GLUCOSE, BLOOD SUGAR CONTROL and FOOD ORDER

Simply put, what we eat affects the 30 trillion cells and the 30 trillion microbes within us. One of the most important nutrients we consume is glucose (sugar) since it is our body's main source of energy. Every second, your body burns 8 billion, billion molecules of glucose. That's 8^{17} (8,000,000,000,000,000,000) molecules. About 25% of the glucose consumed every day is used by the brain. At least 10% of Americans are already diabetic and another 35% are pre-diabetic. As many as another 40% are thought to have Insulin Resistance, where the insulin we produce is not working well and this ultimately leads to prediabetes and eventually type 2 diabetes, but it also affects type 1 diabetics who must inject insulin, or they die. In total, that is 88% of Americans have dysregulated sugar control in one form or another! When you eat the wrong foods (fats and processed sugars), your pancreas produces more insulin than normal, as much as 500% more. It can compensate for as long as 20 years before there are even any signs of diabetes on routine blood tests, let alone symptoms.

The more refined the foods we eat, the faster the glucose gets absorbed causing a spike in glucose, rather than a more gradual rise with less processed foods. This sugar spike then leads to a spike in release of the sugar storage hormone insulin, which then is followed by a greater than normal drop in sugar, called hypoglycemia.

In the long term, dysregulated glucose levels contribute to aging and to the development of serious chronic diseases such as: cancer, heart and vascular disease, dementia including Alzheimer's Disease, acne, eczema, psoriasis, arthritis, cataracts, depression, gut problems, infertility, PCOS, insulin resistance, type 2 diabetes and fatty liver disease.

With flatter glucose curves (lower spikes and not so low drops), we reduce the amount of insulin, the glucose storage hormone, which circulates in our body. This is beneficial as too much insulin is one of the main drivers of inflammation, weight gain, insulin resistance, type 2 diabetes, and PCOS. With flatter glucose curves, we also naturally flatten our fructose curves. This is also beneficial, as too much fructose, often found alongside glucose and can't be used for energy, increases the likelihood of obesity, heart disease, and nonalcoholic fatty liver disease.

Plants take carbon dioxide from the air, and water from the soil, using the energy of the sun, a process called photosynthesis, to make glucose, used to construct every part of themselves. It is the simplest form of carbohydrate. Without glucose, there would be no plants and no life.

Once created, plants can either break down glucose to use as energy or keep it intact to use as a building block. A glucose molecule is so tiny and nimble that you could fit 500,000 molecules of it into the period at the end of this sentence. It can be used to make the plant's rigid trunk, flexible leaves, spindly roots, or juicy fruit. Glucose's natural tendency is to dissolve into everything around it since it is both water and fat soluble.

When glucose molecules are combined, they form more complex carbohydrates. The two main ones are starch and fiber.

STARCH is one form of storage for glucose. It is essentially long chains of individual glucose molecules. It can be stored in small amounts throughout the plant, but mostly in its roots. Beets, potatoes, carrots, celeriac, parsnips, turnips, jicama and yams are all root vegetables which contain a lot of starch. Other examples include rice, oatmeal, corn, wheat, barley, beans, peas, lentils, soybeans and chickpeas. These are all seeds, and all of them also contain starch.

Whenever plants need glucose, they use an enzyme called alpha amylase that breaks up the starch chains in the roots, releasing some glucose molecules.

FIBER. A different configuration of chains of glucose results in the production fiber, the other complex carbohydrate. This substance is as important as grout between the bricks of a house. It's what allows plants to grow tall without falling over. It's most found in trunks, branches, flowers and leaves but there is fiber in roots and fruit as well.

Plants also transform some of their glucose into the extra sweet molecule fructose. It is about 2-3x as sweet as glucose. Plants concentrate fructose into fruit like apples and cherries that they dangle from their branches. From an evolutionary standpoint, fructose is used to make fruit taste irresistible to animals. It's the key to propagation, all living plants' or animals' ultimate goal. When animals eat their fruit and along with the seeds inside, the undigested seeds are pooped out elsewhere. That's how seeds spread far and wide, thereby ensuring plants' survival.

