TODAY'S "HOT TOPICS"

GMOs, GRAINS, DETOXES AND MORE

3

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01

SETTLING THE GREAT GRAIN DEBATE

CAN WHEAT AND OTHER GRAINS FIT INTO A HEALTHY — AND SANE — DIET?

02

ARE DETOX DIETS GOOD FOR YOU?

HOW A 3-DAY JUICE CLEANSE LANDED THIS DIETITIAN IN THE ER.

03

ARE GMOS BAD FOR YOUR HEALTH?

IF YOU'RE ASKING THIS QUESTION, YOU'RE PROBABLY MISSING THE POINT.

04

WHY NUTRITION SCIENCE IS SO CONFUSING. [INFOGRAPHIC]

9 REASONS EATING WELL ISN'T AS STRAIGHTFORWARD AS WE'D LIKE IT TO BE.

SETTLING THE GREAT GRAIN DEBATE

Can wheat and other grains fit into a healthy — and sane — diet?

By Brian St. Pierre

Are grains saving your life — or trying to kill you? In this article, we'll discuss both sides of the debate. We'll also leave you with some actionable steps to start eating better immediately.

Quick: How do you feel about grains?

Are they an essential food group that makes up the foundation of a nutritious diet? Or are they evil little packages of carbs and toxins out to make you fat and inflamed, and slowly kill you?

This discussion is one of the great nutrition debates of our time.

In one camp are vegans, vegetarians, and macrobiotic dieters, who eat a ton of whole grains. They say grains will help them live longer and healthier, free of chronic disease. Indeed, recent news seized on a Harvard study connecting grains with lower risk of death.

In the opposing camp, you've got the Paleo, Whole30, and Atkins advocates, who strictly limit or even completely avoid grains. They say not eating grains will help them live longer and healthier, free of chronic disease. They dominate plenty of news, too.

Celiac disease has gone up over the last 60 years, which has given rise to a gluten-fearing food subculture (and the booming gluten-free marketplace to match).

Tens of millions of North Americans now conduct grain-free experiments on themselves and read bestsellers like Wheat Belly.

As a result, many people now say they feel better when they limit or cut out one or more grains.

Who's right?

And, most importantly, should you eat grains?

Let's iron it out once and for all.

An old staple

Grains, the seeds of grasses, are an ancient food source that is still the main source of calories for people all over the world.

Along with the familiar wheat, rice, oats, corn, barley, buckwheat and rye, there are lots of lesser-known grains such as triticale, quinoa, teff, amaranth, sorghum, millet, spelt, and kamut.

The raging debate about grains can make it seem like they're a relatively new addition to the human diet, but we've actually been consuming them in some shape or fashion for millions of years (yes, the real Paleos ate grains, too). Learning to cultivate wheat helped us give up the nomad life and create civilization as we know it today.

Grains provide a wide array of nutrients, including vitamins, minerals, fiber, and phytonutrients.

Of course, when it comes to grains' nutrients, we're talking about *whole* grains. As in the whole seed. Like this:

Whole vs. refined grains

One of the reasons that this debate became so muddled so quickly is that people conflate “grains” with “carbs.”

Carbohydrates are sugar-based molecules found in a range of foods, including bread, pasta, potatoes, beans, desserts, soft drinks, and — yes — whole grains.

Refined grains — ones that have had their bran and germ stripped away through milling — provide all the carbohydrates with hardly any of the nutrients found in whole grains. They’re often packaged with large amounts of fat and salt.

As a result, these processed grains are really tasty, easy to consume, but way less satiating — a deadly combo that leads many people to overeat, setting them on the path toward weight gain and chronic disease.

But what about whole grains?

Aren't they bad for you, too?

The (supposed) ill effects of grains

Some say grains can really mess up your health by causing inflammation, intestinal damage, obesity, and more. What does science say?

Inflammation

A huge contingent in the grain-hating world claim these plants contribute to low-level inflammation, an ongoing immune response in which your body attacks its own tissue, causing cell damage.

They use a few studies to prove their point.

One study had people add 19 grams of wheat bran — the equivalent of about three cups of bran flakes — to their daily intake. Three months later, the subjects had slightly increased levels of oxidized LDL cholesterol, a possible marker of increased inflammation.

Cue the grains-cause-inflammation rumors.

The problem? By the end of the experiment, 44 of the 67 subjects had dropped out! This makes the final data sketchy at best.

What's more, several large epidemiological studies have actually linked whole grain intake to *lower* levels of inflammation.

Of course, these are just links. You need controlled trials to prove any causal relationship.

Overall, controlled trials are neutral or supporting of the epidemiological studies here, finding that whole grains either have no effect on inflammation or indeed result in a decrease.

Not one single controlled trial has shown that grains increase inflammation.

There's an idea in the fitness industry that inflammation is the root of all health problems, and therefore, that all health problems can be traced back to the diet and your gut. This is a false premise.

Yes, food sensitivities may cause inflammation and eventually, after a long cascade of events, may lead to disease elsewhere in the body.

But the more likely scenario in most cases is that inflammation is a *result* of disease, and that it exacerbates other conditions or disease states that have already been set into motion.

There are lots of research papers on all of this. And lots of inflammatory markers we can now test.

No one — I repeat, *no one* — is really sure what it all means.

But **inflammation probably does not** *cause* **most diseases, even those with an inflammatory component.**

Intestinal damage

Another prevailing idea in the anti-grain movement is that grains damage your intestines because they contain anti-nutrients and other compounds that interfere with how well you absorb minerals.

At least three studies have investigated this theory. The findings: **Consuming various amounts of whole wheat flour, wheat bran, and/or oat bran had no significant effects on absorption or blood levels of calcium, zinc, or iron.**

Let's look at a few anti-nutrient players.

- **Lectins:** These proteins bind to cell membranes, which can cause damage to intestinal tissue if you consume very large amounts or don't cook the plant first (just a few sprouted red kidney beans would result in some terrible GI symptoms). But the body also uses lectins for basic functions like cell-to-cell adherence, inflammation control and programmed cell death. Lectins may even reduce tumor growth and decrease incidence of certain diseases.

- **Phytic acid:** The storage form of phosphorus, phytic acid can bind minerals in the digestive tract, preventing their absorption. In really large doses, it can cause nutrient deficiency and related problems (it's been blamed for short stature throughout Egypt's history). But you'd have to eat copious amounts of bread that hasn't gone through leavening — a standard process that significantly reduces phytic acid levels — for this stuff to be a threat. In fact, in reasonable amounts, phytic acid has a number of possible health benefits.

- **Protease inhibitors:** When raw or lightly cooked, grains still contain large amounts of protease inhibitors, which block the action of protein-digesting enzymes, interfering with your protein absorption. But once appropriately cooked, grains contain very few protease inhibitors — and those that remain actually have anti-inflammatory and anti-cancer properties.

Thus, these anti-nutrients can be a problem if you eat way too much of them, or don't cook the foods that contain them properly. But if you eat like most people do — consuming a variety of foods and carbohydrate sources — you'll probably be just fine.

There is research showing that gluten — a protein found in certain grains (see below) — can cause your intestinal lining to be more permeable. But all of these studies were conducted *ex vivo* — meaning in an unnatural environment outside the body.

In vivo studies, done inside the body and thus more practically useful, have found that the consumption of grains actually *improves* GI symptoms in sufferers of Crohn's, ulcerative colitis, and IBS.

You know, the people who would be most prone to the supposed intestinal damage inflicted by grains.

Yes, grains contain anti-nutrients — because all plants contains anti-nutrients. Broccoli, spinach, and other green leafy veggies. Red wine. Dark chocolate. Nuts. Seeds. Green tea.

Heck, fiber itself is an anti-nutrient.

Not eating plant foods because they have compounds designed to resist their digestion would be like not eating a lobster because it has

a shell and claws. All living things try to avoid being eaten. It's simply not a tenable argument.

Gluten intolerance

A protein found in wheat, rye, and barley, gluten's visco-elastic properties are what make bread so darn delectable.

In people with celiac disease, exposure to gluten causes inflammation and stimulates the immune system to attack the small intestine, damaging its cells.

Over time this can inhibit digestion and make the gut more permeable, allowing in toxins, undigested food, and bacteria that would never normally make it through. Celiac can cause diarrhea, nutrient deficiencies, osteoporosis and even cancer. The only treatment for celiac is a gluten-free diet.

Overall, celiac is still poorly understood and a challenge to diagnose. There are currently several different blood screens and an intestinal biopsy, but none of these are 100 percent accurate.

That's why the estimated celiac rate ranges so widely, generally from 0.3-1.2 percent of the population (some even speculate up to 3 percent). Most experts attribute celiac to about 1 percent of the American population.

An estimated 10-20 percent of the population may suffer some other form of gluten intolerance. Originally coined "non-celiac gluten sensitivity" (NCGS), this condition seems to result in many of the same symptoms seen with celiac (bloating, pain, diarrhea) *without* the intestinal damage or biological markers of an autoimmune disease.

But all of this is up in the air. Experiencing doubts, the researcher whose work seemed to prove the existence of NCGS performed a more rigorous follow-up study. He and his colleagues concluded that NCGS actually does not exist.

Unless you have a confirmed intolerance, there is little evidence to support eliminating gluten from your diet.

In fact, avoiding gluten unnecessarily could have the exact opposite effect you're looking for. Many packaged gluten-free products are jammed with extra sugar and fat to make up for the palatability that's lost when gluten is removed.

FODMAP intolerance

What's going on in people who seem to have gluten sensitivity if it's not celiac or NCGS?

Researchers now believe their symptoms of pain, bloating, and gas may be due to "FODMAPs": fermentable, oligo-, di-, mono-saccharides and polyols.

FODMAPs are carbohydrates that are found in some grains but also in dairy, vegetables, fruits, and many other foods. Some people don't break them down or absorb them properly in the small or large intestine.

FODMAPs then draw water into the gut and get fermented by the bacteria in our colon, producing hydrogen instead of methane (plus a bunch of undesirable GI symptoms).

Does 10-20 percent of the population have a FODMAP problem? Frankly, the research is far from conclusive here.

The best we can say is that if you suffer from NCGS-type symptoms, removing wheat from your diet might be prudent.

Otherwise, there's no need to mess with it. For those who tolerate FODMAPs, the fructans in wheat actually seem to be a beneficial prebiotic.

