THE ENERGY BLUEPRINT

Nutrition Myths and Misconceptions

In this lesson we'll diverge from the fat loss stuff and talk about some basic nutrition hot topics and controversies that I'm sure you have come across.

It's really easy to get confused in the sea of nutrition science, especially on nuanced topics where people like to take polarizing stances.

So, the purpose of this lesson is to address some of those areas and help clear up the air.

Is Organic Produce Worth The Cost?

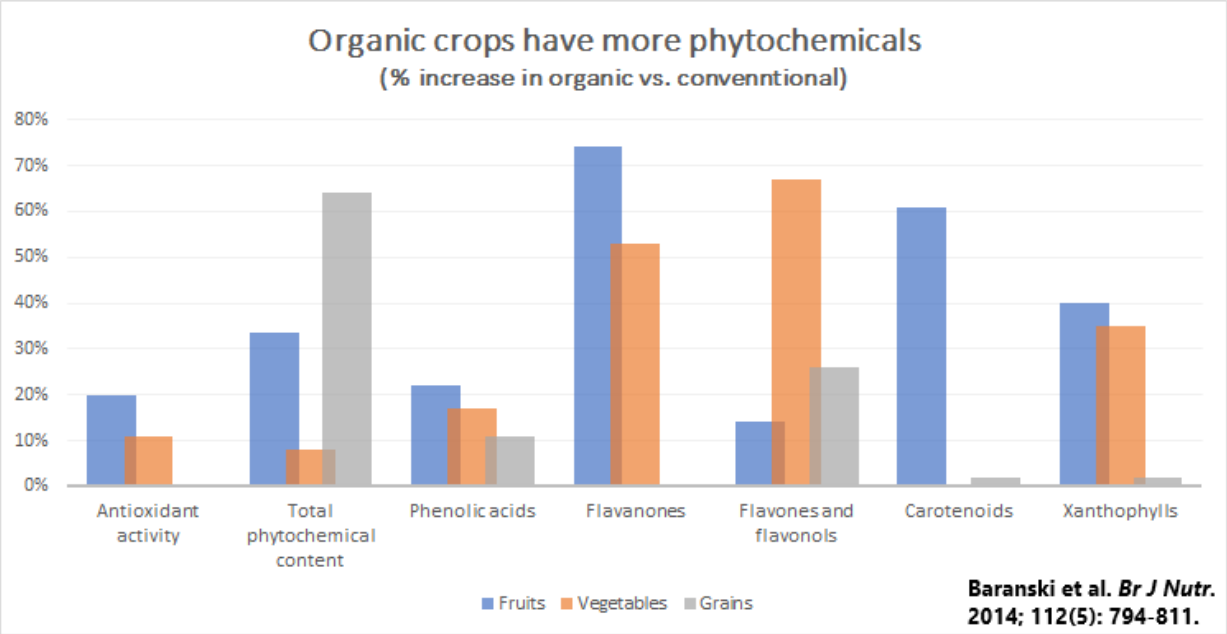
Everyone has their reasons for buying or avoiding organic.

- Surveys of people's eating habits have found that people who buy organic are most concerned with the health effects of eating it, with lesser concern for the environmental, social, and economic sustainability of organic foods.

- For those who don't buy organic, surveys suggest that one important reason is the cost — on average, organic foods are 47% more expensive than their conventional counterparts.

While I can't tell you whether purchasing organic is worth the cost, I can talk about the health effects of eating organic foods. These can be distilled down into two main categories: nutritional content and contaminant concentrations.

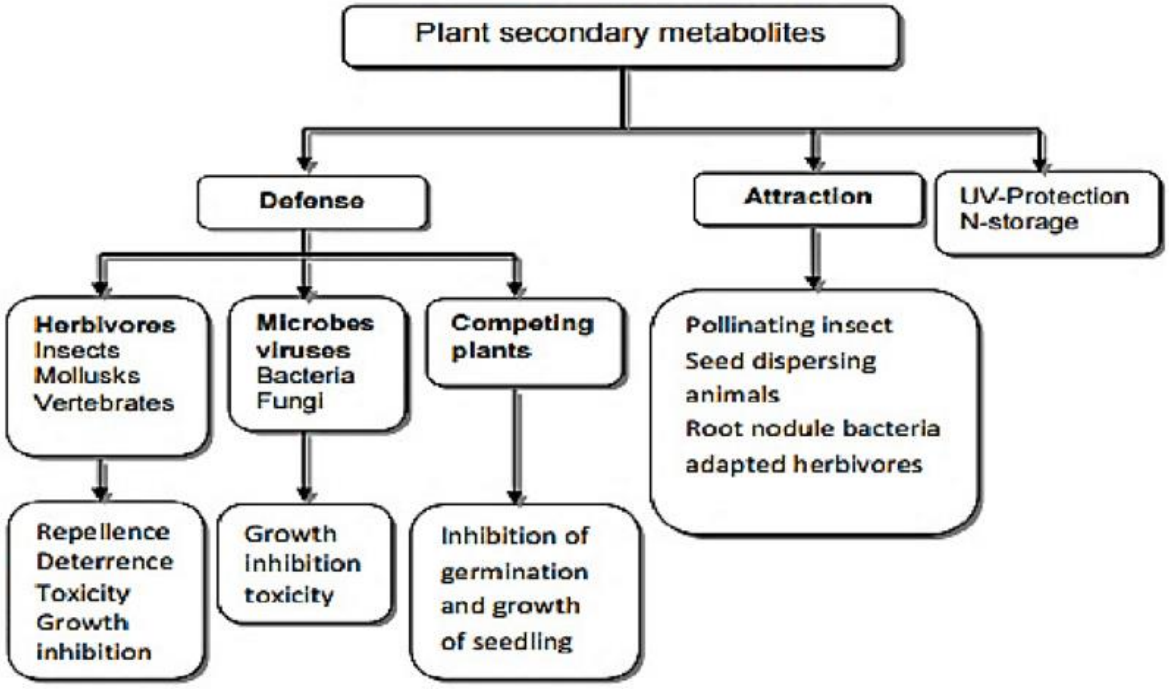
The largest meta-analysis to date, aggregating data from 343 studies around the world, found that, while there weren't meaningful differences between organic and conventional produce in terms of macronutrients, vitamins, or minerals, organic crops had 17% more total antioxidant activity and 18–69% greater concentrations of specific phytochemical compounds than conventional crops.



Overall, the meta-analysis demonstrated that **switching from conventional to organic foods would increase phytochemical intake by the equivalent of 1–2 servings of fruits and vegetables**, without any change in actual food or energy intake.

Remember, phytochemicals are powerful hormetic stressors that ultimately benefit our ability to detoxify the body and are one of the reasons why eating a diet rich in plants is associated with a reduction in numerous diseases.

The higher concentration of phytochemicals with organic farming is likely the result of greater stress on the plant that signal it to produce more phytochemicals to help defend against wounds, pest attacks, and disease. Less pesticide and fertilizer use with organic farming means a greater stress exposure to organic crops.

