BEST DIET
NUTRITION REPORT

EVALUATING POPULAR DIET APPROACHES

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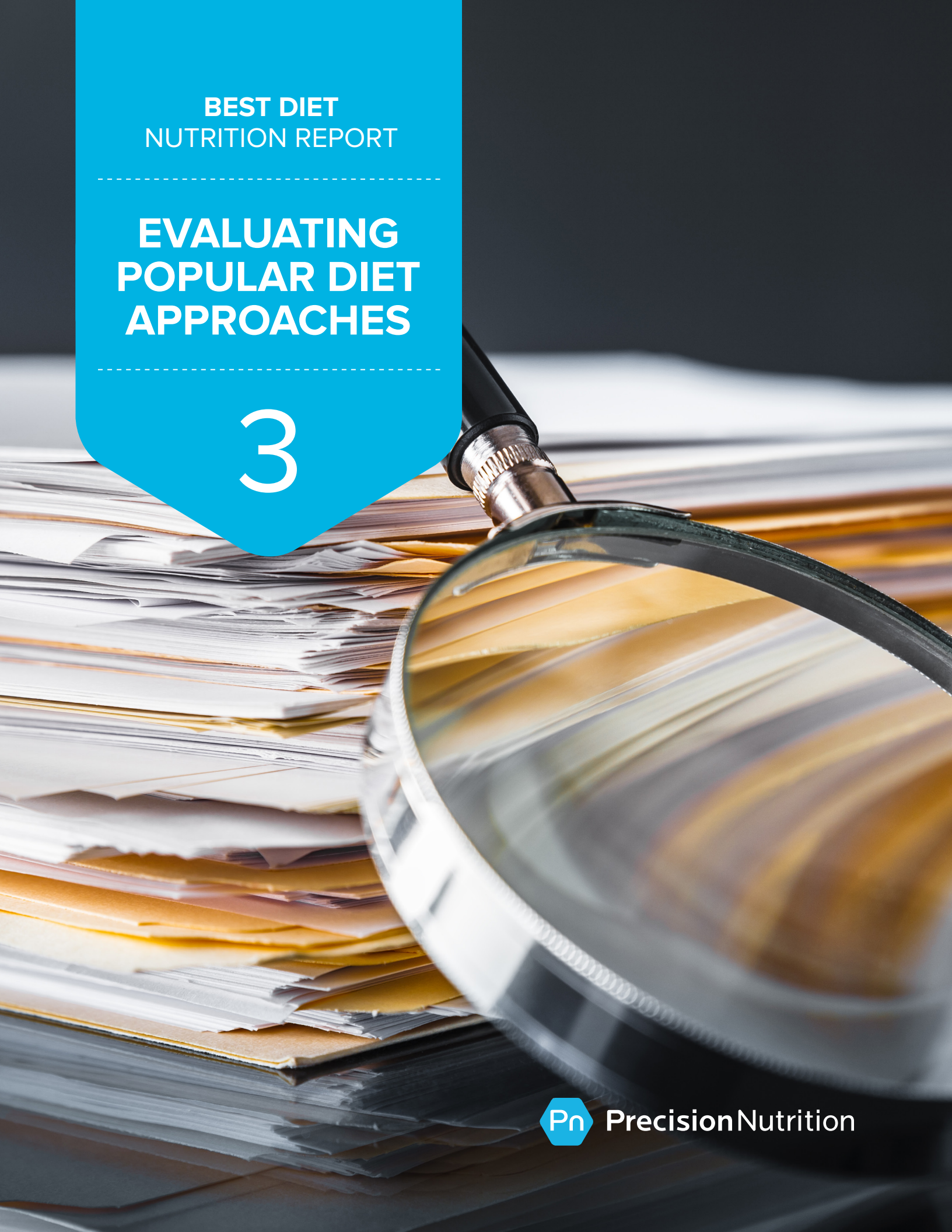

Precision Nutrition

BEST DIET NUTRITION REPORT

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THE PALEO PROBLEM:

Examining the pros and cons of the Paleo Diet.