When fructose combines with glucose, the result is a molecule called sucrose, or as most people know it, common white table sugar. Sucrose exists to help plants compress energy even further. A sucrose molecule is slightly smaller than a glucose and fructose molecule side by side. This more compressed form allows plants to store more energy in a tighter space. For plants, sucrose is an ingenious temporary storage solution, but for humans, it's just a source of dietary pleasure, energy and unfortunately damage and ill health.

When we eat, we also break starch down into glucose, using the same enzyme that plants use to do this task: *alpha amylase*. It begins the process of starch digestion by taking starch chains and breaks them into smaller pieces with two or three glucose units. Two similar types of amylases are made in your body. One, *ptyalin*, is secreted in saliva, where it starts to break down starch grains as you chew. This is why eating slowly and chewing properly is important. The other enzyme is *pancreatic amylase*. It is secreted by the pancreas and is released into the small intestine. These little pieces are broken into individual glucose units by a collection of enzymes that are tethered to the walls of the intestine. Many starchy vegetables, like sweet potatoes or carrots, taste sweeter after they are cooked because the process of cooking breaks up the complex carbohydrates into simpler, sweeter sugars. The same happens with a banana as it ripens. The more complex carbohydrates break down into simpler ones.

Most fruit, in contrast to root vegetables, tastes sweet from the onset, even in their raw form. This is because they already contain simple, unchained glucose molecules, which taste sweet, as well as fructose, which tastes even sweeter. They also contain their combined form, sucrose whose sweetness is in between.

Glucose from fruit is ready to be used and does not need to be broken down. Sucrose does need to be broken down and there's an enzyme, *sucrase-isomaltase* found in the small intestine, that separates it into glucose and fructose molecules. This process is very fast, occurring in a nanosecond.

Sucrase-isomaltase also breaks down maltose, a sugar made of two glucose molecules bound together. It's created in seeds and other parts of plants as they break down their stored energy in order to sprout. Foods like cereals, certain fruits like peaches and pears as well as sweet potatoes contain naturally high amounts of maltose. There is actually a genetic condition which affects about 1 in 5000 Americans in which they lack this enzyme, making them intolerant of sucrose. Congenital Sucrase-Isomaltase Deficiency (CSID) can be treated with a replacement enzyme, in the same way that those who have lactose intolerance (most of us) can take Lactaid to replace the missing enzyme which breaks down lactose, the main sugar in dairy.

Fructose is a little more complicated. After we eat it, a portion of it is turned back into glucose in our small intestine. The remainder of it stays in fructose form. Both penetrate the lining of our gut to enter our bloodstream. Glucose is needed to fuel your body's systems, but fructose isn't. We eat a lot of unnecessary fructose in our diet because we eat a lot more sucrose, which, as a reminder, is 50% glucose and 50% fructose. In addition, the synthetic form of fructose, high fructose corn syrup (HFCS), is cheap and super sweet and despite the warnings against it, remains a staple used to sweeten processed foods. HCFS is 60% fructose and 40% glucose.

Enzymes work to snap the bonds of starch and sucrose, but there is no enzyme that can snap the bonds of fiber. It doesn't get turned back into glucose.

So, to summarize, Carbohydrates = Complex Carbohydrates (Starch and Fiber) and Simple Carbohydrates (Sugars) which include glucose, fructose and sucrose. There are other members of the simple carbohydrate family like maltose, lactose and galactose, a breakdown sugar of lactose which is prominent in fermented dairy products like yogurt, but the other 3 make up the majority.

Members of the carbohydrate family exist in various proportions in plants. For example, broccoli contains a lot of fiber and some starch, but potatoes contain a lot of starch and some fiber. Fruits like peaches contain mostly sugars and some fiber. There is at least some fiber in every plant and the fiber is unique to that specific plant. There is NO fiber in any animal products, even though 70% of surveyed Americans thought that steak was actually a good source of fiber.

Our body can also make glucose from within as well. We don't photosynthesize and make glucose out of air, water, and sunlight like plants do, but we can make glucose from the food we eat. We can make it from fat or protein. Our liver, through a process called gluconeogenesis, performs this process.

Metabolic flexibility describes our ability to switch from using glucose as an energy source to using fat. The only cells that rely exclusively on glucose are red blood cells. Switching to using fat as an energy source typically occurs in times of stress or starvation. When under stress, our body's response is to store energy, including fat, anticipating a possible upcoming famine. This is why chronic stress contributes to weight gain.