Obesity

There's been a lot of research on grains and body weight. Unfortunately, most of this research is, you guessed it, epidemiological.

Regardless, these epidemiological studies are *unanimous* in showing that higher whole grain consumption is associated with lower body weight.

Controlled trials have been less consistent in their results. In these tests, whole grains don't consistently lead to superior fat loss — though the studies didn't show the grains caused people to gain weight, either.

To go beyond the inconclusive controlled-trial data, we can look at how real people do on grain-heavy diets.

These aren't perfect data, because there are many variables. But it can suggest possible trends and give us an idea of how grain consumption affects body weight in the real world, during real life.

If grains were inherently fattening, vegetarians and vegans, as well as many eaters in less-industrialized countries (where grains like rice or sorghum are usually a staple) would likely be more overweight or obese.

No literature exists showing that plant-based eaters, or those folks in regions for whom grains are a staple, have a higher incidence of overweight or obesity. In fact, the research shows just the opposite.

While these correlations certainly don't prove anything, it's likely that if grains really did cause obesity, we would see some trends and correlations to reflect it.

But here's the crux of the issue: Buckwheat, oats, and quinoa aren't making anyone fat.

In their original form, these and other whole grains are relatively bland foods, not overly calorie-dense, not unusually delicious, high in fiber and relatively satisfying. (Remember the old commercials with the grand-fatherly Wilford Brimley telling us that oats would "stick to our ribs"?)

But *refined* grains are a different story.

Whole kernel corn becomes corn syrup. Whole wheat grains become refined white flours for cookies and muffins, pizza dough or toaster pastries. Whole grain rice becomes Rice Krispies and rice noodles that we can then slather with Pad Thai sauce (potentially containing the aforementioned corn syrup).

With processed foods, "carbs" are just a way to deliver hyper-palatable, "can't-eat-just-one" enjoyment as well as calorie-dense fatty meats, cheeses, sauces, and condiments. But are the "carbs" themselves really the main problem here?

OK, so, *are* whole grains good for you?

Here's what we know about the benefits of whole grains. They are:

- high in fiber, a nutrient that can help you maintain a healthy GI tract.
- slow to digest, which helps keep blood sugar under control.
- packed with vitamins and minerals.
- satisfying, which helps keep your appetite in check.

And there may be more specific benefits.

Overall, research shows that whole grains, with varying degrees of success, seem to decrease the risk of colorectal cancer, cardiovascular disease, and diabetes. They also seem to improve blood sugar control and insulin sensitivity, and protect against high blood pressure.

OK, fine. But are grains crucial to health?

Do you *need* to eat grains?

No. You don't *need* to eat any one particular food — be it grains, apples, kale, or fish.

But you need carbs. The amount of carbs you need depends on your activity level.

If you exercise fairly frequently, then you'll likely do best with a moderate carb intake. Not getting enough could mess with your

metabolism, stress hormones, and muscle-building hormones.

If you're sedentary, have blood sugar issues, and/or need to lose a bunch of weight, then you'll likely do best by lowering your carbohydrate intake.

You could replace whole grains with a variety of other high-quality carbs, like potatoes, sweet potatoes, fruit, legumes, squash, yuca, and yams. You'd be able to get all the carbs you need, in addition to plenty of fiber and a wide array of beneficial phytonutrients.

But trying to eliminate grains entirely is going to be difficult in even the best of circumstances.

In a life that involves family holidays, birthday parties, work functions — any instance where others are preparing the food — completely cutting out grains if you're not suffering from celiac or a sensitivity becomes way, way more trouble than it's worth.

Getting perspective on where grains fit

Often when we talk about food, we talk about the awesome things food X does. Or the terrible things food Y does.

In reality, foods are often a mixture of both good and bad outcomes, depending on what the diet as a whole looks like, the amount of food X or food Y being eaten, and the person who's eating them.

The position that all grains are unhealthy and should be categorically avoided is too extreme.

So is the notion that grains are inherent "superfoods" that everyone should consume in massive quantities.

Neither end of the spectrum is right.

Most people can be fit and healthy with a mixed carb intake that includes some whole grains (a few refined carbs can be OK, too).

Weigh the benefits against the risks.

Might wheat carry some low-level of risk for some people? Possibly.

Is it likely that the benefits of whole-grain wheat still outweigh this risk? Yes. The same is true for most whole grains — and whole foods — *in general.*

In the end the best thing to do is:

- Objectively evaluate the research;
- Review the differing opinions of qualified experts with an open yet skeptical mind;
- Test to find what works best for YOU;
- Know that what's best for you may change over time.

What to do next

It's all a lot to process. Where should you go from here?

Let this list be your guide:

1. **Focus on whole, minimally processed, nutrient-rich foods.** This means you'll be eating plenty of lean protein and plants — including grains. It'll also help you limit refined grains (those don't hit the "whole" mark). Remember that what's on top of the potato skin affects your health more than that sad, maligned tuber does itself.

2. **Make sure your grains are thoroughly cooked.** Cooking food drastically reduces its lectin, phytic acid, and protease inhibitor content. For example, fully cooking kidney beans knocks their lectin content from 20,000-70,000 units down to 200-400. Don't eat a lot of unleavened bread.

3. **Try sprouted and fermented breads.** To take it further, grains that have been sprouted (e.g. Ezekiel bread) or fermented (e.g. sourdough) have even lower levels of phytates, lectins, and protease inhibitors. This increases mineral bioavailability and also tends to boost the protein quality of the bread.

4. **If you suspect a problem with gluten, get tested.** Go see your doctor, and get help implementing a gluten-free diet if you test positive for celiac disease.

5. **Zero in on wheat.** While whole-grain wheat is likely still mildly beneficial for most (sprouted wheat might be even better), this appears to be the grain with the most problems and fewest advantages. If you're having GI issues, it's reasonable to see if avoiding wheat helps. Here again, talk to your doctor.

6. **Try other grain options.** Variety is good. We've given you a list of whole grains in the beginning of this article. Try some others you don't normally eat. Have fun expanding your horizons.

7. **Consider an elimination diet.** Food sensitivities do exist, though we don't know with what frequency. They're linked to GI problems and a host of other conditions throughout the body. The gold standard for uncovering a food sensitivity (grain-related or otherwise): elimination diets, in which you systematically remove and then reintroduce foods in your diet, making note of any changes in symptoms.

8. **Stay sane.** Diet extremism leads to stress, unhappiness, and, unfortunately, weight gain and health problems. Tune out the "great grain debate" and use that energy to cook delicious food — and eat it with beloved friends — instead.

ARE DETOX DIETS GOOD FOR YOU?

How a 3-day juice cleanse landed this dietitian in the ER.

By Ryan Andrews

Those colorful, expensive bottles of juice *look* healthy. But are detox diets good for you? Here's what the science says — and how a juice cleanse landed one of our nutrition experts in the ER.

Not too long ago, the only people who went on detox diets were Hollywood stars and trend-obsessed editors at fashion and lifestyle magazines.

These days, everyone knows someone who just finished a juice cleanse.

Whether you've tried one, you're considering one, or you're a trainer (and wondering what the heck to tell your clients when they ask), the big question is:

Are detox diets good for you?

The short answer... maybe, minimally. (And probably not for the reasons you think.)

Even more importantly: When researching and writing this article, my wife and I tested a three-day juice cleanse.

Two visits the emergency room later, I can say this with certainty: **Any small benefit you might get from a detox diet could be overshadowed by the risk**.

More on the emergency room fiasco in a bit. For now...

What is a detox, anyway?

Like other health buzzwords such as "moderation" and "clean", "dietary detox" has no universal definition.

That's partly because "nutritional detoxing" doesn't have a scientific basis.

We've seen throughout history that in the absence of science, people are usually left with confusion, superstition, and myth (plus charlatans ready and willing to take their money).

This trend is no different: Despite a lack of scientific support for any "detoxifying" dietary process, many "detox diets" have emerged. They take various forms, but most prescribe:

- certain foods,
- special juices,
- "detox teas", and/or
- colonics.

And some simply promote fasting.

Of course, the imagined purpose of these interventions is to purge would-be toxins (dirty, yucky, poisonous chemicals) from our bodies. Presumably in the interest of better health.

But, what is a toxin?

By definition, toxins are small molecules, peptides, or proteins capable of causing disease on contact with (or absorption by) body tissues.

Toxins vary greatly in severity, ranging from minor (like a bee sting) to immediately deadly (such as botulinum toxin).

While avoiding bees and deadly bacteria is an obvious best practice, many people in health and fitness are concerned with lifestyle practices that aren't as clearly threatening.

In the natural world, it's not as simple as "toxic" vs. "nontoxic".

Most *everything* is toxic at some level. We can't avoid it.

And we shouldn't try to. Otherwise we'd either eat nothing (because everything contains some level of toxic chemical) or we'd miss out on beneficial toxins.

Wait, what!? That's right: **In relatively small amounts, many toxins can be processed easily — in fact many are actually *good* for us.**

Some examples:

Vitamin A: Overconsumption of this nutrient can cause headaches, drowsiness, and anorexia, among other problems. Of course, in relatively low amounts it's essential to your health, and especially your vision.

Vitamin B: Get too much, and your neurological and liver function will suffer. In normal amounts, vitamin B helps us convert food into energy.

Phytochemicals: Found naturally in plants, high doses of these compounds may be toxic to the liver, kidney, and intestine. Normal doses of phytochemicals, of course, are celebrated for their anti-cancer and other health-protecting properties.

Lectins: These proteins, which are found in grains and legumes, can bind to cell membranes and damage intestinal tissue if consumed in very large amounts. But in smaller quantities (which you achieve by cooking the food), lectins support basic cell functions, help control inflammation, and may even decrease your risk of certain diseases.

Glucosinolates: Found in cruciferous vegetables like broccoli, brussel sprouts, and bok choy, high consumption of these sulfur-containing chemicals have been shown to contribute to hypothyroidism. But in reasonable amounts, glucosinolates may protect against cancer in a variety of ways.

Sugar: Too much sugar could become toxic, as measured by blood sugars and triglycerides. In small amounts, sugar is our primary source of energy (plus offers special enjoyment… so go ahead and eat that cookie).

Alcohol: Heavy drinking can increase your risk of many health problems. But generally you can enjoy a glass of wine a day without worrying about toxicity.

Fortunately, the body "cleanses" itself.