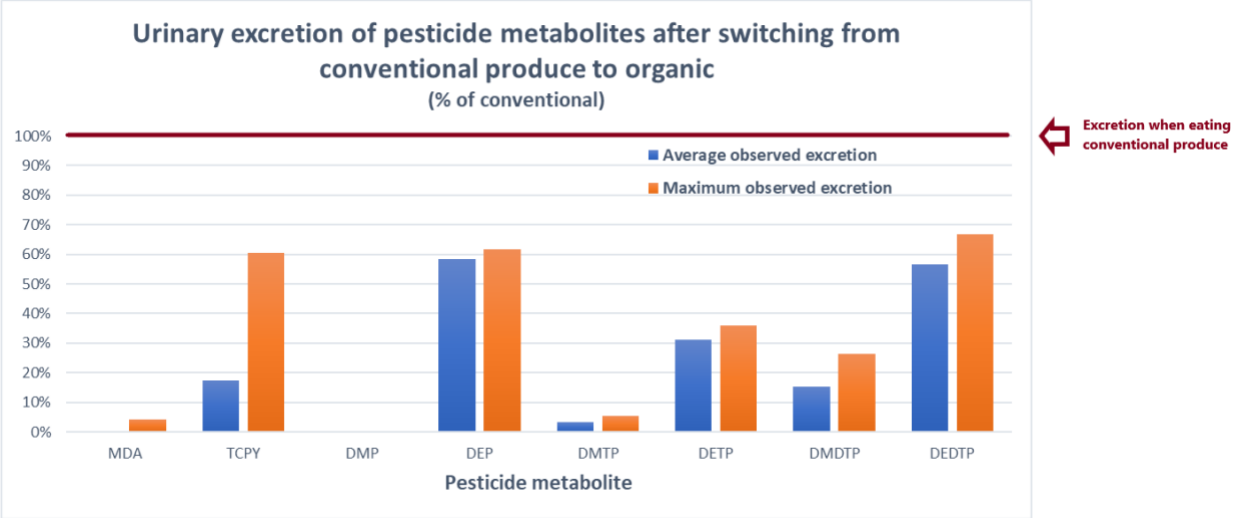


Another huge difference between organic and conventional produce relates to what organic crops don't contain: synthetic pesticides. Although some pesticides are approved for use in organic farming systems, **organic farming generally relies on crop rotation, biological control through employing natural enemies of pests, and hygiene practices**. Of the pesticides that are used, most are of far less

toxicological concern than their synthetic counterparts because they are part of the human diet (e.g., sulfur, potassium bicarbonate, and coconut soap) or are used in pest traps rather than being applied to the crop.

Many synthetic pesticides commonly used in conventional agriculture have been linked to cancer, hormone disruption, and neurological disorders. Exposure can be especially problematic for pregnant women, infants, and children who are in developmental stages where pesticide exposure can have profound developmental effects.

Importantly, we have interventions in children and adults, including pregnant women, showing that switching from conventional to organic produce significantly reduces biomarkers of pesticide exposure in as little as 5–7 days. Fresh produce consumption correlates with pesticide concentrations in the body, further supporting the notion that eating conventional produce is a primary source of pesticide exposure.



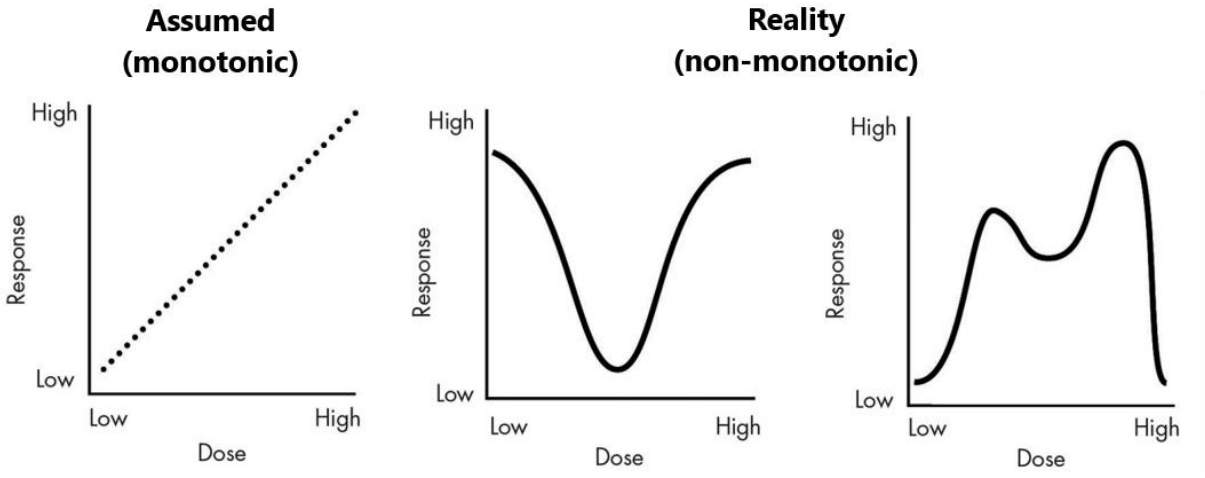
Several studies have reported worse health outcomes with eating conventional produce compared to organic:

- One study following over 145,000 women and over 24,000 men for more than a decade found that eating organic produce correlated with a lower risk of heart disease while eating conventional produce did not, even after adjustment for a healthy lifestyle.

- Another study involving 155 men found that eating conventional produce was associated with lower sperm counts and greater concentrations of dysfunction sperm, while eating organic produce was associated with better semen quality.

- A third study involving 325 women reported that those who ate more conventional produce had a lower likelihood of getting pregnant and avoiding miscarriage.

Despite all this research, there is a persistent belief that pesticide exposure from conventional produce isn't a health concern since the concentrations are well below established safety limits. The issue is that these safety limits are based on an outdated model of toxicology that assumes all chemicals follow a monotonic, or linear, dose-response relationship.



Basically, a monotonic relationship assumes that higher exposure to a chemical leads to greater health effects than lower exposure. It's easily captures in the

colloquialism *the dose makes the poison*. And it is true to an extent, since even drinking water can kill you if you drink enough within a short enough time frame. Accordingly, most toxicology testing looks at very high exposure levels to predict consequences of much lower doses and to establish safety limits.

But most chemicals don't follow this assumed monotonic dose-response relationship. That assumption has been heavily criticized as being "dogma" from the 16th century. Rather, numerous experiments with hormones, drugs, and other chemicals that act via hormonal mechanisms have shown that it is very common for the dose-response curve to be non-monotonic and have notable health effects at low doses below current safety limits.

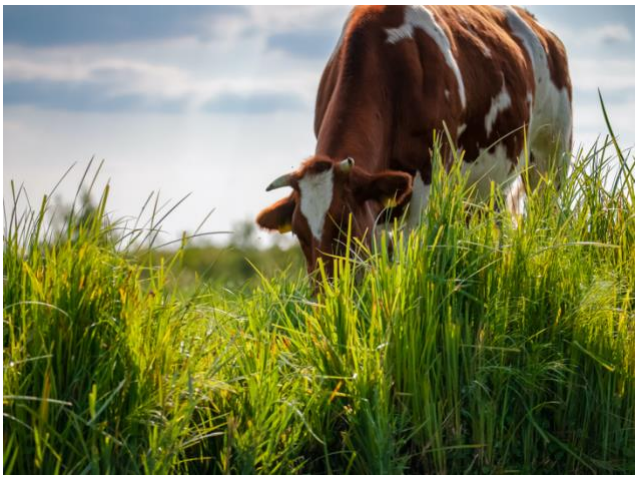
Thus, toxicological testing of various synthetic pesticides may not accurately capture the true risk of exposure. This has been the case with one of the most widely used pesticides on corn, soybeans, and wheat — glyphosate (found in Roundup) is carcinogenic at low doses untested in traditional toxicology studies.

