker of average blood sugar, the A1c test has far more important implications. This test provides valuable information about the glycation of proteins and thus gives insight into both the degree of inflammation as well as the activity of dangerous free radicals.

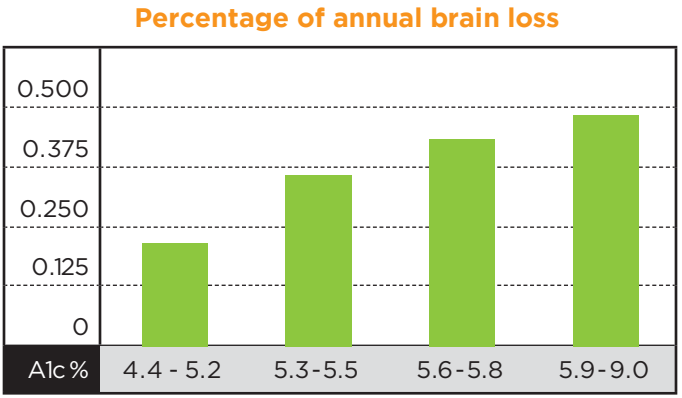

Figure 1.
Percentage of annual brain loss compared to A1c
Adapted from: Neurology 79, no.10 (2012): 1019-1026

Now that you understand how glycation is so damaging to the brain as well as how the process can be measured, it shouldn't surprise you to learn that there is a direct correlation between glycation, as measured by the A1c test, and actual damage to the brain. In a recent study published by the prestigious medical journal Neurology, researchers checked the blood A1c test in 201 nondiabetic adults with normal brain function and measured the actual size of the participants' brains using MRI scans. After six years, the brain scans were repeated. What the researchers found was astounding: As you see in the graphic, there was a direct and powerful relation between the original A1c, a marker of glycation, and the degree of brain atrophy or shrinkage.

The most striking finding was that the A1c level was the most important predictor of brain shrinkage, far more powerful than other variables like alcohol intake, triglyceride level, or cholesterol level. And the empowering take-home message is that the degree of glycation, as measured by the A1c test and relates to the rate at which the brain shrinks, is directly related to food choices. Eating foods with a lower glycemic index will reduce glycation and preserve the brain.

As blood sugar levels rise following consumption of a particular food, the pancreas senses the elevation and immediately starts churning out insulin to bring sugar levels back down.

There's another reason why understanding the glycemic index is critical to health and longevity as well as preserving brain function. As we consume foods that raise blood sugar, we "turn on" a system that allows the sugar in the blood to be transported out of the bloodstream and into the cells, which brings the level of sugar in the blood back down to normal. Insulin is a key hormone manufactured in the pancreas that controls this process. As blood sugar levels rise following consumption of a particular food, the pancreas senses the elevation and immediately starts churning out insulin to bring sugar levels back down. Insulin secreted from the pancreas binds to receptors on the surface of cells and essentially unlocks the gates, allowing the sugar access to the cell's interior.

The glycemic index, which not just reflects how high blood sugar rises after a particular food is consumed but also incorporates the length of time the sugar remains elevated, has important implications in terms of the pancreas and the insulin it secretes. Obviously, the higher the glycemic index of a particular food, the harder the pancreas will have to work producing insulin to get blood sugar under control.

And it's not just the pancreas that works overtime when challenged by high glycemic index foods—as discussed above,

insulin's role is to ask the cells to help out by extracting the sugar from the bloodstream. And when high-sugar, high-GI foods are persistently consumed, ultimately the cells begin to become less responsive to the insulin signal, thus weakening their ability to help lower the blood sugar.

With the elevation of blood sugar that ensues, the pancreas must work even harder, pumping out more and more insulin to deal with this ever-increasing sugar load. We call this condition insulin resistance, meaning that the cells are becoming resistant to insulin's signal to take in sugar. And while insulin resistance is clearly a prelude to diabetes just around the corner, new research shows that individuals with insulin resistance who have not yet progressed to full-blown diabetes already have a dramatically increased risk for dementia. And when insulin resistance does become diabetes, the risk for dementia is doubled!

The information provided below describing the glycemic index for various foods has powerful implications for brain health as well as your overall health. Consuming foods in the lower GI range is associated with weight loss and improvements in blood lipids, which may lead to a meaningful reduction in risk for coronary artery disease.

- **Low glycemic index foods have a GI of 55 or less.**
- **Medium glycemic index foods have a GI of 56-69.**
- **High glycemic index foods have a GI of 70 or above.**

But keep in mind that the glycemic index, while providing valuable information about how your body will handle a particular food in terms of sugar and insulin metabolism, doesn't take into account the all-important consideration of whether a food contains gluten. And you will find much more information about the equally troublesome role of gluten in human health in my book *Grain Brain*.