If we can't ever avoid toxins, doesn't it then make sense to do some sort of detox? Not really. That's because our bodies have very robust detoxification systems. Our major organs of detoxification include the:

- digestive tract,
- kidneys,
- skin,
- lungs,
- liver,
- lymphatic system, and
- respiratory system.

These systems break down chemicals (toxic or otherwise) into other forms we can eliminate via the toilet, sweat, or breathing.

And the body seems to do a pretty good job of this when placed in a balanced (i.e. healthy) environment. More on this to come.

So why do people want to detox?

If the body is so great at self-cleansing, why would anyone consider detoxing in the first place?

Well, some people worry that their lifestyle isn't as healthy and balanced as it should be.

It's true that, in general, people:

- overuse medications,
- don't sleep enough,
- slather chemicals on their skin,
- don't get enough physical activity,
- over-consume alcohol,
- smoke, breathe in smog and ingest other environmental pollutants like heavy metals,
- eat nutrient-poor foods that the body might not recognize as "food", and
- overuse supplements.

And it's true that these factors could lead to:

- higher levels of toxins in the body,
- a weakened ability to chemically modify and excrete them, and
- higher risk for disease.

The theory behind a detox diet is that, by giving the body a break, one can atone for lifestyle sins and purge all the nasty chemicals. It's a health reboot, a fresh start.

But this guilt-rooted logic ignores something important: **The best way to "detox" the body is to ramp up your natural detoxification systems and to take good care of them in the long term — *not* to bypass them altogether, as you do when you're on a detox diet.**

One example: Most detox diets are low in proteins, amino acids, fiber, and probiotics. According to the esteemed Dr. Alan Logan:

"Fasting and low protein diets are counter-productive because our main detox organ, the liver, requires amino acids from protein (e.g. glycine, cysteine, glutamine) in order to support detoxification pathways. Since the assault of man-made chemicals in food, water and our environment never lets up, we need daily detoxification, not some sort of spring cleaning with harsh remedies once per year."

He goes on to say: "Since many of our toxins find themselves in the gastrointestinal tract, a good daily intake of fiber can help bind them up for elimination. Probiotics, live beneficial bacteria such as that found in yogurt, can also — day in and day out — help to transform toxic compounds in the gut and prevent their absorption."

Now, it's important to recognize that health isn't the main motivation for everyone who does a detox diet. Some have much simpler goals:

To lose weight, fit into smaller pants, and radiate good health.

(They might have seen a celebrity touting a cleanse, and the celebrity looked healthy and fit. Maybe if they copy the cleanse, they'll look healthy and fit too.)

But I can say the following with confidence:

Detoxing to lose body fat doesn't work.

For a moment, let's assume that a detox diet will help you get rid of impurities. (It won't, but let's assume it anyway.)

Does ridding yourself of impurities facilitate fat loss? Nope.

The reason folks lose a remarkable amount of weight — quickly — on most detox regimens is because they're "empty".

They quickly lose body water, carbohydrate stores, and intestinal bulk. It's gone during the "cleanse". But all of it comes back a few hours after the detox ends. Because you can't stay empty forever.

Interestingly, these folks lose very little fat — unless their cleanse includes fasting for really extended periods (which, if not done carefully, can be dangerous).

In the end, while it feels like a detox is helping shape up your body, it's a sad illusion. You're not losing anything that won't come right back within hours after the end of the diet. And you're putting your health at risk to support the illusion.

If weight loss is your goal, there are smarter (and more permanent) ways to do it. Ones that are both healthy and sustainable.

Are detox diets good for you?

Given that detox diets won't rid the body of impurities or lead to real weight loss, are there any benefits?

The only thing one can say positively is that:

A detox diet may encourage you to eat more nutritious foods.

Some detox diets recommend nutrient-rich foods like:

- lemons
- green tea
- fruit and vegetable juices
- colorful fruits and vegetables

All of these could, in part, increase your intake of certain nutrients. Some of which might help the body deal with incoming toxins or offer other health benefits.

However, a three-day detox diet won't move the dial on toxicity (or health) anywhere near as much as maintaining a healthy lifestyle the other 362 days of the year.

Some disadvantages of detox diets

For most people, the disadvantages of a detox diet are much more numerous than the potential benefit.

Detox diets are often inconvenient.

Any diet will take some effort to organize, and detox diets are no exception. Ironically, you'll probably never put as much work into eating less as you do into a detox.

People with limited time, money, and resources won't enjoy juicing fifteen pounds of organic veggies and fruits each day. Especially if they're feeling weak, listless, or dizzy – some of the most frequently reported side effects of juice cleanses.

Detox diets are often too low in energy.

Meanwhile, most juice diets are extremely low in calories. In fact, some people argue that juicing is just a way to starve yourself and feel good about it.

With the low energy intake you'll often notice other things slowing down: you may feel colder, or sluggish, or notice digestion taking a while.

Detox diets often swing the pendulum too far.

Many people turn to cleanses in a search for moderation following a period of indulgence.

Yet it's hardly moderate to eat almost nothing for several days, or to pulverize fifteen pounds of vegetables per day to yield a thick green

soup. Can the body even handle fifteen pounds of raw vegetable juice?

Some of the negative side effects that people typically notice on a cleanse could be the result of overload. Their bodies could be working overtime to deal with a noxious cocktail of oxalates, nitrates, etc — all from fruit and vegetable juice.

Ironically, the very "detox" itself could prove "toxic".

Detox diets may be high in nitrates.

This brings me to one of my own theories. Many people get headaches when they are on juice cleanses — even people who aren't suffering caffeine withdrawal.

I think this could be due to nitrates.

Many detox juices incorporate lots of celery and beets. Normally, we don't consume such high quantities of these. **Many detox juices are rich in nitrates, which promote vasodilation. Dilated blood vessels can lead to some pounding headaches.**

Detox diets may cause blood sugar swings.

Cleanses built on fruit juices can cause **major swings in blood sugar** — making them downright dangerous for people with diabetes, and potentially risky for many others.

Detox diets can be tough on your GI tract.

The fruit juices used for many detox diets contain very little fiber. Fiber is a cleanser. It's like a street sweeper for the GI tract; it slows down digestion and aids absorption of nutrients.

There is no credible information saying that the GI tract does better when it doesn't get solid foods (unless the GI tract is damaged). Instead, the gut does well with pre- and probiotics, glutamine from protein-rich foods, and fiber.

You'll struggle to get all of these on a cleanse.

Also, many detox diet advocates claim that crud builds up in our intestines, and we need to "cleanse" our digestive tract. If that were true, endoscopies and colonoscopies would reveal this nasty stucco layer in full color... but they don't.

Again, there's some irony in a "cleansing" diet that reduces the effectiveness of the body's natural cleaning crew!

Detox diets are often low in essential fats.

While some less-extreme detox diets allow things like nuts and seeds, hardcore cleanses typically eliminate most fat-containing foods, even healthy fats.

Extreme variations in fat intake — i.e. swinging from high (pre-cleanse) to low (cleanse) to high (post-cleanse celebration) to low (back on the cleanse train again) — can cause trouble for organs that process dietary fats, like the gallbladder.

Detox diets may cause electrolyte imbalances.

Many cleanses involve drinking a lot of liquid (such as water, herbal teas, and/or juices) while removing many foods that contain salts. Some "detox diets" also suggest using diuretic supplements.

This can cause potentially dangerous imbalances in your electrolytes,

charged chemicals found in fluids throughout your body. The imbalance is even more likely if overhydration is combined with low energy intake.

In fact, there's a name for this phenomenon, well-known to health care providers who deal with extreme anorexia, malnutrition, or any medical condition with severely restricted food intake: refeeding syndrome.

To keep operations running when nutrients and energy are low and electrolytes are disrupted, the body may adjust its metabolic environment (for instance, it may deplete cells of minerals to keep blood levels of those minerals stable).

Not only can this affect health during the detox diet, it can cause potentially serious problems when a person on a detox diet (especially a longer-lasting one) starts eating normally again.

Detox diets can create a cycle of restrictive eating and deprivation.

Detox diets — the entire concept of "cleansing", in fact — can enable feast-or-famine style eating patterns:

- The detox diet starts tomorrow, so I'll eat a bunch of "toxic" foods tonight.
- On the detox diet now. Not allowed any stuff I enjoy.
- The detox diet ends tomorrow, so I'll get set to eat all those "toxic" foods I missed!

And so on.

Recognize that thought pattern? It's the classic dieter mentality. On the

wagon, off the wagon, on the wagon, off the wagon, ad infinitum.

It's always more harmful than helpful. When you think and eat this way:

- You never learn to find the sane middle ground.
- You never learn to prepare real food and real meals that are both nutritious and delicious.
- You're always in "all-or-nothing" mode. (Usually getting "nothing", because "all" is really, really hard.)

Worst of all: **You never feel truly happy with *any* of your choices.**

Our 3-day juice cleanse:

Complete with unscheduled trips to the emergency room!

Despite the numerous disadvantages I've just described, in the name of scientific discovery and self-exploration, my wife and I decided to try a cleanse. Anything in the pursuit of knowledge!

I must admit that things got off to a bad start when my wife reviewed the budget. "Wait," she said. "The cleanse is going to cost *how much?*"

Somewhat sheepishly, I informed her that three days of juice cleansing would set us back $180... each.

Yikes.

Maybe I should have taken the money and mailed it to a non-profit instead. Crap. Or maybe the cost is part of a placebo effect. Knowing I'm spending this much money on three days of juice might make me feel something awesome.

72 hours (and $180) worth of “cleansing” juice

Day 1

At 11:01 AM on a Tuesday, our cleanse box arrived. By then, we were getting hungry, especially since they had instructed us to avoid heavy foods (and alcohol and caffeine) the day before we started.

Immediately, I regretted signing up for the “advanced” cleanse. Maybe I should have done the beginners’ version, which included a kale salad and coconut/agave raw macaroon. Mmmmm, macaroons!

But they suggested we could supplement the juicing with whole veggies, fruits, herbal tea, water, nuts, or avocados if we felt like it. I breathed a sigh of relief.

The first juice contained cucumber, celery, kale, spinach, chard, cilantro, parsley, and sunflower sprouts. It had some protein and very little sugar. And it tasted like it had very little sugar.

This wasn't a shock to me. I'm a fan of leafy greens. My wife, on the other hand, went Incredible Hulk. She couldn't hide her doubts.