Although not a pesticide, BPA (bisphenol A) is another example where an avalanche of research has demonstrated consistent low-dose effects on multiple organ systems, all at currently believed safe exposure levels.

These low-dose exposure issues are coming to light because low doses of these chemicals are being tested in research. A lot of chemicals and synthetic pesticides don't have this type of testing available, so we don't know if the low exposures we get from eating conventional produce are actually harmful, although emerging research certainly suggests that is a likely scenario.

So, while eating organic is unlikely to help you lose more weight, it does come with a variety of health benefits from its higher phytochemical and lower toxicant content.

Is Grass-Fed Beef Healthier Than Conventional?



Just as with organic produce, a lot of people opt for grass-fed beef with the belief that it is healthier than conventional beef. Unlike organic produce, however, the case for nutritional superiority is weak.

I know that some of you may think I'm crazy, but it's true — there simply isn't a lot of data suggesting that grass-fed beef is healthier than conventional grain-fed beef.

In the largest study to date, researchers from Michigan State University analyzed the nutritional content of 750 samples of commercially available grass-fed beef loin from 12 producers across 10 states in the U.S. The beef was supplied by farms raising as little as 25 head of cattle, to farms raising as many as 5,000 head.

The differences from conventional beef were minimal and mostly limited to the fat content. On average, **grass-fed beef was way leaner than conventional, providing only 0.7 grams of fat per 100 grams of beef steak. Compare that to 5.6 grams in conventional beef.**

That 5-gram difference in total fat content translates to 45 Calories per 100 grams of beef, which can easily add up for someone eating a lot of beef and who has a low energy requirement. Still, one could just opt for leaner cuts of conventional beef, such as eye of round which has 2.5 grams of fat per 100 grams of beef.

Plus, there was considerable variation among the samples, with the total fat content ranging from 0.08–3.6 grams per 100 grams of beef. This variation was present with individual fatty acids too.

I want to be generous and use the best possible findings for grass-fed beef. That is, rather than look at the averages among the samples, **I'm going to use the maximum or minimum value that paints grass-fed beef in the best light, just so you can see how insignificant the differences from conventional beef are.** Accordingly, grass-fed beef had:

- 20x less omega-6
- 2.5x more omega-3
- An omega-6 to omega-3 ratio of 1, compared with 16
- Similar amounts of CLA

Grass-fed vs. conventional beef loin fatty acid composition (mg per 100 g beef)			
Fatty acid	Grass-fed average	Grass-fed range	Conventional
Total	720	84–3,610	5,670
Saturated	320	29–1,790	2,345
Monounsaturated	320	15–1,710	2,710
Polyunsaturated	80	25–224	380
Omega-6 Linoleic acid Arachidonic acid CLA	67 47 17 1.5	17–220 12–168 4–50 0.05–23	320 250 46 22
Omega-3 Alpha-linolenic acid EPA DPA DHA	14 6 3.5 4 0.3	1–48 0.3–30 0.2–14 0.4–10 0.05–1	20 10 2 8 0
Omega-6 to -3 ratio	9.9	1–96	16

When reported like that, grass-fed beef seems pretty awesome, right? But let's take a closer look...

The omega-6 to omega-3 ratio is excellent and right in-line with what our ancestors ate. But **focusing on the omega-6 to omega-3 ratio of isolated foods is basically useless since what matters is the ratio of our overall diet**. While the ratio seems good, it will easily be drowned out by other foods we eat since the absolute amounts of omegas are so low.

- Grass-fed beef had 20x less omega-6, but this corresponds to a difference of just 300 mg per 100 grams of beef. If you eat an entire kilogram of grass-fed beef, or 2.2 pounds, then you're avoiding only 3 grams of omega-6 fatty acids. That's 3x less than what you would get in an ounce of walnuts and equivalent to an ounce of almonds.

- Grass-fed beef had 2.5x more omega-3 fatty acids, but this corresponds to a difference of just 28 mg per 100 grams of beef. Again, if you eat a kilogram of grass-fed beef, you're getting a meager 280 mg more of omega-3 fatty

acids. Plus, 200 mg of that would be from ALA, which is not readily converted into EPA and DHA — less than 6% is turned into EPA and less than 3% to DHA.

If we look exclusively at EPA and DHA, a kilogram of grass-fed beef gives you, at most, 140 mg of EPA and 10 mg of DHA. You can get the same amount of EPA and 14x more DHA from eating just 14 grams, or half an ounce, of king salmon, which has 1 gram of EPA and 1 gram of DHA per 100-gram fillet.

- Grass-fed and conventional beef had equivalent amounts of CLA, or about 20 mg per 100 grams of beef. That's nothing. One of the best-controlled studies on the effects of CLA in humans found that supplementing with 2.2–2.7 grams of CLA per day for several weeks had no significant effects on health markers other than a marginal reduction in triglycerides. To obtain this level of CLA intake would require eating 10–12 kg (22–27 lbs) of beef.

Now, many of these differences are probably appreciable when using isolated tallow, since it is pure fat. However, when opting for beef, especially lean beef, there isn't that big of a difference between grass-fed and conventional cattle. So, **when you hear people talk about how grass-fed beef has more omega-3 or CLA or whatever, we need some context for that statement. Three pennies are more than one penny, but it's still not a lot of money!**

The Michigan State University study also looked at concentrations of minerals and antioxidants. Again, there was wide variation in many of these compounds, including iron, zinc, copper, selenium, vitamin E, and β-carotene. On average, amounts of most were higher than conventional beef, but not to an appreciable extent.

In short, **there are differences between grass-fed and conventional beef, with grass-fed being more nutritionally dense. However, the differences are small**

and of little real-world significance, especially considering that eating other foods can easily overshadow any contributions from the beef.

Aside from nutritional content, however, there is a potential superiority for grass-fed beef when it comes to pathogens and toxicants.

Beef can be contaminated with a variety of bacteria found in fecal matter, the most notable being *E. coli O157:H7*. Although grass-fed and conventional beef have similar levels of E. coli in their feces, **commercial beef is more often contaminated with E. coli due to how the cattle are slaughtered and brought to market** (e.g., meat and fat coming from multiple animals and slaughter rates of a couple hundred head per hour).

Plus, **the bacteria on conventional beef demonstrate a greater resistance to common antibiotics**, meaning that any food poisoning has a chance of being more severe. Of course, this entire issue is circumvented by simply cooking your meat thoroughly, but that runs into other problems with palatability and the formation of carcinogens from high-heat cooking methods.

As for toxicants, many persistent organic pollutants are lipid-soluble and stored in the fat of animals, including humans. It makes sense that cattle which are exposed to higher levels of environmental pollutants and pesticides on their feed would contain more toxicants in their meat. However, **one of the most common pesticides — glyphosate — doesn't appear to negatively impact the health of cattle or show up in their meat or milk**.

Finally, we don't have a lot of research on the health effects of eating beef from cattle that were stressed at slaughter. We've known since at least the 1970s that

stress within 48 hours of slaughter causes glucocorticoids to infiltrate the meat, making it more acidic and less tender. However, whether slaughter stress or chronic stress from the factory farm environment impacts the nutritional content of beef hasn't been investigated.