By Brian St. Pierre, MS, RD

Unless you've been living in an actual cave, you've probably heard all about the Paleo – or "caveman" – diet. Maybe you've even tried it. A little meat here, some fresh veggies there. Perhaps going grain- or processed-food-free.

It's a cool idea that captures the imagination. But is it healthy? And does it work? That's what we'll explore in this article.

What we'll cover

In this article, we'll give you a definitive guide to the Paleo diet.

First:

- We'll define just what "Paleo" refers to.
- We'll explain what's so special about hunter-gatherers.
- We'll review how and what ancestral-style eaters actually do.

Then, we'll explore the ideas and evidence critically.

- What does Paleo promise?
- What evidence supports ancestral-style eating?
- What might cause our chronic 21st century health problems?
- Is the Paleo diet truly primal?
- What does our GI tract tell us?

Finally, we'll give you the all-important conclusion:

- **What should YOU do with all of this?**

“Paleo” defined

The Paleo, or primal, diet is based on two central ideas.

We adapted to eat particular kinds of foods.

To stay healthy, strong, and fit — and avoid the chronic diseases of modernity — we need to eat like our ancestors.

A brief history of eating

Our oldest cousins, the earliest primates, lived more than 60 million years ago. And, just like most primates today, they subsisted mainly on fruit, leaves, and insects.

About 2.6 million years ago, at the dawn of the Paleolithic era, things began to change.

Our early human ancestors started rockin’ the opposable thumb and big brain adaptations. They started using stone tools and fire, and, as a result, slowly changed their diet.

By the time truly modern humans came on the scene about 50,000 years ago, our ancestors were eating an omnivorous hunter-gatherer diet.

The basic Paleo diet

And thus we arrive at a model of a Paleo diet that includes:

- **animals** (meat, fish, reptiles, insects, etc. — and usually, almost all parts of the animals, including organs, bone marrow, and cartilage)

- **animal products** (such as eggs or honey)
- **roots/tubers, leaves, flowers and stems** (in other words, vegetables)
- **fruits**
- **nuts and seeds** that can be eaten raw

Recently, many Paleo proponents have suggested that eaters start with the above, then slowly introduce grass-fed dairy (mostly yogurt and other cultured options), and small amounts of "properly prepared" legumes — meaning legumes that have been soaked overnight.

What's so special about hunter-gatherers?

About 10,000 years ago, most of the world figured out agriculture. And thus, we moved from the Paleolithic to the Neolithic period.

Planting and farming provided us with a consistent and relatively reliable food supply, without which civilization could never have developed.

Yet the 10,000-year time frame since the dawn of the Neolithic period represents only about 1% of the time that we humans have been on earth.

Many people believe that the change from a hunting and gathering diet (rich in wild fruits and vegetables) to an agricultural diet (rich in cereal grains) gave rise to our modern chronic diseases such as obesity, diabetes, and cardiovascular disease.

This is a fundamental tenet of the Paleo Diet, and a big reason why proponents say we should return to the meat and produce-based diet of our past.

How do “ancestral eaters” fare?

Of course, while we have extensive skeletal remains, cooking sites, and other types of evidence, we don’t have detailed medical records of our hunter-gatherer hominid ancestors.

However, we do have real live sample populations that we can look at.

A diverse dietary world

The very few surviving hunter-gatherer populations subsist on a wide variety of diets, from the “nutty and seedy” African !Kung, to the root vegetable-eating Kitavans near Papua New Guinea, and the meat and fat-loving Inuit of the Arctic.

These foraging diets are diverse and probably reflect the widely varying diets of our prehistoric ancestors, simply because what people ate depended on where they lived: mostly plant-based (in the tropics), mostly animal-based (in the Arctic), and everything in between.