First she gagged. Then she tried to get festive and used a straw, but it didn't help. Her grimace after each sip was impressive.

(Note: My wife is a confirmed "supertaster," so the first juice tasted abnormally bitter to her.)

The juice we were drinking was created using a juicing machine to extract only juice from organic fruits and vegetables. I started to think about the difference between whole foods and extracted juices.

What if I ate all of these foods instead? Would that not be equally detoxifying? How would juice, per se, enhance my organs' ability to eliminate toxins?

The cleanse website claims that I am consuming the equivalent of twelve to fifteen pounds of fresh fruits and veggies each day from six juices — an amount that even I, a certified veggie-lover, wouldn't be able to consume if I were actually chewing and swallowing all of them.

When we eat solid foods, the foods must go through digestion in order for us to liberate nutrients. When food is pre-chewed by a juicer or blender, this likely decreases the work of digestion.

Maybe you've heard of the thermic effect of eating. Certain foods and nutrients have a higher thermic effect. Eat a big steak, there is a lot of work to be done by your gut. You might even get the meat sweats.

Drink fresh kale juice, and you've removed fibers and cell walls. All that's left are liquids and nutrients ready to cross the intestinal barrier and enter circulation.

On the positive side, maybe you're getting your nutrients faster. On the negative side...

When you're on a juice cleanse, the nutrients are so accessible that you burn significantly fewer calories via digestion.

As I finished sipping my first juice, I felt satisfied. It quenched my feelings of hunger. So far, so good. Sort of.

Because already, on that first day, I started to get a little bit of a headache. I don't usually get headaches, and when I do, it's typically because I didn't drink enough water.

What's up with headaches during cleansing? For most folks, it's simple caffeine withdrawal or blood sugar swings. For others, it might be the effects of increased vasodilation, as I mentioned earlier.

Whatever the cause, my headache eventually disappeared. As I lay in bed at the end of Day 1, all I could think about was how hungry I was. It reminded of my bodybuilding days when I was dieting for a contest.

At 3am 4am, and 5am, I was reminded of that time in my life again. Because I kept waking up with hunger pangs.

My wife had the same experience.

I actually enjoy going to bed at night without an overly full stomach. I think this serves me very well for my health/body goals and it leaves me hungry for breakfast when I wake up in the morning.

But the level of hunger I felt on Day 1 of the cleanse was substantial. And this can make for a crummy sleep.

Day 2

As it happened, we chose to do a cleanse during the holiday season. So on Day 2, my wife visited her mother's house for pre-holiday food-prep festivities. This included covering pretzels with chocolate, frosting cookies, and other similar tasks.

During this process, my wife came to an important realization about the power of pre-deciding. Other years, she would have been snacking during cookie preparations, but since she was committed to the three-day cleanse, she didn't feel conflicted about eating.

She had pre-decided not to have any cookies. Not an option, not a problem. Meanwhile, I tried a light workout. Just a simple circuit with some weights and conditioning drills. About midway through, I started to reek of ammonia. Good ol' breakdown of body proteins due to a low energy intake.

One of the juices on the detox plan included probiotics. Probiotics can help to populate the GI tract with beneficial bacteria, which in turn can help our digestive systems work more smoothly.

Nevertheless, towards the end of day two I was not feeling particularly "cleaned out". I did feel hungry, but not like I had prepped for a colonoscopy.

In the early afternoon I started to get a strange twinge/pinching sensation in my lower right abdomen. I don't know if it was my GI tract on hyperdrive or an inevitable (non-cleanse related) appendicitis. But it was strange. I thought some apple slices and almond butter would help, but they didn't.

Later in the afternoon, my wife and I both got a deep chill. Winter in Boston is cold. And apparently, winter in Boston while drinking only

green juices is even colder.

That evening, bundled in a sweater, as I sipped one of my juices, I began another quest for credible research and resources in support of detoxing and juice cleansing.

Surely I'd find something out there to convince me that this cleanse was a great idea?

Well... not exactly. Because at this point, there just doesn't seem to be a strong scientific case in support of detox diets.

Let's put it in context. Most of the articles I write take months of research. There are so many studies, so much literature to review and sift and consider. There's no way I could get through it and make sense of it all in one night.

But with this article, I found only a few credible sources to review. The research took a couple of hours.

Here are the conclusions: One study demonstrated that eight days of juice fasting can have mixed results on blood fats. And another case series showed that a whole-foods cleanse resulted in weight loss and improved blood lipids.

That's about it.

Now, beyond controlled research, there are plenty of anecdotes in support of detoxing, especially from companies selling detoxing kits.

But the vast majority of unbiased health and nutrition experts say that a simple eating pattern built around whole, nutritious foods trumps a 100 percent juice cleanse every time.

Day 3

My wife and I wake up tired after two nights of poor sleep. Each night, we've been kept up with a bad case of the "growlies". (This is one of my client's terms for excessive hunger.)

The one bright spot at this point in the cleanse is that we've both had minimal bloating. I wonder how much of this has to do with a lack of solid foods. Maybe in the future, taking more time to chew completely would lead to this same feeling.

So our stomachs are flat. But we're tired, grumpy, and hungry. We're also freezing cold. And we really, really dislike the taste of two of the juices. We can only tolerate four of the six juices today.

In the late afternoon, we start to reflect on the cleanse. For sure, we feel lighter; there's nothing moving through our intestines. But we're ready to transition to solid foods.

On the night of day three we begin to taper off of the cleanse with double bacon cheeseburgers and a couple of pints.

No, only kidding. We eat a light dinner of soup, salad, rice/quinoa, and beans.

My wife and I agreed that we wouldn't do a juice cleanse again.

If we want to take a break from eating for whatever reason, we've decided that a 12-24 hour water/tea fast will do the trick.

Call me crazy, but I'm not sold on the idea of spending $60 for juice

each day. And the high financial outlay wasn't the only difficulty we encountered with the cleanse.

As I mentioned, my colon and GI tract were on overdrive starting on day two.

To my surprise, this continued for about two weeks after the cleanse and even led to some weird abdominal pain, an appendix inflammatory episode, and a trip to the ER!

That wasn't exactly what I had in mind when I began this adventure.

As for my wife, she was extremely hungry for about five days after the cleanse, and actually became dehydrated with low potassium. She even passed out... and wound up in the ER.

Seriously! Both of us had to visit the ER. After a three-day cleanse! (I hate to imagine what might have happened if we'd tried a longer one.)

Needless to say, our post-cleanse time was eventful (and not in a good way).

Obviously this was just our experience, and I'm not sure if it was directly related to the cleanse, but I do think it's worth sharing.

Lying next to the CT scanning machine at 4am, I tried to remind myself that the purpose behind cleansing is to increase overall wellness. It's not supposed to make you feel miserable.

What the heck happened?

Now, whenever anything bad occurs in our house, we joke, "It's because of the cleanse."

What's the future of cleansing?

Maybe we'll eventually discover that there's something really powerful and health-promoting about drinking juice extracted from pounds and pounds of fresh produce, but right now, we just don't know.

If you detox, and your life is better for it, cool. But based on what I know about nutrition, the human body, and the world – I don't recommend it.

Detoxing doesn't appear to be a route to a healthy lifestyle. Instead, most people detox for a few days and then want to go back to their normal way of living.

What if we just aimed to eat and live in a way that supports the body's natural detox – all the time?

We already know the main dietary risks in North America, which include excess calories, processed sugars, fats, and salt. Simply cutting down on these would improve our health and functioning. We can do this by eating the highest quality, freshest food possible, paying attention to body cues, and not overeating.

We don't need a magical weekend juice cleanse.

What to do next:
Some tips from Precision Nutrition.

Here are 10 steps you can take each day to help your body do its natural detox job.

1. **Eat reasonable amounts.** If you're eating too much, you're probably accumulating more toxins than your body needs. Eating one cookie instead of six is a detox diet. Slow down and chew your food. We all have "anatomical juicers" – our teeth and our stomachs. Use them as they're meant to be used.

2. **Eat plenty of plant foods, and choose organic options when possible.** Veggies and fruits contain compounds that can help the body deal with all of the incoming chemicals. Organically raised plants and livestock are generally lower in the types of things you don't want, such as pesticides, hormones, antibiotics, etc.

3. **Stay lean.** Certain fat-soluble compounds can accumulate in body fat. Less body fat = less real estate for potentially problematic chemicals.

4. **Drink enough fluids, including water and tea.** And use a water filter. The kidneys are major organs of elimination for fluids. But don't overdo it: Fluid intake needs to balance our bodies' electrolytes. Generally you can avoid overhydration by not drinking more than one liter of fluid per hour.

5. **Allow a little extra time between dinner and breakfast.** During brief periods of fasting (such as overnight), our bodies clear out cellular debris. If you finished eating dinner at 7pm, maybe you could eat breakfast at 7am. This gives the body a 12-hour break from food for every 24-hour cycle. This might also improve your

sleep, which is another critical factor in allowing your body to appropriately recover.

6. **Get outside in the sun and fresh air each day.** Not only do we synthesize vitamin D from the sun, but we can breathe fresh air into our lungs and hear the sounds of nature. Good ol' Mother Nature.

7. **Exercise regularly.** Getting your blood flowing will help circulate good stuff where it needs to be, and clear out waste products more effectively.

8. **Limit unnecessary dietary supplements.** Supplements don't automatically equal health. And some might just be another burden for the body. Make sure each supplement in your cabinet serves a purpose.

9. **Cut down foods that you know are bad news for you.** You may know that some foods don't agree with you, whether because they make you feel bad physically, because of how they make you feel emotionally, or because you don't like the person you become when you eat them. Consider moving away from these foods gradually. (Eliminating them all at once may work, but you may find the same problem with all-or-nothing thinking that characterizes detox diets.)

10. **Check your cosmetics.** Our skin is our largest organ; each day we lather hundreds of chemicals into it. These then enter our blood and circulate throughout the body. If you want to burden your body with fewer chemicals, check your body products.

ARE GMOS BAD FOR YOUR HEALTH?

If you're asking this question, you're probably missing the point.

By Helen Kollias

GMOs are such a hot topic. With so many people debating pros and cons, it's hard to know what to think. So let's answer the question: Are GMOs bad for your health? Then let's look at a few other important questions.

Vitamin A deficiency leaves up to half a million kids blind each year.