In short, **there may be small advantages to eating grass-fed meat in terms of minimizing the risk of exposure to antibiotic resistant bacteria, but there doesn't seem to be notable differences in the beef's nutrient and toxicant concentrations.**

This, of course, ignores the environmental and ethical considerations that do pose good rationale for choosing grass-fed beef over conventional.

Are GMOs Safe?

Genetically modified organisms (GMOs) are defined by the World Health Organization as "organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination."

Since their entrance into the world market in the 1990s, there has been considerable debate in the scientific and consumer communities over the perceived benefits and risks that would result from the widespread adoption of GMOs in the food supply.

Several arguments have been put forth in favor of GM crops, including increased crop yields, increased nutritional value, and improvement in food processing.

- Increased crop yields are notable in light of the ever-growing world population and simultaneous reduction of arable land to cultivate crops. The current world population of 7.6 billion is expected to reach 8.6 billion in 2030, 9.8 billion in 2050, and 11.2 billion in 2100. We need at least a 2.4% increase in crop yield each year to sustain this growth, but current increases amount to only 0.9–1.6%.

- Improved nutritional value and food processing capabilities are more subjective, with benefits being largely context-dependent. For instance, the genetic engineering of rice to have higher beta-carotene (called Golden Rice) has the specific goal of reducing vitamin A deficiency in developing nations where rice is a staple component of the diet. In developed nations where vitamin A deficiency is not of as great concern, the increased nutritional value of Golden Rice is arguably not as great a benefit of GMOs.

  Similarly, a GM potato was created to reduce acrylamide formation when cooked at high temperatures, such as when potatoes are processed into French fries or potato chips. That's probably a good thing for the general population, but it isn't a great reason to eat GMOs if you stray away from fried foods, as you should.

On the other hand, there are both direct and indirect risks with eating GMOs.

- Direct effects are best demonstrated by the ways in which genetic modification expresses itself — not always in ways we can anticipate. Examples include the expression of allergenic proteins and changes in metabolite concentrations, including toxic ones, that result from poorly understood regulatory pathways in plants in response to genetic modification.

For example, Starlink maize was classified as “potentially allergenic” in the mid 1990s by the USDA’s Scientific Advisory Panel, and was banned from human consumption in 1998 by the EPA.

- Indirect effects come from how GMOs are used in agricultural practices. Currently, most GM crops are aimed at providing the plant with inborn resistance to either pests or pesticides or both. One example is Bacillus thuringiensis (Bt) crops, which have genes from the Bt bacterium inserted into their DNA to have them produce their own pesticides and therefore require less pesticide application from farmers. On the other hand, crops like Roundup Ready crops are genetically modified to resist the effects of the pesticide glyphosate, so spraying can be done more frequently.

There is still much work to be done on determining the short- and long-term effects of widespread GMO acceptance. Many of the risks of GMOs are speculative, but they are scientifically plausible. Whether they are healthy or harmful is not a black and white issue and not amenable to a simple “yes” or “no”.

Until the debate is settled, you can actively avoid GMO products by looking for foods certified to be non-GMO or certified organic, since organic foods cannot contain GMOs.

And this is really the central issue — transparency. In Europe, GMOs must be labelled as such, but there is no such requirement in the U.S. and Canada. Yet, depending on cultural worldview, 53–83% of Americans believe that the federal government should require mandatory GMO labeling and are willing to pay an extra 29–45% more money to avoid purchasing GMOs.

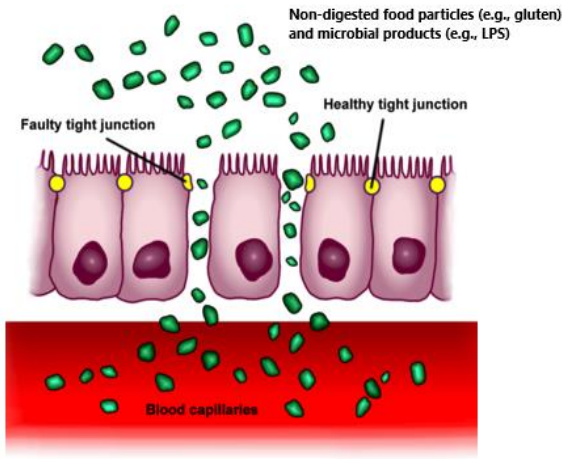
Should I Go Gluten-Free?

Wheat entered the human diet just under 10,000 years ago as humans transitioned to relying more on agriculture and less on hunting and gathering. It quickly became a worldwide staple, and current global wheat production is over 750 million tonnes per year. The average U.S. adult is no stranger, eating roughly 132 pounds of wheat per year.

But does wheat deserve its place in the human diet, or is it contributing to many of the maladies we see in developed countries? There has been a surge of alternative health circles promoting the avoidance of wheat for optimal health, while conventional views hold that there is nothing wrong with eating wheat products.

The truth is somewhere in the middle.

Everyone experiences an increase intestinal permeability from eating gluten, even otherwise healthy people. This so-called “leaky gut” is caused by an interaction between gluten and zonulin, a protein in our gut that regulates the integrity of tight junctions within the intestinal tract.