Fiber is often removed in the creation of processed foods because its presence is problematic if you're trying to preserve things for a long time. Fiber spoils. That's not good for shelf life and shelf life is good for profitability! Fiber breaks down into smaller bits during the freezing and thawing process. The fiber is still there, and still has health benefits, but the texture is not the same, and humans are all about taste and texture. Fiber is often removed from processed foods so that they can be frozen, thawed, and last on shelves for years without losing their texture.

Something else is done to foods to turn them into successful supermarket products is to increase their "sweetness". The taste of sweetness in nature signals those foods are both safe, since there are no foods that are both sweet and poisonous. Sweetness also signals that the food is packed with energy. It was an advantage to eat all the fruit before anyone else could, so we evolved to feel pleasure when we tasted something sweet.

Plants have been concentrating glucose, fructose, and sucrose in their fruit forever. Humans started refining it in India about 2500 years ago. From there, the technique spread east towards China, and west towards Persia and the early Islamic worlds, eventually reaching the Mediterranean in the 13th century. We started breeding plants so that, among other reasons, their fruit would taste even sweeter. And then, by boiling sugarcane and crystallizing its juice, humans created table sugar which is 100% sucrose.

Sugar has become ever more concentrated and available. We have gone from eating in-season, foraged fibrous fruit in prehistoric times to eating minuscule quantities of sucrose in the 1800's, to eating more than 150 pounds of sugar per year today.

The ADA, American Diabetic Association, has guidance as to what normal blood sugars should be. However, what it describes as "normal" may not actually be optimal. It rarely is. Early studies showed that the thriving range for fasting glucose may be between 72 and 85 mg/dL. That's because there is more likelihood of developing health problems from 85 mg/dL and up. The ADA states that our glucose levels shouldn't increase above 140 mg/dL after eating. But again, that's "normal" and not optimal. Studies in nondiabetics give more precise information. We should strive to avoid increasing our glucose levels by more than 30 mg/dL after eating.

Furthermore, a glucose spike from a sweet, processed food like a cupcake or doughnut, is much worse for our health than a glucose spike from a starchy food like rice. The reason has nothing to do with the glucose measured though but with a molecule that's not visible, fructose.

A sweet food contains table sugar, sucrose, which is made up of glucose and fructose. Starchy food doesn't. Whenever we see a glucose spike from a sweet food, there is a corresponding fructose spike that unfortunately we can't see. Continuous glucose monitors can detect only glucose but not fructose, and continuous fructose monitors don't exist yet. Until they do, remember that if the food you ate was sweet and it created a glucose spike, it also created an invisible fructose spike, and that's what makes a sweet spike more harmful than a starchy spike. The reason has to do with the inflammation it causes.

The mitochondria are the part of the cell responsible for energy production and they do so by using glucose in our blood and oxygen from the air we breathe to create the chemical version of electricity. As glucose floods into our cell, it heads straight to the mitochondria to undergo its transformation.

Damaging inflammatory molecules, free radicals, are released when our cells are overloaded with sugar. Free radicals randomly snap and modify our DNA, creating mutations that activate harmful genes leading to the development of cancer. They also damage our cell function by making their membranes porous. In addition, some of that glucose is converted to fat.

When there are too many free radicals to be neutralized, our body is said to be in a state of oxidative stress, which is a driver of heart disease, type 2 diabetes, cognitive decline, and general aging. Fructose increases oxidative stress even more than glucose alone. That's one of the reasons that sweet foods, which always contain fructose, are worse than starchy foods, which contain no fructose. Too much fat in the diet, particularly saturated fat, can also increase oxidative stress.

Over decades of elevated sugar, cells become ravaged. Because they're stuffed, crowded and overwhelmed, our mitochondria can't convert glucose to energy efficiently. The cells starve leading to organ dysfunction.