BAKERY PRODUCTS AND BREADS	Glycemic index (glucose = 100)	Serving size (grams)
Banana cake, made with sugar	47	60
Banana cake, made without sugar	55	60
Sponge cake, plain	46	63
Vanilla cake, made from packet mix with vanilla frosting (Betty Crocker)	42	111
Apple muffin, made with sugar	44	60
Apple muffin, made without sugar	48	60
Waffles, Aunt Jemima (Quaker Oats)	76	35
Bagel, white, frozen	72	70
Baguette, white, plain	95	30
Coarse barley bread, 75-80% kernels, average	34	30
Hamburger bun	61	30
Kaiser roll	73	30
Pumpernickel bread	56	30
50% cracked-wheat kernel bread	58	30
White-wheat flour bread	71	30
Wonder™ bread, average	73	30
Whole-wheat bread, average	71	30
100% Whole Grain™ bread (Natural Ovens)	51	30
Pita bread, white	68	30
Corn tortilla	52	50
Wheat tortilla	30	50

BEVERAGES	Glycemic index (glucose = 100)	Serving size (grams)
Coca-Cola®, average	63	250 mL
Fanta®, orange soft drink	68	250 mL
Lucozade® original (sparkling glucose drink)	95 ± 10	250 mL
Apple juice, unsweetened, average	44	250 mL
Cranberry juice cocktail (Ocean Spray®)	68	250 mL
Gatorade	78	250 mL
Orange juice, unsweetened	50	250 mL
Tomato juice, canned	38	250 mL

BREAKFAST CEREALS AND RELATED PRODUCTS	Glycemic index (glucose = 100)	Serving size (grams)
All-Bran™, average	55	30
Coco Krispies™, average	77	30
Corn Flakes™, average	93	30
Cream of Wheat™ (Nabisco)	66	250
Cream of Wheat™, Instant (Nabisco)	74	250
Grape-Nuts™, average	75	30
Muesli, average	66	30
Oatmeal, average	55	250
Instant oatmeal, average	83	250
Puffed wheat, average	80	30
Raisin Bran™ (Kellogg's)	61	30
Special K™ (Kellogg's)	69	30

GRAINS	Glycemic index (glucose = 100)	Serving size (grams)
Pearled barley, average	28	150
Sweet corn on the cob, average	60	150
Couscous, average	65	150
Quinoa	53	150
White rice, average	89	150
Quick-cooking white basmati rice	67	150
Brown rice, average	50	150
Converted, white rice (Uncle Ben's®)	38	150
Whole-wheat kernels, average	30	50
Bulgur, average	48	150

COOKIES AND CRACKERS	Glycemic index (glucose = 100)	Serving size (grams)
Graham crackers	74	25
Vanilla wafers	77	25
Shortbread	64	25
Rice cakes, average	82	25
Rye crisps, average	64	25
Soda crackers	74	25

DAIRY PRODUCTS AND ALTERNATIVES	Glycemic index (glucose = 100)	Serving size (grams)
Ice cream, regular	57	50
Ice cream, premium	38	50
Milk, full fat	41	250 mL
Milk, skim	32	250 mL
Reduced-fat yogurt with fruit, average	33	200

FRUITS	Glycemic index (glucose = 100)	Serving size (grams)
Apple, average	39	120
Banana, ripe	62	120
Dates, dried	42	60
Grapefruit	25	120
Grapes, average	59	120
Orange, average	40	120
Peach, average	42	120
Peach, canned in light syrup	40	120
Pear, average	38	120
Pear, canned in pear juice	43	120
Prunes, pitted	29	60
Raisins	64	60
Watermelon	72	120

BEANS AND NUTS	Glycemic index (glucose = 100)	Serving size (grams)
Baked beans, average	40	150
Black-eyed peas, average	33	150
Black beans	30	150
Chickpeas, average	10	150
Chickpeas, canned in brine	38	150
Navy beans, average	31	150
Kidney beans, average	29	150
Lentils, average	29	150
Soy beans, average	15	150
Cashews, salted	27	50
Peanuts, average	7	50

PASTA AND NOODLES	Glycemic index (glucose = 100)	Serving size (grams)
Fettucini, average	32	180
Macaroni, average	47	180
Macaroni & Cheese (Kraft)	64	180
Spaghetti, white, boiled, average	46	180
Spaghetti, white, boiled 20 min, average	58	180
Spaghetti, wholemeal (whole wheat), boiled, average	42	180

SNACK FOODS	Glycemic index (glucose = 100)	Serving size (grams)
Corn chips, plain, salted, average	42	50
Fruit Roll-Ups®	99	30
M&M's®, peanut	33	30
Microwave popcorn, plain, average	55	20
Potato chips, average	51	50
Pretzels, oven-baked	83	30
Snickers®	51	60

VEGETABLES	Glycemic index (glucose = 100)	Serving size (grams)
Green peas, average	51	80
Carrots, average	35	80
Parsnips	52	80
Baked russet potato, average	111	150
Boiled white potato, average	82	150
Instant mashed potato, average	87	150
Sweet potato, average	70	150
Yam, average	54	150

MISCELLANEOUS	Glycemic index (glucose = 100)	Serving size (grams)
Hummus (chickpea salad dip)	6	30
Chicken nuggets, frozen, reheated in microwave oven 5 min	46	100
Pizza, plain baked dough, served with Parmesan cheese and tomato sauce	80	100
Pizza, Super Supreme (Pizza Hut)	36	100
Honey, average	61	25

Glycemic Load

The glycemic load is another valuable tool for calculating the effects various foods will have on blood sugar. The glycemic load takes the glycemic index into account but is more reflective of what represents a typical serving.