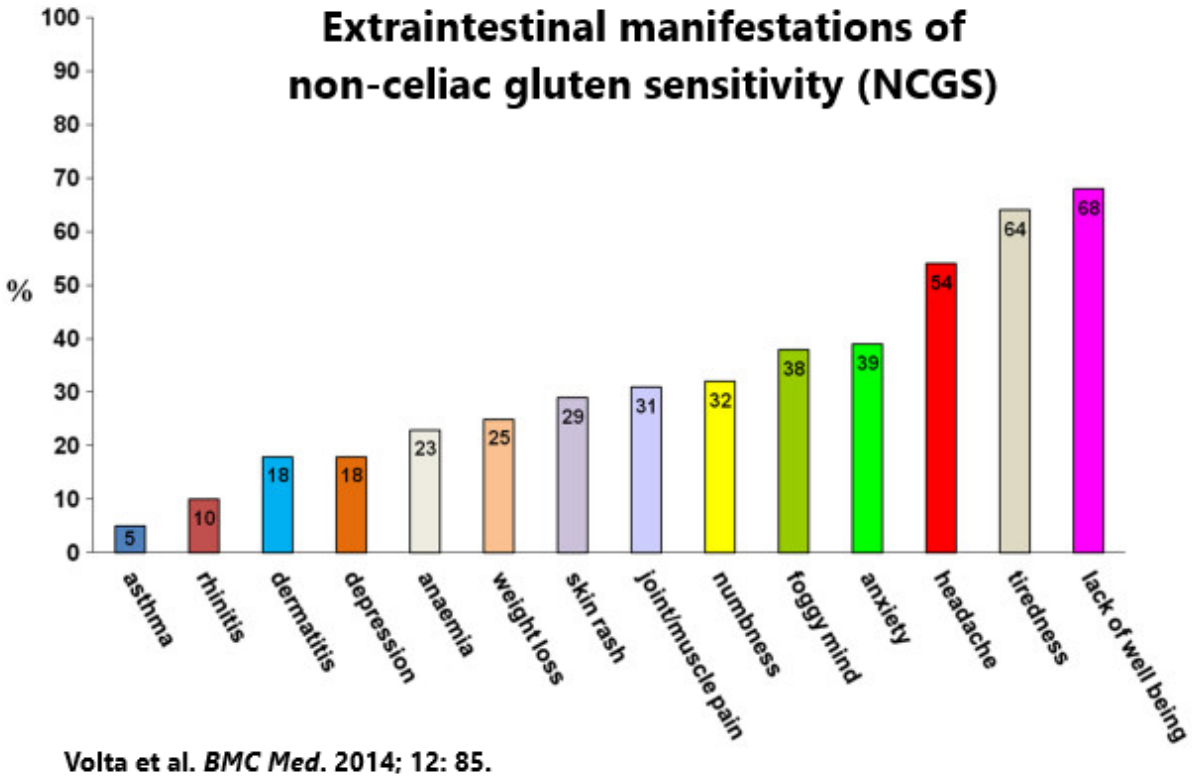


That increase in intestinal permeability isn’t necessarily problematic, but it definitely can be depending on other aspects of the diet. For instance, it could theoretically increase the absorption of any toxicants on your food, such as pesticides. It can also lead to an increase in the absorption of inflammatory microbial compounds like lipopolysaccharides (LPS).

For some people, the negative effects of eating gluten severe enough to make following a wheat-free or gluten-free diet mandatory: those who have a wheat allergy (allergic reaction), those who have Celiac disease (an autoimmune condition), and those who have non-celiac gluten sensitivity (NCGS; a food sensitivity).

The effects of consuming wheat and gluten in people with celiac disease and wheat allergies are well-established, in most causes leading to a diagnosis early in life. Comparatively, NCGS lacks rigorous diagnostic criteria and remains more elusive than other gluten-related conditions, despite up to 13% of people believed to have it.

One reason for the difficulty in diagnosing NCGS is because **many of the symptoms associated with NCGS are nonspecific, such as fatigue, headache, anxiety, and an overall lack of wellbeing.**



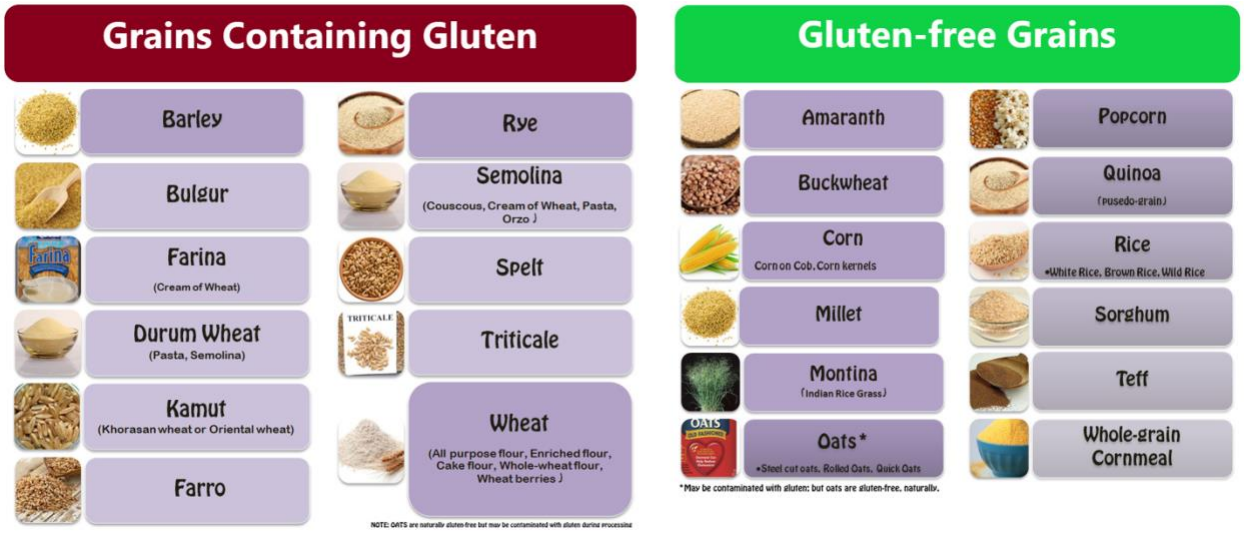
Volta et al. *BMC Med*. 2014; 12: 85.

Moreover, there is overlap with general intestinal distress from fermentable, poorly absorbed, short-chain carbohydrates (fermentable, oligo-, di-, monosaccharides, and polyols (FODMAPs)). Some research has suggested that NCGS is owed to a combination of FODMAP and gluten sensitivity, since following both FODMAP-free and gluten-free diets lead to symptomatic improvement in people with NCGS.

It is currently believed that people with NCGS elicit a systemic immune response towards microbial products (such as LPS) that inappropriately enter the bloodstream as a result of gluten-induced intestinal permeability. Accordingly, reducing the consumption of FODMAP-rich foods will help those with NCGS by virtue of reducing the amount of microbial products being absorbed.

So, from a big picture perspective, **there's a chance that eating wheat could be having negative effects on your quality of life, effects that may not be overtly noticeable until you stop eating wheat regularly.**

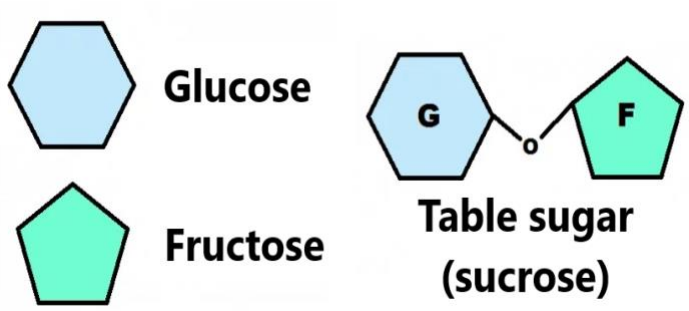
Thankfully, avoiding gluten is pretty easy these days, and there are plenty of gluten-free grain options available if you want a replacement.



Is Fructose Harmful?