When a glucose molecule bumps into another type of molecule, a reaction which causes damage. The second molecule is then said to be "glycated". Glycation damages the cell permanently. The long-term consequences of glycated molecules range from wrinkles and cataracts to heart disease and even Alzheimer's disease. The HbA1c test, well known among diabetics, measures how many red blood cell proteins have been glycated over the past 2-3 months, basically the lifespan of a red blood cell. It's a percentage and the higher the percentage, the higher the average blood glucose level suggesting poorer blood sugar control. It is not a perfect test, but it is a helpful guide.

Fructose also causes glycosylation but at a rate 10x greater and faster than glucose, generating much more damage. Again, this is another reason why spikes from sugary foods such as cookies, which contain a lot of fructose, make us age faster than spikes from starchy foods such as pasta, which contain much less fructose.

The combination of too many free radicals, oxidative stress and glycation leads to a generalized state of inflammation in the body.

Although insulin also stores fat, leading to weight gain, and acts as a growth stimulant, promoting cancer cell growth as well, insulin's principal purpose is to store excess glucose in storage units called glycogen. This keeps excess amount of glucose out of circulation and protects us from damage. Without insulin, we would die within minutes to hours.

Insulin stashes excess glucose in several storage locations, the most important being the liver and the muscles.

Our liver stores glucose in a form called glycogen. The liver can hold about 100 grams of glucose in glycogen form, the amount of glucose in 2 large servings of McDonald's fries. That's half of the 200 grams of glucose that our body needs for energy in a typical day.

Muscles are effective storage units because we have so many of them. The muscles of a typical 150 pound adult can hold about 400 grams of glucose as glycogen, or the amount of glucose in 8 large McDonald's fries.

Once insulin has stored all the glucose it can in our liver and muscles, any glucose beyond that is turned into fat and stored in our fat cells, a significant contributor to weight gain. But fructose cannot be turned into glycogen and stored in the liver and the muscles. The only thing that fructose can be stored as is fat and given that, it is an even greater contributor to weight gain.

The fat our body creates from fructose has a few unfortunate destinies.

- First, it accumulates in the liver and drives the development of nonalcoholic fatty liver disease, the most common cause of liver transplants today.

- Second, it fills up fat cells all over our bodies but particularly in between our organs, also known as visceral fat. All that extra fat adds to weight gain.
- Finally, it enters the bloodstream and contributes to an increased risk of heart disease. Ironically, processed foods that are “fat free” often contain a lot of sucrose, so the fructose in it is turned into fat after we digest it.

When our glycogen reserves begin to diminish, our body draws on the fat in our fat reserves for energy. We go into fat-burning mode, and we lose weight. But this happens only when our insulin levels are low. If there is insulin present, our body is prevented from burning fat. We’re not able to burn any existing reserves until our insulin levels start coming back down which starts about two hours after the glucose spike.

Excess glucose in our body and the spikes and dips it causes change us on a cellular level. Weight gain is just one of the many symptoms we can see.

Constant hunger is a symptom of high insulin levels. When there is a lot of insulin in our body, built up over years of glucose spikes, our hormones get mixed up. *Leptin*, the hormone that tells us we are full and should stop eating, has its signal blocked, while *ghrelin*, the satiety hormone that tells us we are hungry becomes overactive. Even though we have fat reserves, with lots of energy available, our body tells us we need more so we eat. The more weight we put on, the hungrier we get.

When we eat something that tastes sweet, we may think that we are helping our body get energized, but it’s just an impression caused by the dopamine rush in our brain that makes us feel high. With every spike, we are impairing the long-term ability of our mitochondria to function properly and our energy plummets. Diets that cause glucose roller coasters lead to higher fatigue than those that flatten glucose curves.

People with insulin resistance are twice as likely to have regular migraine headaches than women who don’t. Many skin conditions, including eczema and psoriasis, are driven by inflammation which is a consequence of glucose spikes. Alzheimer’s and glucose levels are so closely connected that Alzheimer’s is sometimes called “type 3 diabetes” or “diabetes of the brain”.

Cancer may begin with DNA mutations produced by free radicals which are partly caused by high glucose spikes. Secondly, inflammation caused by the glucose spikes promotes cancer’s proliferation. When there is more insulin present, cancer spreads even faster since it acts as a growth promoter.

When people eat a diet that leads to erratic glucose levels, they report worsening moods, more depressive symptoms and more mood disturbances compared to those on a diet of similar composition but with steadier glucose levels.