However varied their diets across the globe, ***most* Paleolithic humans likely consumed about three times more produce than the typical American.**

And when compared to the average American today, **Paleolithic humans ate more fiber, protein, omega-3 fatty acids, unsaturated fat, vitamins and minerals, and much less saturated fat and sodium.**

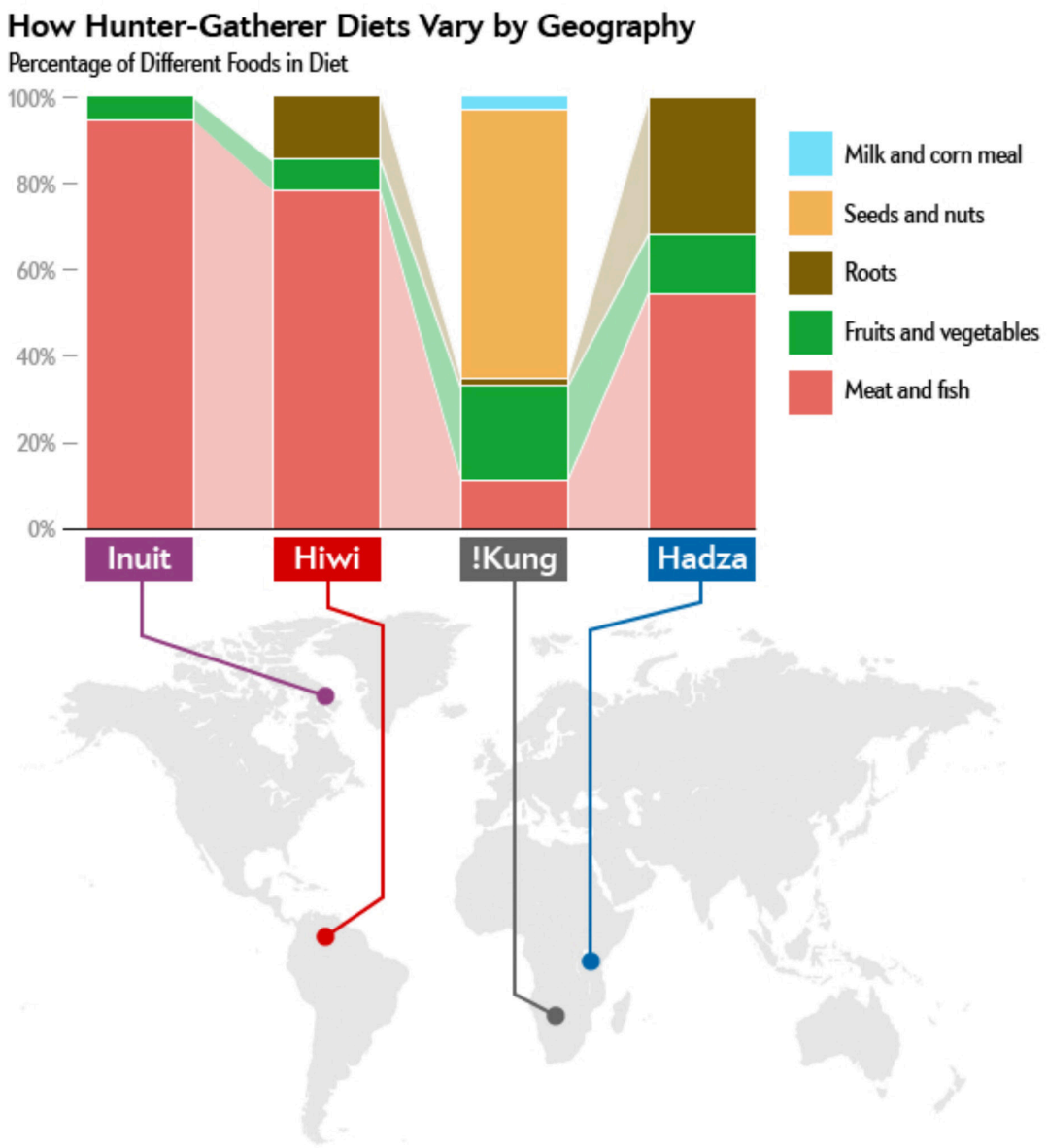


Image source: Jen Christiansen (Scientific American)

A modern example

The residents of Kitava Island, off Papua New Guinea, are probably the most famously researched modern hunter-gatherer population.

According to Dr. Staffan Lindeberg, who's extensively studied their habits, Kitavans live exclusively on:

- starchy root vegetables (yam, sweet potato, taro, tapioca);
- fruit (banana, papaya, pineapple, mango, guava, watermelon, pumpkin);
- vegetables;
- fish and seafood; and
- coconuts.