If I were to tell you that *this* is the most powerful statistic in the debate over GMOs, what would you think?

Would you wonder how vitamin A could possibly relate to those little "Non-GMO Project Verified" labels you see on cereal boxes at Whole Foods? If so, here's the story.

Ingo Potrykus is a humanitarian and plant scientist in Switzerland who co-invented genetically modified rice. Yep, he makes GMOs, aka genetically modified organisms.

Is he a villain then? Or at least a shill for some multinational corporation?

Actually, his "golden rice" was engineered to fortify itself with vitamin A. By inserting a mere three genes into the plant's DNA (out of around 50,000 total genes), Potrykus was able to create rice that carries the vitamin A in its grain instead of just in its inedible leaves.

Up to 500,000 children lose their sight each year due to vitamin A deficiency, with half of them dying within 12 months of going blind. Golden rice would prevent this.

Unfortunately, even though Potrykus finished his project about 15 years ago and made the seeds available *for free* to subsistence farmers around the world, malnourished children still can't get golden rice. Because passionate opposition has blocked its development.

So here we have a cheap, nutritious crop. Seven years of extensive scientific research. An invention that could completely eliminate an unnecessary epidemic.

And that simple invention can't reach the people who need it.

But aren't GMOs evil?

I know, I know. "GMO" science can sometimes sound like comic-book stuff: crazy laboratories and mad geniuses, megalomanic super villains messing around with people's food for their own entertainment and/or financial gain.

Fish mated with cantaloupe! Rice with eyeballs! Wheat that makes you grow a tail! Frankenfoods! Island of Dr. Moreau! Etc.

The whole issue has become synonymous with unchecked power, unethical tinkering, Monsanto, pesticides, contamination, and greed.

I get it. Nobody loves giant evil conspiracies (except for super villains). But this is real life. There are no superheroes and super villains. The truth, as usual, is much more complex. And less diabolical.

When it comes to GMOs, scientists — who are just highly educated regular folks, by the way, and rarely malevolent geniuses — are mostly working toward innovations in genetics that:

- fight disease;
- fight hunger and malnutrition;
- improve animal and crop breeding practices; and
- potentially even save lives.

Of course, scientists haven't been all that great at explaining this to the average person. (That's what happens when you're sequestered all day at a fluorescent-lit lab bench trying to splice DNA from fungi or whatever, along with writing grant proposals.) So, naturally, the

average non-scientist imagines scary stuff.

Allow me to speak for my people — the science geeks — and bridge the gap.

How "GMOs" became a four-letter word

If GMOs creep you out, you're not alone.

A growing team of anti-GMO activists — including hundreds of reputable advocacy groups, state legislators, and big-name chains like Chipotle, Whole Foods, and Trader Joe's — are questioning the safety of GMOs.

They say GM foods could cause major health problems like tumors, liver toxicity, allergic reactions, and death.

So it's no surprise that over half of the U.S. public said genetically modified foods are unsafe to eat in a recent survey from Pew Research Center. One-quarter of those surveyed said they check product labels for GMOs every single time they shop.

GMOs *sound* scary and evil.

But do people really even know what they are? Or how they work?

What are GMOs?

A GMO, or genetically modified organism, is any living thing that's been manipulated to evolve, whether via breeding, engineering, or mutagenics (something that purposely changes an organism's genetic material).

Most of the time, people debating GMOs aren't really talking about GMOs. Instead, they're talking about GEOs: genetically *engineered* organisms, things that have somehow been constructed by scientists in a lab.

Genetically engineered (GE) plants, animals and microorganisms have had their DNA surgically altered for some specific purpose, such as increasing the vitamin A content of rice, making plants that need less water, or exploring genetic disorders.

For instance, you've probably heard of Roundup Ready® Wheat. This is a strain of wheat that resists a weed-killing herbicide known as Roundup.

Roundup is often sprayed on crop fields to kill off weeds. It works by attacking a plant enzyme called EPSP synthase. When EPSP synthase is attacked, weeds die. But so do other plants.

While Roundup Ready Wheat still has the EPSP synthase enzyme, it has a different version, which is invulnerable to that attack. So the weeds die while the wheat survives.

As simple as addition or subtraction

When we talk about altering an organism's DNA, we may be talking about adding something in or taking something away:

- **You can add "programming" to the existing DNA system to make something new.**

The product would be a transgenic organism (as in, you transferred in a gene), and that method has come to be known as gene "knock-in."

For example, to create Roundup Ready Wheat, they added a gene for EPSP synthase from a bacteria.

- **Or you can stop the program of an existing portion of DNA.**

This is called gene "knock-out."

Interestingly, both knock-ins and knock-outs happen normally in nature.

For example, chickens used to have alligator-like teeth. (Creepy, huh?)

Oddly, they still carry *talpid2*, the gene that used to make the teeth, but over time the gene got knocked out by regular old evolution. Now it's nonfunctional. Thankfully.

When engineered, knock-outs are usually done for research. They help us figure out what a gene does.

Did a GMO save your life today?

As I mentioned earlier, the vast majority of GMOs aren't crops like corn and soy, but rather mice, bacteria, and viruses used to investigate diseases and cures in labs all over the world.

As a molecular biologist, I've made hundreds of GM bacteria, hundreds of GM yeasts and one GM mouse. They've helped me understand how muscle develops and fixes itself, and, from there, how we might develop treatments for muscular dystrophy.

Genetically modifying microorganisms has led to some of the most revolutionary, life-saving medicines of our time:

- If you have type 1 diabetes, GM bacteria made your **insulin** cheap, safe, and accessible.

- If you've suffered from a genetic growth disorder such as Turner's syndrome or short bowel syndrome, GM bacteria made the **Human Growth Hormone** injections that help regulate your growth.

- If you're a hemophiliac, I'm sure you feel much safer with your treatment coming from GMO rather than from blood donations. Cells in a lab dish made **recombinant human factor VIII.**

- If you ever suffer a stroke or heart attack, you might be treated with medication made by **tissue plasminogen activator**, a cellular GMO.

- If you have multiple sclerosis, you're perhaps thankful for **interferon**, also made by a cellular GMO.

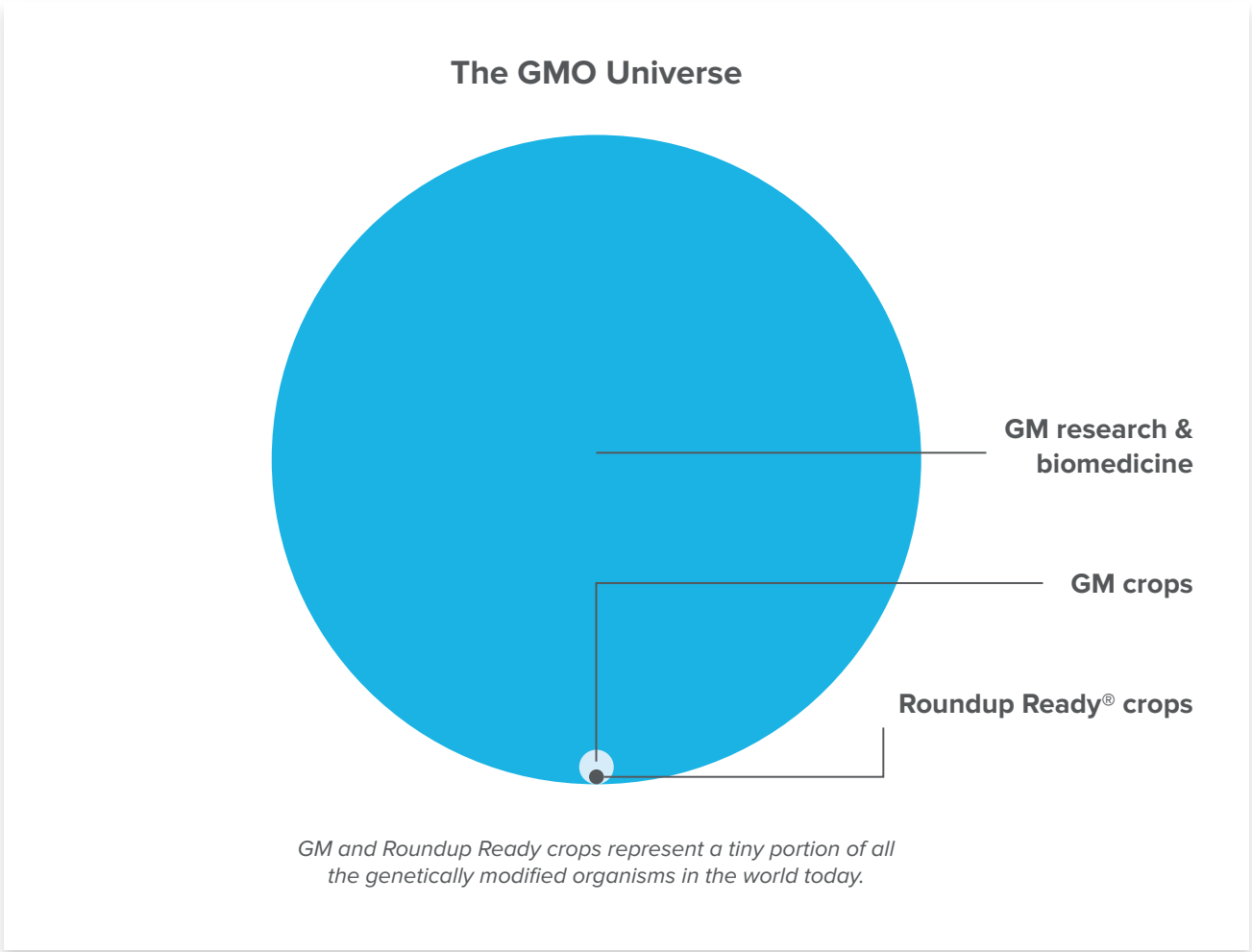
- If you have cystic fibrosis, the enzyme you take, **Dornase alfa**, is made by a GMO.

- Undergoing chemotherapy for cancer? Two GMO drugs that help your bone marrow and blood counts are **Erythropoietin** (EPO — yes, that EPO) and **granulocyte-colony stimulating factor** (G-CSF or GCSF).

- Lactose intolerant and taken **lactase**? It comes from GMOs thanks to genes from either a fungus or a yeast.