50% of people who have a heart attack have normal levels of cholesterol. We now know that it’s a specific type of cholesterol, LDL-B, as well as inflammation that drive heart disease. It’s linked to glucose, fructose and insulin.

The lining of our blood vessels is made of cells. Heart disease starts when plaque accumulates underneath that lining. These cells are particularly vulnerable to mitochondrial stress. When our levels of insulin are too high, our liver actually starts producing LDL-B. This is a small, dense kind of cholesterol that creeps along the edges of the vessels, where it’s likely to get caught.

When that cholesterol is oxidized, which happens the more glucose, fructose and insulin are present, it lodges under the lining of our blood vessels and sticks there. Plaque builds up and obstructs the flow and this is how heart disease starts. Even if your fasting glucose is normal, each additional glucose spike increases your risk of dying of a heart attack. The more you flatten the glucose, fructose and insulin curves, the more you protect the heart.

Again, what’s important is LDL-B and inflammation. Statins lower LDL-A but they don’t lower the problematic pattern B. This is why statins don’t always decrease the risk of a first heart attack.

Triglycerides to HDL ratio and C reactive protein (CRP), an indicator of inflammation, are very important parameters and predictors of heart disease. The TG:HDL ratio tells us about the presence of the small, dense LDL-B. Triglycerides become LDL-B in our bodies. By measuring triglycerides we can gauge the amount of the problematic LDL-B in our circulation. If you divide the level of triglycerides by HDL level, you'll get a ratio that is surprisingly accurate in predicting LDL size. If the result is smaller than 2, that's ideal. If the result is above 2, it can be problematic. Because inflammation is a key driver of heart disease, measuring CRP, which increases as inflammation does, is better at predicting heart disease than cholesterol levels.

Insulin also signals the ovaries to produce more testosterone. In addition, with too much insulin, the natural conversion from male to female hormones that usually takes place, is hampered. This leads to even more testosterone in the body. Because of the excess testosterone, women suffering from PCOS display masculine traits such as excessive facial and body hair, baldness, irregular or missed periods or acne. Ovaries can also retain and accumulate eggs leading to infertility.

Elevated glucose levels are associated with reduced sperm quality and erectile dysfunction in men. The mechanism of ED has to do with vascular impairment. ED, in an otherwise asymptomatic man, is a much stronger predictor of heart disease than even smoking is. Vascular disease anywhere = vascular disease everywhere.

When insulin levels have been high for a long time, our cells start becoming resistant to insulin. The common but misguided method of treating type 2 diabetes is to give the patient more insulin. This brings the glucose levels down temporarily but leads to more fat storage and weight gain. More fat leads to more insulin resistance and the cycle spirals in a downward direction.

How Can I Flatten My Glucose Curves? It sounds odd, but the order in which you consume your food, independent of timing, may significantly impact on glucose spikes. The order is fiber (think non-starchy vegetables) first, protein and fat second, starches, like potatoes and rice and sugars, like fruit, last.

Every minute, on average, about 3 calories' worth of food trickles through from stomach into the small intestine. This process is called gastric emptying. The more carbs you eat and the quicker you eat them, the more forcefully the load of glucose appears and the bigger the resultant glucose spike. On the other hand, consuming the veggies first and the carbs second significantly changes what happens.

Fiber, which again you only get from plants, has three superpowers.

1) It reduces the action of intestinal alpha amylase, the pancreatic enzyme that breaks starch down into glucose molecules.
2) It slows down gastric emptying.
3) Finally, it creates a viscous mesh in the small intestine. This slows absorption and makes it harder for glucose to make it through to the bloodstream.

Foods that contain protein often contain fat too, and fat is also found on its own in foods such as butter, oils and avocados. These are heavier foods and also slow the processing of glucose in the small intestine, further slowing its absorption.

If starches and sugars are consumed first, ghrelin, our hunger hormone, returns to premeal levels after just 2 hours. If starches and sugars are consumed last, ghrelin, and hence apatite, stays suppressed for much longer.

How long you must wait between consuming those categories of food seems to be irrelevant. Even no wait time results in flatter glucose curves, assuming the order is maintained. However, you should not wait more than 2 hours after starting with your veggies since it takes 2 hours for fiber to clear the stomach.