Kitavans are healthy and robust, free of obesity, diabetes, heart attacks, stroke, and acne — despite the fact that most of them smoke!

Things are looking good for eating like a cave dweller.

What Paleo promises

The main idea of a primal diet — as you've probably gathered (no pun intended) — is that our ancient human genetic "blueprint" doesn't match our current 21st century diet and lifestyle.

As a result, our health and wellbeing suffer.

The Paleo diet also makes some key evolutionary assumptions:

- Paleolithic hunter-gatherers were robust and healthy; if they didn't die young from accident or infectious diseases, they lived about as long as we do now.
- When Paleolithic hunter-gatherers shifted to Neolithic agriculture, they got relatively sicker, shorter, and spindlier.

- Modern hunter-gatherers are healthy, and their health declines when they switch to a modern diet.

What's the evidence?

While a case can be made for this evolutionary trend, as a matter of fact, hunter-gatherers were not pristine models of health.

To begin with, they certainly harbored various parasites. They were also subject to many infectious diseases.

What's more, a recent study in *The Lancet* looked at 137 mummies from societies ranging all over the world — from Egypt, Peru, the American Southwest, and the Aleutian Islands — to search for signs of atherosclerosis.

They noted probable or definite atherosclerosis in 47 of 137 mummies from all four geographical regions, regardless of whether the people had been farmers or hunter-gatherers, peasants or societal elite.

All got hardening of the arteries, no matter what their lifestyle. In fact, the hunter-gatherers of the Aleutian Islands had the highest prevalence, with 60% of their mummies having evidence of atherosclerosis.

Food for thought.

Diseases of affluence and industrialization

Although atherosclerosis may be a common human experience no matter what, "diseases of affluence" (obesity, diabetes, and cardiovascular diseases) have certainly gone up dramatically in the past 50 years in industrialized countries like the U.S., especially

compared to non-industrialized populations.

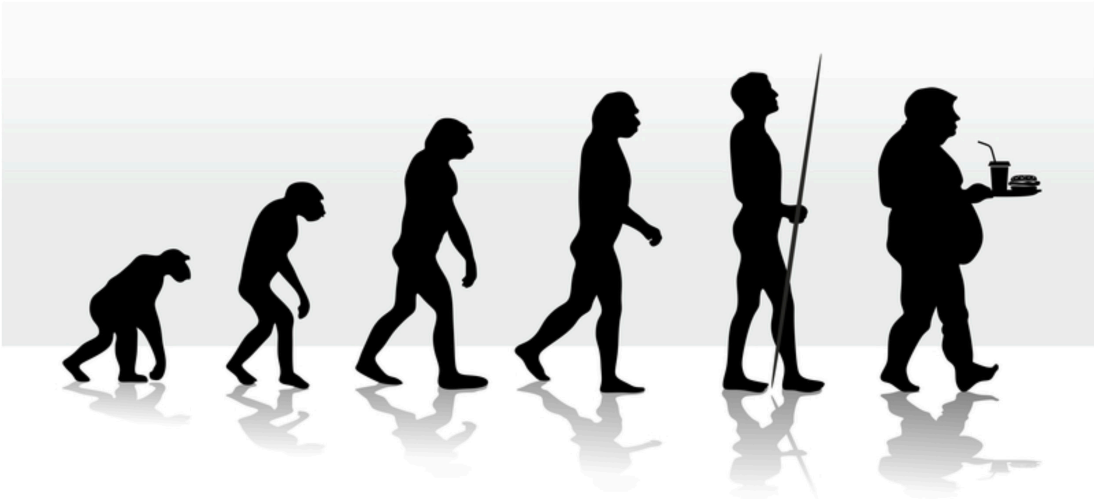
Over the last century — a period that is undoubtedly far too short for significant genetic adaptation — industrialization and technology have radically changed the way we eat and live.

Today, the average American subsists on foods that are packaged and commercially prepared. Rich in refined sugars and starches, highly processed fats, and sodium, these foods are designed to be so delicious that they run roughshod over the body's normal fullness signals, and encourage overeating.