- If (heaven forbid) you ever contract Ebola, you'll be beyond grateful for **ZMap**, a collection of antibodies grown from GM tobacco infected by GM viruses.

In the end, it's kind of a shame that the debate over GM crops has led the general public to brand everything "genetically modified" as bad. Because GM crops only represent a teeny, tiny percent of what's happening in the GM universe, most of which is geared toward helping people and saving lives.



GM and Roundup Ready crops represent a tiny portion of all the genetically modified organisms in the world today.

“But they’re unnatural!”

Sometimes people say that GMOs aren’t natural. And, if they’re referring to genetic engineering, they’re correct.

Most of the evolution we’ve known on this planet has been the result of naturally occurring, random gene recombinations and mutations. In fact, that’s how you and I came to be.

Intentionally making a GMO on the other hand — again, that’s genetic engineering — is deliberate and strategic. And that may be a good thing.

Here’s why.

Farmers have been deliberately changing organisms by playing with DNA (whether they realized it or not) for millennia. More than 10,000 years ago, our ancestors domesticated hundreds of plants, inventing agriculture and cultivating crops that are still our main food sources today.

Through artificial selection — selecting specific traits over generations of crop or livestock — plants like corn and wheat have been bred for flavor, texture, size, and tolerance to environmental conditions.

Tomatoes, for example, used to be small and tart; if you want a bigger, sweeter tomato, then you only plant seeds from the biggest, sweetest tomatoes.

In the 17th Century, Dutch farmers bred carrots that were orange instead of yellow or purple — a nod, some speculate, to the Netherlands’ orange flag.

Today's consumers typically want all of their produce to be bright with no blemishes, and seed-free. (Did you know that bananas used to have seeds?) The reason this is possible: Most produce has been bred (i.e. genetically modified through artificial selection) to be blemish and seed-free. Artificial selection has been used with domesticated animals too: In 1950, an average chicken would produce 125 eggs a year. Decades later, we've bred them to lay 250 eggs annually.

Cows' great-great-great-great (plus a bunch more "greats") grandparents were aurochs. They were bigger and they were total jerks. After years and years and years of people picking the most agreeable aurochs, we ended up with creatures so docile you can tip them over (if you yourself are a jerk).

The point is:

Genetic modification isn't some scary new science.

We've been doing it for a long time. However, we've been doing it in a very rough, imprecise, "chainsaw" sort of way.

Now, with genetic engineering, we're able to do it in the best possible way — in a strategic, precise, "scalpel" sort of way. We also have a much better idea of what we're changing and what impact it'll have.

It's true that with genetic engineering you can use any gene from anything — you could even make up your own DNA — potentially creating combinations that would never otherwise exist. But this isn't really an argument against GE.

"Foreign" DNA inserts itself into other organisms in the wild all the time, likely yielding all manner of outcomes — positive, negative, and unknown.

For example, around 8 percent of human DNA is actually from viruses, which have invaded our bodies throughout history. This viral DNA has helped placental development during pregnancy, and for making more enzymes to break down carbs.

In general, corn is corn is corn

One major source of concern about GM foods is that genetic engineering might cause the DNA to go haywire, accidentally turning on nonfunctional genes (such as ones that could make the plant toxic), or creating genetic instability that would allow the plant to continue to evolve (in unintended, potentially scary ways) even after the scientists are "finished."

Some of these concerns have to do with the aforementioned fear of inserting "foreign" genes into the DNA of the crops.

The truth is that GE foods really aren't so different from conventionally bred plants and animals.

Look at Figure 1. We have wild corn alongside conventional corn artificially selected for hundreds of years. Notice how different the corn has become through non-GMO strategies (i.e. artificial selection or "the chainsaw method").

Figure 1. Teosinte ear (Zea mays ssp mexicana) on the left, maize ear on the right, and ear of their F1 hybrid in the center (photo by John Doebley.) Tracking Footprints of Maize Domestication and Evidence for a Massive Selective Sweep on Chromosome 10. Tian, Feng, Natalie M. Stevens, and Edward S. Buckler. Proceedings of the National Academy of Sciences of the United States of America 106.Suppl 1 (2009): 9979–9986.

Figure 2 compares conventional corn and genetically modified corn. Can you guess which is which?

Figure 2. Photo courtesy of Jason Haegele.

And check out Figure 3. Is that bull on steroids, or what? (More on this to come.)

Figure 3. Double muscling in cattle due to mutations in the myostatin gene. Alexandra C. McPherron and Se-Jin Lee PNAS 1997 94 (23) 12457-12461

Bottom line: Genetic engineering is a much more exact method that leaves less to chance than conventional breeding or artificial selection.

Both methods change genes in an organism. The difference is *how much* change, and how precise that change can be. A quick comparison:

Genetic engineering	Classical breeding
Modifies only a few genes (usually only one, in fact) leaving the rest untouched.	Shuffles hundreds of genes at once, changing their position in the DNA.
Allows strict control of each gene's production — where (for example, in the seed but not the plant) and when (for example, during development but not once the plant is mature) genes are on.	Breeders have no idea where and when these genes will end up and how they'll be expressed.

What this means:

Genetically modified corn is *exactly the same* as domesticated corn, with the exception of one or two genes.

In comparison, wild corn has many genes that differ (about 5 clusters of genes), each producing small variations in the plant.

These effects include:

- How much starch corn makes, and what type
- The type of environment and soil the corn will grow in

- How long the cob is, and how many kernels are in each row
- The size, shape, and color of the kernels
- Resistance to pests (yes, even conventional corn can and does resist pests)

So, in most ways, conventional farming methods have had much more of an impact on our food than genetic engineering.

Oh, and by the way, Figure 3 is a not a GM bull, but one made from breeding. Again, artificial selection not genetic engineering.

Some fluke (there's the chainsaw analogy again) mutated a gene (myostatin) and made this cow (Belgian blue). It has double the muscle and nearly no fat (less than boneless skinless chicken breast.)

With the precision of genetic engineering — what most people fear when talking about GMOs — this "accident" wouldn't have likely happened. But with artificial selection — what most people seem okay with — you get this freaky cow.

The biggest threats posed by GMOs

There's nothing intrinsically unsafe about genetic technology. As I argue above, it's probably even safer than most of the approaches being used today.

However, there are some GMOs that could harm the world's food supply.

First, certain kinds of GM crops could be wiped out by weeds or pests.

Humans and weeds are at war with each other. Crops go to the winner. As with many wars, this one has seen a military escalation, with more and better weapons.

Humans use herbicides (chemicals that are toxic to weeds and living things in general). The weeds retaliate by evolving to resist the herbicides. Humans then use more of a different herbicide. And on and on the escalation goes.

Problem is, the crops can only take so much herbicide exposure before they become collateral damage in the war.

Solution! Enter genetic engineering and its herbicide-resistant crops (remember Roundup?).

Great! War over, right?

It doesn't work that way. The massive use of herbicides wiped out nearly all of the weeds — but the few that survived are now hyper-evolved, breeding herbicide-resistant strains.

Let's use more herbicide! The war drags on.

Eventually, the weeds become resistant to these herbicides, and there's major loss in crops.

Similarly, Bt-corn is programmed to make its own pesticide to wipe out the caterpillars that might munch on it. Good, right? But what if there are other, just as destructive pests just waiting for those weak and frail caterpillars to get out of the way so they can jump in to eat the leftovers?

The second big threat GMOs pose to our food supply is genetic erosion.

Genetic erosion happens when an already-small gene pool gets even smaller and more uniform.

Getting GM food to market is a strictly regulated process that takes up to 12 years. One part of this process is ensuring that GM foods are 100 percent genetically uniform. Every single seed, every single ear of corn, has to have the exact same DNA.

This homogeneity — this genetic erosion — may mean that we lose diversity, which could make our food supply less robust.

With the same DNA, organisms have the same vulnerabilities. A plague, drought, fungus, or other pathogens could wipe out all our crops at once. Then we starve.

Don't blame the GMOs

Herbicide escalation and genetic erosion should be taken seriously, to be sure. But in order to consider solutions, it's important to recognize that **these problems aren't specific to GMOs**.

For instance:

- We're well aware of the unacceptably high pesticide levels found in many of the fruits and vegetables at the grocery store.
- Non-GMO crops can be the source of herbicide escalation, too (weeds simply become resistant through natural selection).
- Genetic erosion isn't a new worry: 100,000 years of breeding

practices have led to a certain amount of uniformity already (though it's prudent to make sure GM crops with advantages over conventional ones don't further narrow the genetic pool).

No doubt that GM practices should be checked and strictly regulated. It's a good thing that we have watchdog groups keeping the balance. Like everyone, scientists make mistakes and do the wrong thing sometimes!

But we have to look at the big picture. Focusing on GM foods means missing 99 percent of the problem.

So are GM foods safe?

I know you want to know — and I sympathize. GM ingredients and additives are used in so many of the foods we eat.

To begin with, there are 1500 published studies indicating that GM foods are safe. But I'm not going to rest a case on them. There are some animal studies that might raise red flags, but I won't cite those, either.

Because here's reality: **While most scientists believe GM foods are probably safe, science will never prove it 100 percent unequivocally. The answer is much more complicated than "yes or no," "pro- or anti-."**

We need to get beyond that, to stop throwing studies at each other.

Nothing can be proved to be absolutely unequivocally safe. Pick anything, and somebody has died from it.

So let's explore the grown-up questions and gray areas, and think about what trade-offs we're willing to make, in a scientifically informed and literate way.

For instance:

- What aspects of GM technology could be really good for the world? Why?
- Which aspects should we be cautious about? Why?
- What do we know to be true (or is probably true), and what is speculation? What's the evidence?
- How much is our discomfort with the unfamiliar driving the fears?
- Are we correctly assessing risk and reward?
- What's an acceptable level of risk to get the benefits?

As a scientist, I would love people to embrace science, evidence, and the joy of discovery. Scientists grapple with some very difficult and complex questions. And most of them just want to make the world a better place.

What to do next:

Short of going back to school for a Ph.D. in biology, what can you do right now?

1. Elevate your thinking game.

Almost no scientific question is about good versus evil. Even spacetime bends occasionally. Recognize that issues are complex.

If you'd like some practice with this, may we recommend our Level 1 and Level 2 Nutrition Certifications?

2. Be a critical consumer, learner, and listener.

Contrary to what the mainstream media might lead you to believe, the biggest threats posed by GMO crops on the market today are not to your individual health, and they're not even specific to GMOs.