Some protein is also converted into glucose, but at a much lower rate than carbohydrates. However, it is still beneficial to start with veggies and have protein and fats second. The most important thing to remember is that it's best to eat starches and sugars as late in the meal as possible.

One of the reasons a diet high in fruit and vegetables is healthy is because of the fiber it provides. Green veggies are the best source of fiber to get the ball rolling. These contain mostly fiber and very little starch. Start with your salad!

A calorie is a unit of heat. At a very basic level, a calorie is a calorie regardless of where it comes from, but that is not exactly accurate. Equal amounts of calories of fructose, glucose, protein or fat may release the same amount of heat when they burn, but they have vastly different effects on your body because they are different molecules.

Reactive hypoglycemia is what happens when our glucose level dips and before our body brings it back up by releasing extra glucose into the blood. This happens almost every time we consume simple carbohydrates (sugars) like hyper processed foods. It occurs because the high and rapid spike results in a rapid overproduction of insulin. We can feel side effects which include hunger, cravings, shakiness, lightheadedness or tingling in our hands and feet.

Americans love their hyperrepressed foods, especially at breakfast time. More than 2.7 billion boxes of cereal are sold every year in the United States alone. The most popular brand is Honey Nut Cheerios. These types of cereals are refined carbohydrates, loaded with fructose. These rapidly processed and absorbed sugars lead to a significant spike in blood sugar (both glucose and fructose). All the excess sugar can't be used as immediate energy since we are saturated. So instead of the newly digested molecules staying around in our system to be used for fuel, they are stored away as glycogen or fat.

It sounds counterintuitive, but more carbohydrates in a meal leads to less available circulating energy post digestion. More carbs for breakfast means less available energy later on.

In addition, that high sugar breakfast will deregulate our glucose levels for the rest of the day, so our lunch and dinner will also create big spikes. On top of that, first thing in the morning, when we are in our fasted state, our bodies are the most sensitive to glucose.

Regardless of which plant they come from, glucose and fructose molecules have the same effect on us.

"Natural" sugars are not any better. Agave nectar comes from over 200 different types of agave plants which are succulents, not cactuses as most people believe. It is about 80% fructose, compared to table sugar, which is 50% fructose. And although this means the glucose spike it causes is smaller, the fructose spike is bigger. Since agave has more fructose than table sugar does, it is actually worse for our health than table sugar.

Artificial sweeteners are also no better. In fact, they can be up to 1000x sweeter than table sugar. The taste of sweeteners increases our craving for sweet foods, even more so than sugar does. They also change the composition of our intestinal bacteria and break down the gut barrier, making food allergies and sensitivities worse.

The best sweeteners are the ones which come from whole fruit like dates or smashed bananas. However, there are some processed ones which are OK and have little impact on glucose and insulin levels. Some include:

- ALLULOSE. D-Psicose ($C_6H_{12}O_6$), also known as D-allulose, or simply allulose, is a low-calorie epimer (mirror image) of fructose and is used by some major commercial food and beverage manufacturers as a low-calorie sweetener. First identified in wheat in the 1940s, allulose is naturally present in small quantities in certain other foods like, jackfruit, figs, raisins, brown sugar and maple syrup. It's about 75% as sweet as table sugar.
- MONK FRUIT is a small Asian melon that has been used in Chinese medicine for centuries. Monk fruit extract is derived by crushing the fruit, then drying the juice into a concentrated powder that has no calories, carbs or sugar. Monk fruit extract is extremely sweet, which comes from an antioxidant in the fruit called Mogroside V. It's very concentrated and is 400x as sweet as sugar.
- STEVIA is a natural sweetener derived from the leaves of the stevia plant (Stevia rebaudiana). It has zero calories but is 200x sweeter than table sugar.

- ERYTHRITOL. This organic compound, a sugar alcohol, is used as a food additive and sugar substitute. It is naturally occurring but can also be made from corn using enzymes and fermentation. It is slightly less sweet, ~70%, than table sugar.