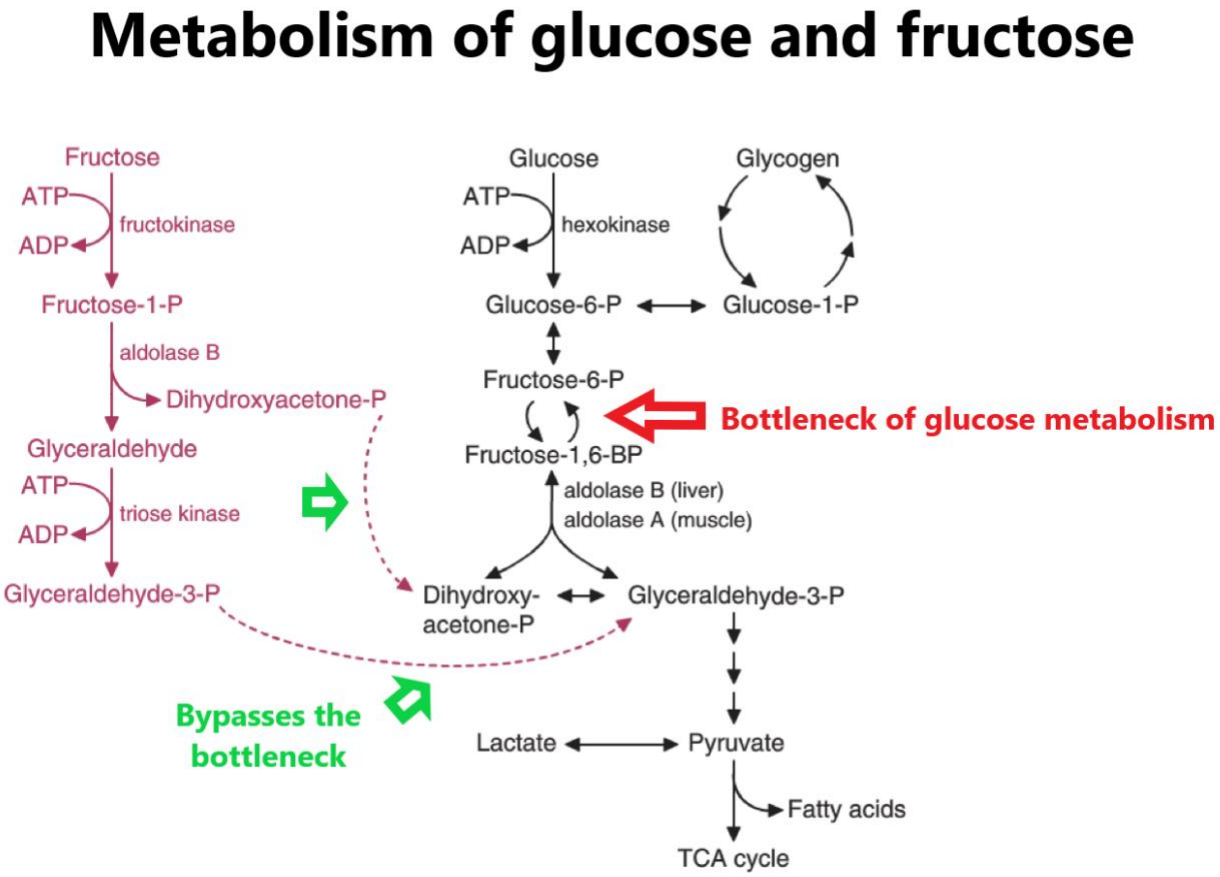
Fructose has gotten a bad rap lately, being blamed for most (if not all) of the harmful effects we see when people drink soda and other sugar-sweetened beverages.

Now, there is certainly reason to minimize the consumption of added sugars in the diet, especially those from sugar-sweetened beverages. Numerous observational and intervention studies have demonstrated that consuming added sugars are associated with cardiovascular diseases and type II diabetes secondary to promoting excessive energy intake and obesity.



However, the battle against sugar-sweetened beverages has become a battle against fructose. Even in the scientific field, fructose has been called a "weapon of mass destruction" and compared to alcohol in terms of its metabolic effects. Of course, these hyperbolic positions and what is called the "fructose hypothesis" are not without pushback from other researchers.

The battle against fructose centers on the fact that, unlike glucose, **fructose is metabolized primarily within the liver and bypassess a critical bottleneck step in glycolysis** — the process through which we break down glucose into energy.



When too much energy is available, this bottleneck step prevents more glucose from being broken down, since it isn't needed. However, since fructose side-steps this bottleneck, it continues to be broken down no matter how much energy is available.

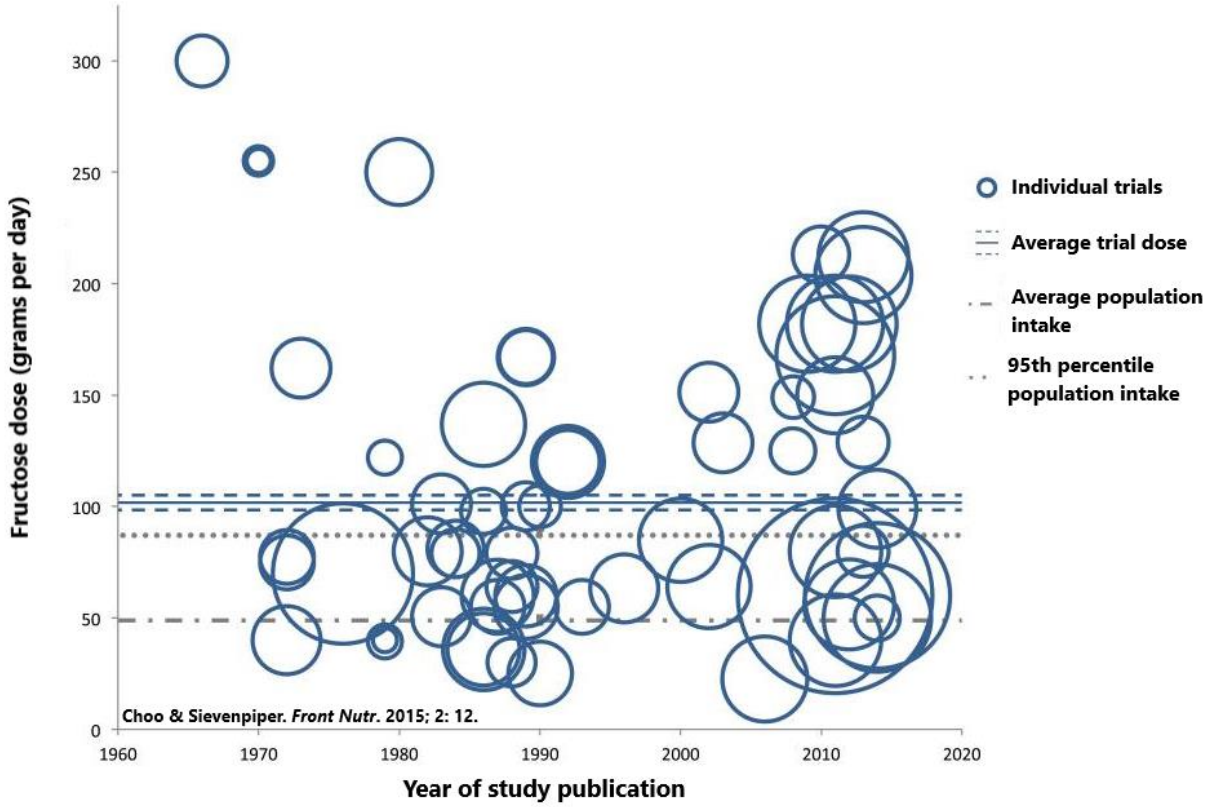
If you have more energy than you need, then the extra gets turned into fat within the liver — a process called *de novo lipogenesis* (DNL) — and stored either as body fat or as liver fat if the amount of fat being created can't be exported from the liver at an adequate rate.

Since DNL is greater with fructose than with glucose, this has been the basis of arguments that fructose is uniquely harmful.

What gets left out of this argument against fructose, however, is that DNL is not the main fate of fructose. When researchers create radioactive isotopes of fructose to follow its metabolism throughout the body, 50% of ingested fructose is converted into glucose, 25% into lactate, at least 15% into liver glycogen, and only 10% oxidized directly for energy or converted to fat.

Additionally, **the battle against fructose relies heavily on studies with any combination of three huge limitations: the study was conducted in mice and rats, the study used unrealistically high doses of fructose, and the study provided the fructose in isolation.**

Consider, for example, a meta-analysis of 80 human studies in which fructose was exchanged for other carbohydrates in the diet, like starch and glucose, in order to determine how it affects cardiometabolic health. The average dose of fructose was 100 grams per day. That's double the average American intake of 49 grams per day, and still higher than what 95% of the population consumes.