Consider: The top six calorie sources in the U.S. diet today are grain-based desserts (cake, cookies, etc.), yeast breads, chicken-based dishes (and you know that doesn't mean roast chicken), sweetened beverages, pizza, and alcoholic drinks.

These are not ancestral foods. Nor foods that any nutrition expert, regardless of dietary persuasion, would ever recommend.

So when proponents of the Paleo diet claim that our modern Western diet isn't healthy for us, they are absolutely correct.



But is the Paleo diet really Paleo?

Remember: **There's no single "Paleo diet".**

Our ancestors lived pretty much all over the world, in incredibly diverse environments, eating incredibly diverse diets.

Still, in most cases, primal diets certainly included more vegetables and fruits than most people eat today. So if we want to be healthier, we should do what our ancestors did and eat a lot of those. Correct?

Maybe so... but not necessarily for the reasons that Paleo proponents recommend.

First of all, **most modern fruits and vegetables are not like the ones our ancestors ate.**

Early fruits and vegetables were often bitter, much smaller, tougher to harvest, and sometimes even toxic.

Over time, we've bred plants with the most preferable and enticing traits — the biggest fruits, prettiest colors, sweetest flesh, fewest natural toxins, and largest yields.

We've also diversified plant types — creating new cultivars from common origins (such as hundreds of cultivars of potatoes or tomatoes from a few ancestral varieties).

Likewise, **most modern animal foods aren't the same either.**

Beef steak (even if grass-fed) is not the same as bison steak or deer meat. And so on.

This doesn't make modern produce or modern meat inherently good or bad. It's just *different* from nearly anything available in Paleolithic times.

So the claim that we should eat a diet rich in vegetables, fruits, and meats *because we are evolved to eat precisely those foods* is a little bit suspect. The ones we eat today didn't even exist in Paleolithic times!

Grains and grasses

Proponents of the Paleo diet argue that our ancestors' diets could not have included a lot of grains, legumes, or dairy foods. And they contend that the past 10,000 years of agriculture isn't enough time to adapt to these "new" foods.

This argument is compelling but doesn't stand up to scrutiny.

- To begin with, recent studies in the *Proceedings of the National Academy of Sciences*, using more advanced analytical methods, have discovered that ancient humans may have begun eating grasses and cereals before the Paleolithic era even began — up to **three or even four million years ago!**

- Further research has revealed granules of grains and cereal grasses on stone stools starting at least **105,000 years ago**.

- Meanwhile, grain granules on grinding tools from all over the world suggest that Paleolithic humans made a widespread practice of turning grains into flour as long as **30,000 years ago**.

In other words, the idea that Paleolithic humans never ate grains and cereals appears to be a bit of an exaggeration.

Are beans really bad for you?

Grains are not the only plant type that the Paleo diet typically limits.

Advocates also recommend that you avoid legumes (beans, peanuts, peas, lentils) — and for a similar reason.

However, the idea that legumes were not widely available or widely consumed in Paleolithic times — like the argument that humans didn't eat grains in the Paleolithic era — is false.

In fact, a 2009 review revealed that **not only did our Paleolithic ancestors eat legumes, these were actually an important part of their diet!** (Even our primate cousins, including chimpanzees, got into the bean-eating act.)

Legumes have been found at Paleolithic sites all over the world, and in some cases were determined to be the dominant type of plant food available. In fact, the evidence for wild legume consumption by Paleolithic humans is as strong as it is for any plant food.

What about anti-nutrients?

Okay. Maybe our ancient ancestors did eat a little bit of grain and some legumes — so the argument from history doesn't really hold.

But Paleo proponents also offer another reason to avoid these foods: Their high concentration of anti-nutrients, which supposedly reduces their nutritional value to zilch.

There's just one problem with this argument. It's wrong.

Indeed, research suggests that **the benefits of legumes far outweigh**

their anti-nutrient content, especially in light of the fact that cooking eliminates most anti-nutrient effects.

Lectins and protease inhibitors, in particular, are greatly reduced with cooking. And once cooked, these chemicals may actually be good for us.

Lectins may reduce tumor growth, while protease inhibitors become anti-inflammatory and anti-carcinogenic.