But when we're done eating, our organs are just getting started. They keep working for 4 hours on average after our last bite. The postprandial state is the period of our day when the largest hormonal and inflammatory changes take place. To digest, sort, and store the molecules from the food we just consumed, blood rushes to our digestive system and our hormone levels rise. Some systems are put on hold (including your immune system), while others are activated (such as fat storage). Insulin levels, oxidative stress and inflammation increase. The bigger a glucose or fructose spike after a meal, the more demanding the postprandial state is for our body to deal with because the more free radicals, glycation, and insulin release it has to manage.

We spend about 20 hours a day in the postprandial state because we have on average three meals and two snacks a day. Up through the 1980's, people didn't snack as often between meals, so they spent only 8-12 hours in the postprandial state. Snacking is a 1990's invention.

OTHER SIMPLE MEASURE TO BLUNG GLUCOSE SPIKES

Acetic acid in vinegar temporarily inactivates alpha amylase. As a result, sugar and starch are transformed into glucose more slowly, and the glucose hits our system more softly. This may partly explain why vinegar with your salad or diluted in a drink after a meal can blunt sugar spikes in the blood. Once acetic acid gets into the bloodstream, it penetrates our muscles where it encourages our muscles to make glycogen faster than they usually would, which in turn leads to more efficient uptake of glucose.

Acetic acid not only reduces the amount of insulin present, which helps us get back to fat-burning mode, it also impacts on our DNA, telling it to reprogram a bit so that our mitochondria burn more fat. Acetic acid also enhances the enzyme which activates nitric oxide, a compound which relaxes arteries. Taken with greens, which contain a lot of nitrates, acetic acid helps reduce blood pressure as well.

Any type of vinegar works. One tablespoon of rice vinegar in a bowl of white rice, as per Japanese tradition, will help steady your glucose levels. Balsamic vinegar in a salad is great. Apple cider vinegar is popular in the wellness world and adds some fermentation to the nutritional benefits.

Although vinegar can cause some reflux-associated burning, it does not appear to damage the stomach lining, since it's actually less acidic than gastric juices and even less acidic than Coca Cola or lemon juice. It does help to dilute it if you are drinking it, especially if you have reflux.

Fiber also has a dampening effect on alpha amylase, which is one of the reasons fiber helps flatten our glucose curves too.

Movement after a meal helps quite a bit. There may be something to the old Indian custom of "100 steps after a meal".

You can work out at any time up to an hour after the end of your meal to curb a glucose spike but 70 minutes is around the time when that spike reaches its peak, so using your muscles before that is ideal. Exercising after a meal seems to be the best option but before is also useful. In a study of resistance training in obese people, exercising before dinner, eating 30 minutes after the workout was over, lowered their glucose and insulin spikes by 35% as opposed to 48% drop if the exercise was started 45 minutes after dinner.

When you exercise and you haven't yet eaten, meaning that you are engaging in fasted exercise, your liver releases glucose into your blood to fuel the mitochondria in your muscles. The net effect of exercise however is to reduce oxidative stress, despite the increase in blood sugar. All that sugar ends up getting burned by your active muscles.

WHAT TO DO WHEN YOU'RE HAVING A CRAVING

Sometimes you may get hit with a craving for sugar. Giving a craving a 20-minute cooling off period is helpful. After a glucose drop the liver quickly, within 20 minutes, releases stored glucose from those reserves into our bloodstream bringing our levels back to normal. At that point, the craving often dissipates.

If the 20 minutes have come and gone and you're still thinking about that cookie, set it aside for dessert at your next meal.

Then try these craving killers:

- take a walk
- a big glass of water with a big pinch of salt
- licorice root tea
- peppermint tea
- pickle juice
- chewing gum
- brush your teeth

Certainly, sugar sweetened beverages, including juices, are loaded with sugars and should be avoided. Alcohol can also be problematic, but it is mostly what you mix them with. Alcohols that keep our levels steady are wine (all forms) as well as spirits (gin, vodka, tequila, whiskey and even rum) if consumed on the rocks (only with ice). We can drink these on an empty stomach and they don't cause a glucose spike. Watch out for mixers however. Adding fruit juice, something sweet, or tonic will cause a glucose spike. Drink your alcohol on the rocks, with sparkling water or soda water or with some lime or lemon juice. When it comes to beer, which causes spikes because of its high carb content, ale and lager are preferable to stout (such as Guinness) or a porter.