A glycemic load of 10 or less is considered low,
11-19 is medium, and 20 or greater is high.

BAKERY PRODUCTS AND BREADS	Glycemic load per serving
Banana cake, made with sugar	14
Banana cake, made without sugar	12
Sponge cake, plain	17
Vanilla cake, made from packet mix with vanilla frosting (Betty Crocker)	24
Apple muffin, made with sugar	13
Apple muffin, made without sugar	9
Waffles, Aunt Jemima (Quaker Oats)	10
Bagel, white, frozen	25
Baguette, white, plain	15
Coarse barley bread, 75-80% kernels, average	7
Hamburger bun	9
Kaiser roll	12
Pumpernickel bread	7
50% cracked-wheat kernel bread	12
White-wheat flour bread	10
Wonder™ bread, average	10
Whole-wheat bread, average	9
100% Whole Grain™ bread (Natural Ovens)	7
Pita bread, white	10
Corn tortilla	12
Wheat tortilla	8

BEVERAGES	Glycemic load per serving
Coca-Cola®, average	16
Fanta®, orange soft drink	23
Lucozade®, original (sparkling glucose drink)	40
Apple juice, unsweetened, average	30
Cranberry juice cocktail (Ocean Spray®)	24
Gatorade	12
Orange juice, unsweetened	12
Tomato juice, canned	4

BREAKFAST CEREALS AND RELATED PRODUCTS	Glycemic load per serving
All-Bran™, average	12
Coco Krispies™, average	20
Corn Flakes™, average	23
Cream of Wheat™ (Nabisco)	17
Cream of Wheat™, Instant (Nabisco)	22
Grape-Nuts™, average	16
Muesli, average	16
Oatmeal, average	13
Instant oatmeal, average	30
Puffed wheat, average	17
Raisin Bran™ (Kellogg's)	12
Special K™ (Kellogg's)	14

GRAINS	Glycemic load per serving
Pearled barley, average	12
Sweet corn on the cob, average	20
Couscous, average	9
Quinoa	13
White rice, average	43
Quick-cooking white basmati rice	28
Brown rice, average	16
Converted, white rice (Uncle Ben's®)	14
Whole-wheat kernels, average	11
Bulgur, average	12

COOKIES AND CRACKERS	Glycemic load per serving
Graham crackers	14
Vanilla wafers	14
Shortbread	10
Rice cakes, average	17
Rye crisps, average	11
Soda crackers	12

DAIRY PRODUCTS AND ALTERNATIVES	Glycemic load per serving
Ice cream, regular	6
Ice cream, premium	3
Milk, full fat	5
Milk, skim	4
Reduced-fat yogurt with fruit, average	11

FRUITS	Glycemic load per serving
Apple, average	6
Banana, ripe	16
Dates, dried	18
Grapefruit	3
Grapes, average	11
Orange, average	4
Peach, average	5
Peach, canned in light syrup	5
Pear, average	4
Pear, canned in pear juice	5
Prunes, pitted	10
Raisins	28
Watermelon	4

BEANS AND NUTS	Glycemic load per serving
Baked beans, average	6
Black-eyed peas, average	10
Black beans	7
Chickpeas, average	3
Chickpeas, canned in brine	9
Navy beans, average	9
Kidney beans, average	7
Lentils, average	5
Soy beans, average	1
Cashews, salted	27
Peanuts, average	7

PASTA AND NOODLES	Glycemic load per serving
Fettucini, average	15
Macaroni, average	23
Macaroni & Cheese (Kraft)	32
Spaghetti, white, boiled, average	22
Spaghetti, white, boiled 20 min, average	26
Spaghetti, wholemeal (whole wheat), boiled, average	17

SNACK FOODS	Glycemic load per serving
Corn chips, plain, salted, average	11
Fruit Roll-Ups®	24
M&M's®, peanut	6
Microwave popcorn, plain, average	6
Potato chips, average	12
Pretzels, oven-baked	16
Snickers®	18

VEGETABLES	Glycemic load per serving
Green peas, average	4
Carrots, average	2
Parsnips	4
Baked russet potato, average	33
Boiled white potato, average	21
Instant mashed potato, average	17
Sweet potato, average	22
Yam, average	20

MISCELLANEOUS	Glycemic load per serving
Hummus (chickpea salad dip)	0
Chicken nuggets, frozen, reheated in microwave oven 5 min	7
Pizza, plain baked dough, served with Parmesan cheese and tomato sauce	22
Pizza, Super Supreme (Pizza Hut)	9
Honey, average	12

The glycemic load and glycemic index information presented above is used with permission from Harvard Health Publications of Harvard Medical School.

About the Author

David Perlmutter, M.D., is a practicing board-certified neurologist and Fellow of the American College of Nutrition.

He is the author of the #1 *New York Times* bestseller *Grain Brain* and lectures to medical doctors and healthcare providers worldwide.