Phytic acid

But what about phytate?

Grains, nuts, and legumes are rich sources of this anti-nutrient, which can bind to minerals such as zinc and iron and prevent their absorption. Surely that, in itself, is enough reason to avoid grains and legumes?

Not necessarily.

While phytic acid can be toxic if we eat too much of it, in more reasonable amounts it actually offers benefits.

For example, it can:

- have antioxidant activity
- protect DNA from damage
- be prebiotic (i.e. food for bacteria)
- have anti-cancer properties
- reduce bioavailability of heavy metals like cadmium and lead.

And, in a mixed diet composed of other nutrient-dense whole foods, phytic acid is unlikely to cause problems.

In fact, nearly *all foods* contain anti-nutrients as well as nutrients — particularly plant foods.

For example, incredibly healthy foods such as spinach, Swiss chard, many berries, and dark chocolate are also sources of oxalate, an anti-nutrient that inhibits calcium absorption.

Green tea and red wine contain tannins, another anti-nutrient that inhibits zinc and iron absorption.

And so on.

Overall, phytic acid and other so-called anti-nutrients probably have a "sweet spot" (just like most nutrients).

- Eating none or a small amount might be inconsequential.
- Eating a moderate amount might be good.
- Eating too much will hurt you.

Grains and inflammation

Another argument for a Paleo diet is that eating grains can lead to inflammation and related health problems.

While this can be true for people with celiac disease (about 1% of the population) and for those with non-celiac gluten sensitivity (estimated to be about 10% of the population, if it even truly exists), on the whole, the research does not support this argument any more than it supports the argument about anti-nutrients.

In fact, observational research has suggested that:

- *whole* grains may *decrease* inflammation, but
- *refined* grains may *increase* inflammation.

In other words, it appears that **processing may cause problems, not the grain itself.**

Meanwhile, controlled trials consistently show that **eating grains, whether whole or refined, does not affect inflammation at all!**

What can we make of that?

At worst, whole grains appear to be neutral when it comes to inflammation.

And overall, a substantial body of evidence from both observational and controlled trial research suggests that **eating whole grains and legumes improves our health**, including:

- improved blood lipids;
- better blood glucose control;

- less inflammation; and
- lower risk of stroke and coronary heart disease.

Eliminating these important foods from our diet to conform to anybody's dietary ideology is probably a poor idea.

Evolution of the human GI tract

In Paleo circles, it's sometimes said that while the world has changed in innumerable ways in the last 10,000 years, our genes have changed very little. And further, that we really only thrive in a world with similar conditions to the Paleolithic era.

Quite frankly, this is not how evolution or genetic expression works.

If humans could thrive only in an environment similar to or the same as the ones their ancestors lived in, our species would not have lasted very long.

Examples of the ways we have evolved in the past 10,000 years abound.

For example, over the past 8,000 years or so, about forty per cent of us have developed the capacity to consume dairy for a lifetime. As a species, we're evolving a mutation whereby we continue to produce the lactase enzyme to break down lactose for far longer periods than our ancestors ever could. True, not everyone can digest lactose well, but more of us can do so than ever before.

And studies have shown that even people who *don't* digest lactose well are capable of consuming moderate amounts of dairy, tolerating an average 12 grams of lactose at a time (the amount of lactose in one cup of milk) with few to no symptoms.

Additionally, the emerging science of epigenetics is showing that a "blueprint" alone isn't enough — genes can be "switched off" or "on" by a variety of physiological and environmental cues.

Gut knowledge

Our digestive systems have adapted over millennia to process a low-energy, nutrient-poor, and presumably high-fiber diet. Meanwhile, Western diets have become high-energy, low-fiber, and high-fat.

Our genes produce only the enzymes necessary to break down starch, simple sugars, most proteins, and fats. They aren't well adapted to cope with a steady influx of chicken nuggets, Tater Tots, and ice cream.

So how is it that we can still digest our food, albeit imperfectly at times?

Thank the trillions of bacteria that live in our gut. These friendly critters interact with our food in many ways, helping us break down tough plant fibers, releasing bound phytonutrients and antioxidants, and assisting us to assimilate many important compounds.