Picking a side — and assuming the other side is unreasonable — makes real communication impossible. Scientific findings presented as the "final word" are probably being misinterpreted; be wary of anyone who tells you something is "100 percent true" about GMOs.

Even as sciencey folks ourselves, we're not going to give you The Big Definitive Answer either. Because there isn't one.

3. Address specific issues. Don't mix them up.

With GMOs and other food safety and regulatory issues, it's important to think critically about our concerns.

- Are you against pesticides? Great! But that's different from being against GMOs, and to focus on GMOs here is to ask the wrong questions.
- Want GM foods to be labeled as such? Great! But the importance of food labeling goes way beyond GMOs.
- Worried about large companies controlling our food? I get that. Be against Big Food, not GMOs.

Both conventional farming and GMOs use herbicides and pesticides, narrow the genetics pool, and increase the risk of catastrophic loss of

crops. Conflating these issues means change will never happen.

4. Focus on the big picture and real-life priorities.

The fourth-largest cause of death in the United States is accidents. Wearing your seat belt will lower your risk of early death much more than worrying about GMOs. (And quit texting and driving. You know who you are.)

Other leading causes of death are largely due to the toxic combination of sedentary lifestyles, stress, and poor nutrition. Never mind GM vegetables — people aren't eating vegetables, period.

So start with the key behaviors that will really make a difference.

5. Keep things sane and sensible.

The world, in general, can feel scary. Things we don't understand can feel even more so.

Control what you can control, as best you can. Make PN-friendly choices as consistently as possible, as well as possible.

WHY NUTRITION SCIENCE IS SO CONFUSING [INFOGRAPHIC]

9 reasons eating well isn't as straight-forward as we'd like it to be.

By John Berardi, Ph.D.

From a certain perspective, nutrition science can seem like a mess. From another, it illustrates the very nature (and beauty) of the scientific process. Here we'll explain why nutrition science is so confusing at times. We'll also explain why, in the grand scheme of things, that's okay.

I recently participated in a health and fitness roundtable at a large event.

During the discussion, one smart, educated, PhD-trained expert complained about the state of nutrition science.

“You nutrition people make me mad!”

“Why so much conflicting information?”

“Why so much nonsense?”

“Why can’t you make it clear and simple?”

I can totally empathize.

From a certain perspective, nutrition science can seem like a mess.

Lots of competing theories. One study seems to suggest one thing. The very next study seems to say the opposite.

People interested in health and fitness are stuck in the middle. Confused. Directionless.

From another point of view, that “mess” of competing ideas demonstrates the real beauty of science.

You see, science means putting all the ideas — good, bad, otherwise — into the ring and letting them fight it out over hundreds of years, using a particular method to determine the winners.

And that’s precisely why nutrition science is so confusing at times. We

haven't yet had the hundreds, even thousands, of years for the best ones to emerge.

For example, macronutrients (fat, carbohydrates, and protein) weren't even discovered until the mid-1800s. Vitamins weren't discovered until the 1900s.

And that's just the study of *what's in* food, driven by problems — malnutrition and starvation — that we don't face as often today in industrialized countries. (They're still a problem in many parts of the world, though.)

It's only in the last 20 years that we've begun studying newer problems, such as what's healthy in a world full of tasty processed food and very little movement.

Just so you know, *all* scientific disciplines begin with confusion, dead ends, frustration, and silliness. (Before humans understood weather patterns, a tornado happened because someone angered the wind gods.)

But what's young is destined to mature.

Nutrition science will eventually grow up.

Perhaps not as quickly as we'd like. Yet over time, the scientific method will cut and prune and do its work.

Meanwhile, here's a nice summary of 9 main reasons why nutrition science can be so confusing at times.

And why (sometimes) the media screws up reporting it.

WHY NUTRITION SCIENCE IS SO CONFUSING

9 REASONS EATING WELL ISN'T AS STRAIGHTFORWARD AS WE'D LIKE IT TO BE.

1 NUTRITION RESEARCH IS STILL YOUNG.

It takes time to master a science. Compared to chemistry, for example, nutrition is in its infancy.

CHEMISTRY

<1200 BC

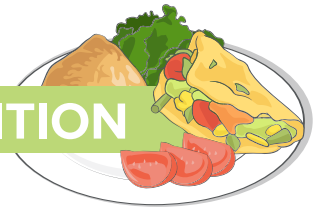
Metals are first recorded and manipulated.

430 BC

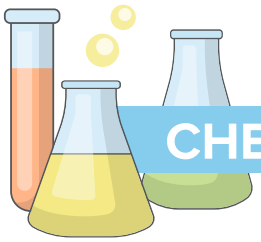
Greek philosophers propose the idea of the atom.

300 BC

Aristotle wrongly declares the existence of only four elements.



NUTRITION



CHEMISTRY

1520

Alchemists try to make the elixir of life.

1774-1794

Joseph Priestley discovers "dephlogisticated air" (oxygen).

LATE 1700S

Robert Boyle disproves alchemy and Aristotle's four elements.

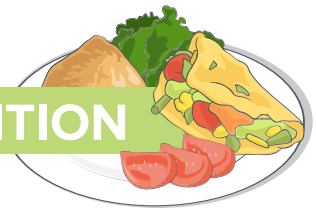
MID-1800S

Chemistry becomes a science: Discoveries include protons, X-rays, fluorescence, electrons, radioactivity, atomic mass, relative molar mass, and more.

MID-1900S

Molecular biology and biochemistry come into being with discovery of DNA.

NUTRITION



1842

Scurvy is successfully treated for the first time.

MID-1800S

Researchers realize that the body oxidizes fat and carbohydrates for energy.

1902

Wilbur Atwater publishes his "Atwater factors" -- estimates for the metabolizable energy from carbohydrates, protein and fat in mixed diets.

EARLY 1900S

Vitamin A, B, C, D and E, B5, B6, B3, K, and folate are discovered.

1970S

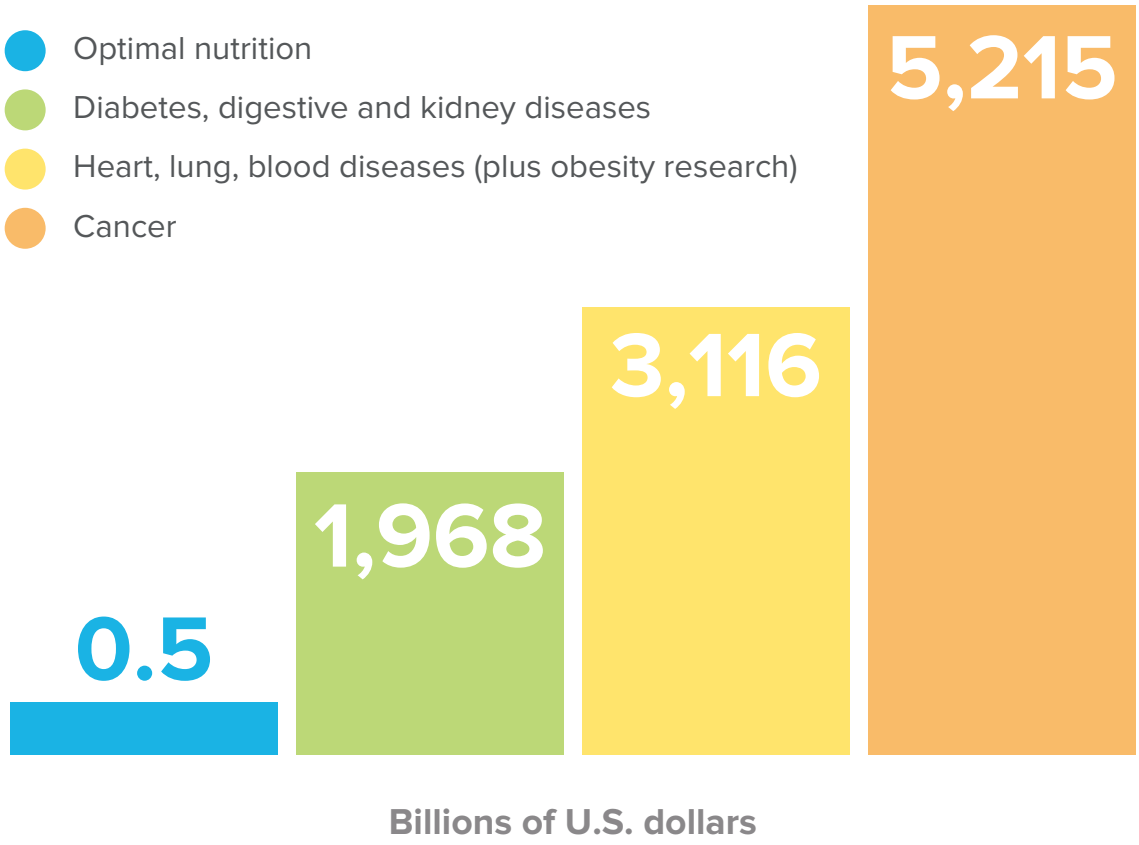
Researchers discover the link between risk of coronary heart disease death and low HDL cholesterol level.

As you can see, the field of chemistry has been around at least 10X longer than the field of nutrition — and it made almost no progress in its first 200 years. By this comparison, one could say the field of nutrition is in its "alchemy days".

2 MOST FUNDING GOES TO DISEASE TREATMENT, NOT PREVENTIVE NUTRITION.

Most researchers would rather ask,
"How can we end this epidemic?" than, "How can we get abs?"

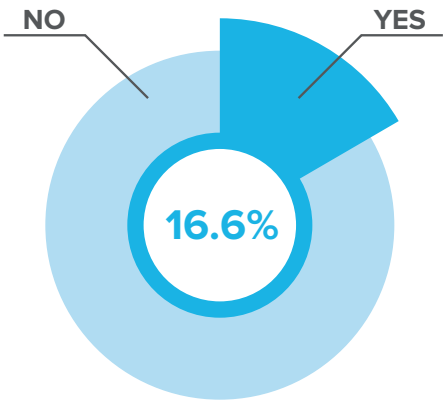
2016 U.S. NATIONAL INSTITUTE OF HEALTH FUNDING BY AREA OF RESEARCH



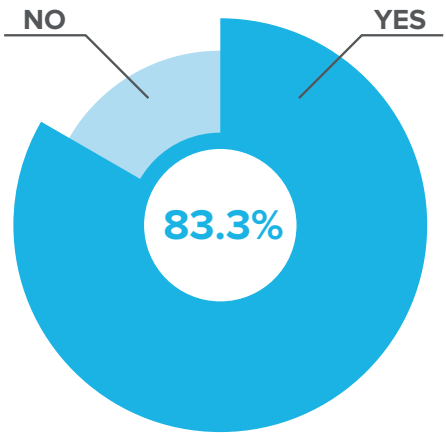
3 OTHER NUTRITION QUESTIONS ARE OFTEN FUNDED BY INTERESTED PARTIES.