Even with these unrealistically high doses of fructose, numerous meta-analyses have reported that fructose doesn't have a uniquely harmful effect on body weight, blood lipids, or the development of fatty liver when directly compared to other types of carbohydrates, and may in fact reduce blood pressure and benefit glycemic control.

The only time fructose shows harmful effects is when it is added to the diet on top of what is already being consumed, thus leading to an excess energy intake. This isn't an issue with fructose per se; it is an issue with consuming too many calories. This plays right into the issue with sugar-sweetened beverages since they promote overeating and consequential weight gain.

Also, we shouldn't confuse fructose provided as added sugars with fructose provided by whole fruit.

- A systematic review of 16 randomized controlled trials found that increasing whole, fresh fruit consumption reduces energy intake and promotes weight maintenance or modest weight loss.

- A meta-analysis of 155 studies found that substituting fresh fruit into the diet lowers HbA1c without notably affecting fasting glucose or insulin levels.

Basically, it is a good idea to minimize our consumption of added sugars, especially in the form of sugar-sweetened beverages. But there is no reason to fear fructose or believe that it is uniquely harmful.

Are Sugar Substitutes Safe?

I think it is safe to say that there is little disagreement on the negative health effects of added sugar in the diet, especially from sugar-sweetened beverages like soda. The food industry has capitalized on this concern by swapping out sugar for three main types of sugar substitutes:

- Artificial sweeteners,
- Natural nonnutritive sweeteners, and
- Sugar alcohols.

My goal here is to briefly outline some of the controversy and health effects of each.

Artificial Sweeteners

Artificial sweeteners are synthetic sugar substitutes that are much sweeter than sugar, provide little to no calories, and don't affect blood glucose or insulin levels when eaten. There are currently six FDA-approved artificial sweeteners on the market: Ace-K, Advantame, Aspartame, Neotame, Saccharin, and Sucralose.

Artificial sweetener	Sweetness relative to table sugar	FDA safe intake level *	Safe intake level as tabletop sweetener packets **
Acesulfame Potassium (Ace-K)	200 x	15	23
Advantame	20,000 x	32.8	4,920
Aspartame	200 x	50	75
Neotame	10,000 x	0.3	23
Saccharin	400 x	15	45
Sucralose	600 x	5	23
* mg per kg body weight | ** for a 60 kg (132 lb) adult			

The use of artificial sweeteners remains a point of controversy among many due to beliefs that they are toxic and can cause weight gain and metabolic dysfunction. The reality is a lot more nuanced.

From a toxicity standpoint, the FDA has established an Acceptable Daily Intake (ADI) level for each sweetener, which represents the amount believed to be safe for consumption every day for a lifetime. The ADI is typically 100x lower than the

dose of the sweetener that caused toxicity in animal studies, which provides a buffer to ensure true safety.

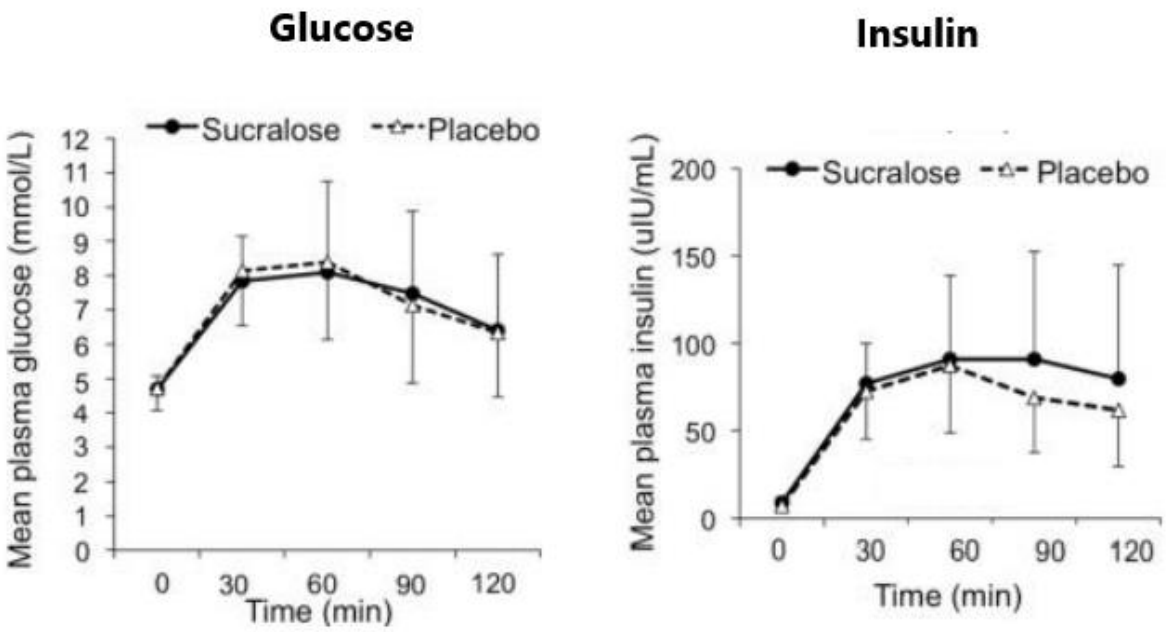
Although you can find any number of websites on the internet claiming that artificial sweeteners cause cancer, that is simply not the case. **Any validity to those claims comes from test tube studies where cells and incubated with the compound or animal studies where the artificial sweetener is fed at unrealistically high doses.**

That isn't to say that there is no risk, however, as you can meet the ADI for some of the artificial sweeteners if you binge on "diet" foods, especially since many food products don't list how much of an artificial sweetener it contains. But even then, the safety limit is 100x lower than the level shown to be toxic in animals.

Overall, regular use of artificial sweeteners is unlikely to be toxic. **Using diet soda as one example, which contains a combination of aspartame and Ace-K, and you would need to drink 15 cans just to hit the ADI for those two artificial sweeteners.** That's not very realistic.

Now, there has been an emerging concern about the effects of sucralose on glycemic control. Two studies published in 2018 suggested that regular use of sucralose at realistic doses reduces insulin sensitivity and worsens glycemic control.

- The first study had 15 healthy adults supplement with 200 mg of sucralose, equivalent to about 3 cans of sucralose-sweetened diet soda, every day for 4 weeks. There was a 12% reduction in insulin sensitivity and compensatory increase in the insulin response to an oral glucose tolerance test, despite no change in the glycemic response.



Lertrit et al. *Nutrition*. 2018; 55-56: 125-130.

- The second study had 61 healthy adults consume 160 mg of sucralose, just 15% of the ADI, every day for 2 weeks. Again, insulin sensitivity was reduced by about 15% compared to a group of adults that didn't supplement with sucralose.

The big pickle with these studies, however, is that we have a third study using a much higher amount of sucralose — about 1,000 mg — daily for a longer period of time — 12 weeks — that reported no effect on glycemic control or insulin sensitivity in 48 healthy adults. It's possible that any negative effect of sucralose is transient and disappears with regular use.

Also, we have to remember that weight loss itself has a far more profound effect on improving metabolic health, so if using some sucralose makes dieting more successful, then that should be reason enough to keep using it.