Where funding comes from can affect what studies find.

CAN SUGARY DRINKS LEAD TO WEIGHT GAIN?



Studies WITH financial conflict of interest



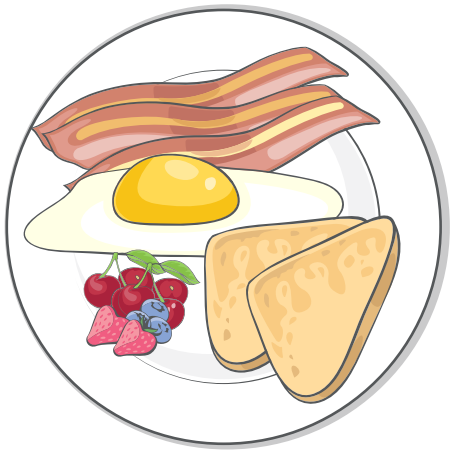
Studies with NO financial conflict of interest

This doesn't mean researchers are cheating. At the same time, corporate pressures can influence study design such that the research is more likely to show what the company wants it to show.

4 CONFOUNDING VARIABLES MAKE IT HARD TO PROVE FOOD'S EFFECTS.

Even in the best controlled trial, it's hard to isolate the effects of nutrition from all the other factors that affect your health.

EPIGENETICS MICROBIOME INCOME CLIMATE
ETHNIC HERITAGE AGE CHRONIC DISEASES EDUCATION PHYSICAL ACTIVITY ALCOHOL
WHETHER AND WHEN YOU HAVE KIDS STRESS LEVEL CONSUMPTION
YOUR HEALTH
CULTURE YOU LIVE IN AGE
HOW MANY DR. OZ DIETS YOU'VE TRIED SLEEP WHO YOUR FRIENDS ARE FOOD PREFERENCES
HORMONES GENETICS TRAUMAS AND AVERSIONS GENDER
SMOKING ADDICTIONS MENTAL HEALTH

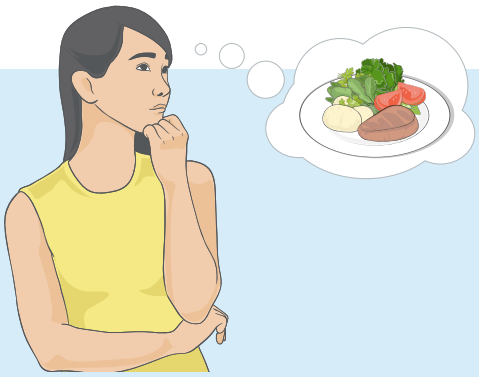


Participation in a study can itself become a confounding variable.

For example, when scientists asked subjects who normally eat breakfast to stop, and asked non-breakfast eaters to start — both groups lost weight. It was the dietary change that created weight loss, not breakfast.

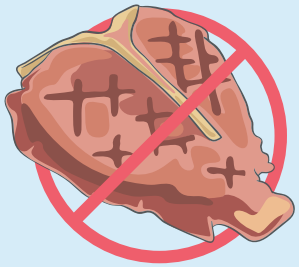
5 MOST NUTRITION STUDIES ARE OBSERVATIONAL.

Observational studies have subjects fill out questionnaires about their lifestyle and eating habits. This is a problem because:



People are terrible at remembering what or how much they ate. Quick! What did you eat for breakfast two Tuesdays ago? Exactly.

There are a lot of weird (and meaningless) correlations. One research group found that organic food sales are correlated with autism.

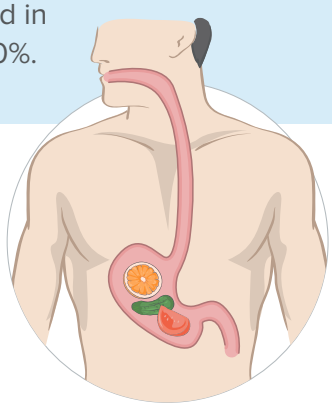


Correlation isn't causation. Does red meat cause heart disease and cancer, or do people with these chronic diseases happen to eat more red meat? Since an observational study can't account for all variables, it can't answer this question.

6 MEASUREMENT TOOLS ALWAYS HAVE LIMITATIONS.

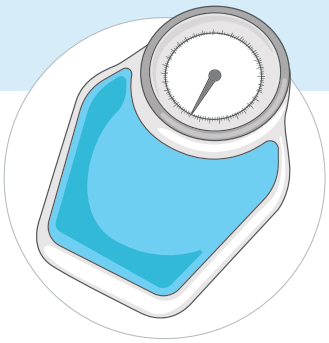
For example, even with a straightforward question like, "How do calories affect our weight?" it's hard to get an answer, because:

Calorie counts on food labels and in databases can be off by up to 50%.



We don't absorb all of the energy we consume, and there's no standard for how much energy we absorb, because individuals are unique.

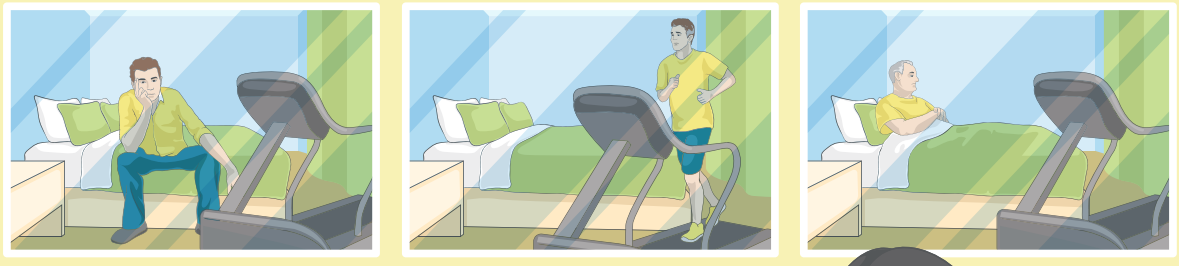
Calorie burn estimates can be off by 3 - 45%.



Your history of dieting and body composition influences how much energy you'll use.

7 WHAT YOU EAT DOESN'T AFFECT YOUR HEALTH RIGHT AWAY.

For example, to find out whether red meat causes cancer, you'd need study subjects to live in hermetically sealed metabolic chambers and eat varying amounts of red meat for 30 years. Who's going to sign up for that?



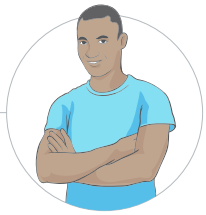
8 YOU CAN NEVER ASSUME A STUDY'S FINDINGS APPLY TO YOU.

Even if you *could* seal people in a metabolic chamber for 30 years, you *still* couldn't be sure who else those findings would apply to.

First, nutrition studies tend to use subjects who don't match the general population. They're often...

YOUNG AND HEALTHY

Grad students are popular subjects since they live near academic study labs, have time, and need a paycheck.



MALE

Men are easier to study than women, whose hormonal cycles are hard to control for.

SICK

Subjects suffering from problems like obesity, metabolic syndrome, and/or hypertension help researchers develop treatments.

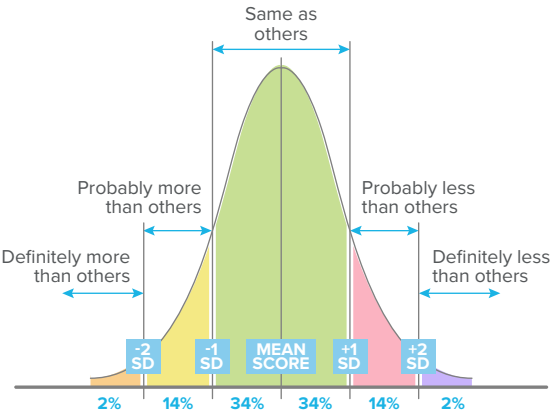
ULTRA FIT

Elite athletes' excellent physical condition minimizes variables and makes hours of exercise in the lab possible.

NON-HUMAN

Animals are captive and have short lifespans, making them convenient and cheap to study.

Second, study averages still may not apply to you, because...



SD = Standard Deviation

Averages are bell curves.

Most people won't match averaged study findings (at least not precisely).

Averages pool unlike subjects.

For example, a study where subjects metabolize caffeine either quickly or slowly could mistakenly show no effect of caffeine on health when 1/2 the subjects had a positive effect and 1/2 a negative one.

9 IF DOING THE RESEARCH IS DIFFICULT, REPORTING ON IT IS EVEN TOUGHER.

Journalists aren't usually trained research scientists. Which means they often:

- Misunderstand study conclusions
- Over-exaggerate single study findings
- Don't see how single studies fit into the big picture

Individual studies are interesting but not often important. They usually provide only one tiny piece of a gigantic puzzle that may take thousands of years to complete.

PrecisionNutrition

There you have it: Why nutrition science is so confusing at times. And why (sometimes) the media screws up reporting it.

Want to learn more?

If you'd like to learn more about helping people find the best way of eating for them, check out our Precision Nutrition Level 1 Certification program; the next group kicks off soon.

The Precision Nutrition Level 1 Certification gives you the knowledge, systems, and tools you need to build a rewarding career as a fitness and nutrition coach.

Developed over 10 years, and proven with more than 100,000 clients, our curriculum stands alone as the authority on the science of nutrition and the art of coaching.

Whether you're already mid-career, or just starting out, the Level 1 Certification is your springboard to a deeper understanding of nutrition, the authority to coach it, and the ability to turn what you know into results.

Visit this link for more information:
http://get.pn/level-1

[Of course, if you're already a student or graduate of the Level 1 Certification, check out our Level 2 Certification, an exclusive year-long Master Class for elite professionals looking to take their nutrition knowledge and coaching techniques to the highest possible level.]