Of course, it isn't hard to find a news article or blog post talking about how artificial sweeteners cause weight gain and obesity. These articles all rely on

observational studies showing that artificial sweeteners, most commonly consumed as diet soda, are linked to weight gain and obesity. While it is tempting to believe that drinking diet soda caused weight gain, it is more likely that **people become obese and then begin to consume more artificial sweeteners in an attempt to lose weight.**

All we need is a little logic:

- Diet soda is associated with less healthy lifestyle habits, like being less physically active, so is it any surprise that obese people drink more diet soda than lean people?

- Plus, other observational research shows that the use of artificial sweeteners is associated with an intent to lose weight, so again is it any surprise that someone who is overweight would drink more diet soda?

- One reason their use is associated with an intent to lose weight is because diet soda and artificial sweeteners provide zero calories. How can a calorie-free food cause weight gain?

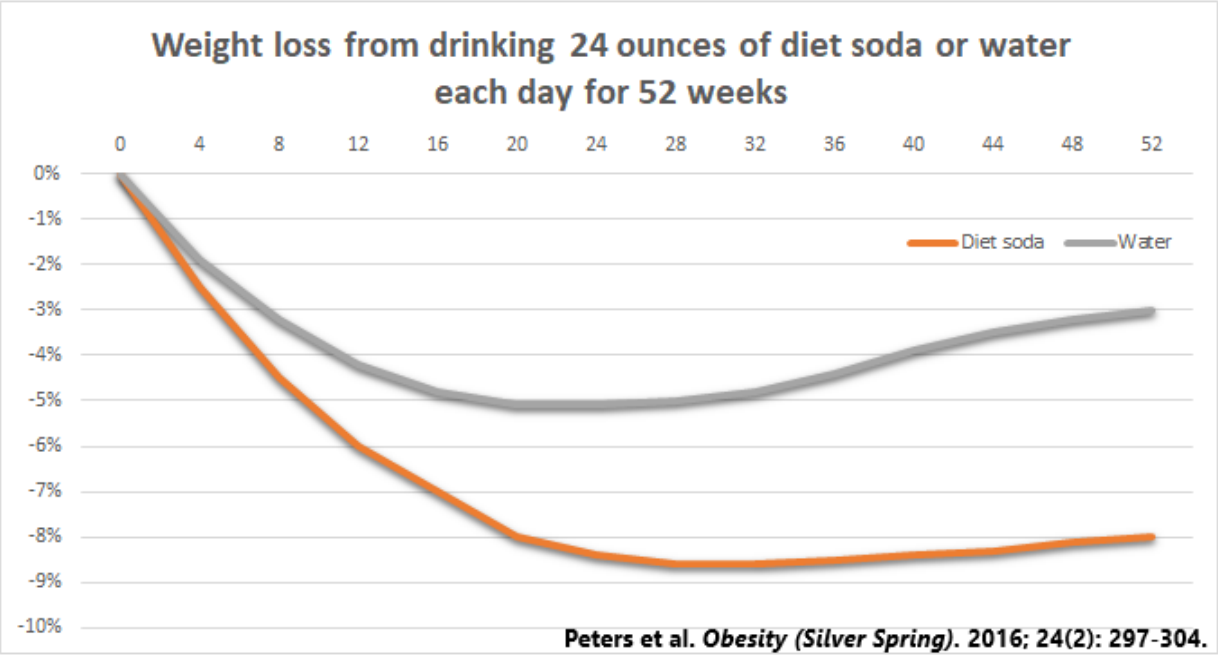
- Perhaps it stimulates appetite or messes with hormones, but if that were the case, then why do emaciated eating disorder patients with anorexia and bulimia drink 5–7 cans, or about one 2-liter bottle, of diet soda per day?

  A systematic review found that only 10 of 60 studies investigating how artificial sweeteners use affect short-term appetite and food intake have reported increases. The other 50 studies reported either no effects (n=39) or reductions in appetite and food intake (n=11).

Finally, we have controlled interventions clearly demonstrating that diet soda and artificial sweeteners help folks lose weight, especially when they replace things like regular soda in the diet.

For instance, a meta-analysis of 15 randomized controlled trials reported that substituting artificial sweeteners for sugar modestly reduced body weight, fat mass, and waist circumference among people with overweight and obesity.

One of the largest studies to date recruited over 300 overweight and obese men and women to drink 24 ounces of diet soda or water per day for both a 12-week weight loss program and a one-year weight-maintenance follow-up. Not only did the diet soda drinkers lose 50% more weight and have less hunger than the water drinkers while dieting, they were better able to maintain their weight loss over the following year.



Despite the benefits of artificial sweeteners and diet soda on weight loss and hunger, the caveat relates to the health halo effect. I'm sure you have heard the stereotypical example of someone eating large fast food meals alongside a diet soda — as if getting a diet soda allows for eating more of other calorie-dense foods.

All in all, the current research does not really warrant the conclusion that artificial sweeteners are really harmful to human health in typically consumed amounts, and shows that they can be helpful for weight loss.

However, if you are still concerned with adverse effects from them, we suggest you simply opt for natural non-nutritive sweeteners like stevia or monk fruit, which are discussed next.

Natural Nonnutritive Sweeteners

Natural nonnutritive sweeteners are naturally occuring sugar substitutes with little to no caloric value. Two natural nonnutritive sweeteners are approved for us by the FDA: steviol glycosides and monk fruit extract.

You'll notice that I said steviol glycosides rather than stevia. That was for a reason. Stevia leaf is not allowed to be used as a sweetener by the FDA because most of stevia's adverse effects, like lowering testosterone, are linked to the stevia leaf, not to the steviol glycosides like rebaudioside A (Reb A).

Both sweeteners have been in use for centuries by our ancestors: stevia in South America and monk fruit in China. They are considered relatively safe and may actually have some health benefits from regular consumption, such as lowering fasting glucose and insulin levels when used regularly and reducing the glucose and insulin responses to eating carbohydrates.

Certainly, opting for stevia and monk fruit would be a safe bet as a sugar alternative. They provide zero calories, a lot of sweetness, and may benefit metabolic health.

Sugar Alcohols

Last up we have sugar alcohols, the six most common being erythritol, lactitol, maltitol, mannitol, sorbitol, and xylitol. They are 30–100% as sweet as sugar, lower in calories, and have a lesser effect on blood glucose when eaten.

Sweetener	Glycemic index *	Calories (kcal/g)	Sweetness **
Erythritol	0	0.2	0.6–0.8
Lactitol	6	1.9	0.3–0.4
Maltitol	35	2.1	0.9
Mannitol	0	1.6	0.5–0.7
Sorbitol	9	2.7	0.5–0.7
Xylitol	13	2.4	1.0
* Glucose = 100; table sugar = 65 | **Relative to table sugar (1.0)			

Sugar alcohols are notorious for causing bloating and diarrhea when consumed in excess, since they are only partially absorbed in the gastrointestinal tract and are rapidly metabolized by the microbiome in the colon. They also have a reputation for helping prevent dental plaque and cavities, especially xylitol.

The real star of the bunch is erythritol, though, which beats out the others on four main points:

- It has zero impact on blood glucose and insulin levels
- It provides virtually zero calories
- It doesn't cause bloating and diarrhea when consumed in large amounts
- It is superior to xylitol for preventing the buildup of dental plaque

So, for those of you that want to avoid artificial sweeteners, erythritol is another great option.