Now, we don't have direct evidence of which bacterial species thrived in Paleolithic intestines, but we can be pretty confident that our ancestors' microbial communities would not exactly match our own.

That's because bacteria evolve and adapt at a rate much faster than our slow human genes. And for us, that's a good thing.

It helps to explain why, even if the ancient human diet didn't include grains, legumes, dairy, and other relatively modern agricultural products, we still might thrive on such a diet today – at least, with a little help from our bacterial friends.

The magical microbiome

Thanks to the Human Microbiome Project and other massive research projects around the world, we now know that trillions of microorganisms from thousands of different species inhabit the human body.

In fact, the total genetic makeup of these little creatures is at least 100 times greater than our own! (Essentially, we're only 1% human. Think about *that*.)

This vast genetic diversity ensures that our GI tracts can adapt rapidly to changes in diet and lifestyle.

A single meal can change the type of bacteria that populate your gut. And as little as several days on a new diet can lead to dramatic changes in the bacterial populations in your GI tract.

The diverse, complex, and dynamic nature of our microbiome helps to explain why some of us seem to do well on one type of diet, while others will feel and perform better with another type of diet — even though, genetically, we're all 99% the same!

Many of us can break down the more "modern" food compounds that Paleo advocates claim we do not tolerate well — simply because our intestines harbor bacteria that have evolved to do that job.

For instance, some Japanese people host unique bacteria that can help them digest seaweed.

And many people can alleviate symptoms of lactose intolerance by eating yogurt or other probiotic-rich foods that provide lactose-digesting bacteria.

So even if you don't naturally break down lactose well, it's possible, through the right combination of foods and/or probiotic supplements, to persuade the bacteria in your gut to do this job on your behalf.

What's more, the same strategy could also address gluten intolerance.

Recent research shows that some bacteria actually produce enzymes that break down gluten — as well as phytic acid — reducing any inflammatory or anti-nutrient effects.

Which, as we know, are two of the main reasons people recommend starting Paleo diets in the first place.

Modern Paleo research

No matter how you slice it, the Paleo proponents' evolutionary arguments just don't hold up.

But that doesn't mean that the diet itself is necessarily bad.

Maybe it's a good diet for completely different reasons than they say.

To find out if that is so, a number of researchers have been putting Paleo diets to the test with controlled clinical trials. And so far, the results are promising, though incomplete.

Paleo vs. Mediterranean diets

Perhaps the best known of these researchers is Dr. Lindeberg — the one who also studied the Kitavan Islanders. He and his colleagues have conducted two clinical trials testing the efficacy of the Paleo diet.

In the first, they recruited diabetic and pre-diabetic volunteers with

heart disease and placed them on one of two diets:

- **A "Paleolithic" diet** focused on lean meat, fish, fruit, vegetables, starchy root vegetables, eggs, and nuts, or

- **A "Mediterranean" diet** focused on whole grains, low-fat dairy, vegetables, fruit, fish, oils, and margarine.

After 12 weeks, the Mediterranean group lost body fat and saw an improvement in markers of diabetes. Four of the nine participants with diabetic blood sugar levels at the beginning of the study had normal levels by the end. That's a very good result and must have made the participants happy.

But those in the Paleo group fared even better.

They lost *70 percent more* body fat than the Mediterranean group and also normalized their blood sugars. In fact, all ten participants with diabetic blood sugar levels at the beginning of the study reached non-diabetic levels by the end of the study.

By any estimation, that is an astonishing result.

Now, these volunteers were suffering from mild, early cases of diabetes. But a second study of long-term diabetics showed that a Paleo diet didn't cure them but it did improve their condition significantly.

Other research has found:

- The Paleo diet is more satiating per calorie than a Mediterranean diet.
- The Paleo diet improves blood pressure, glucose tolerance, and blood lipids.

However, one caveat: Like most low-carb trials, the macronutrients (especially protein) in these studies weren't matched.

The Paleo group ate a lot more protein, compared to the other diet groups. Plenty of protein helps keep our lean mass dense and strong, stay lean, and feel satisfied by our meals.

So, we're not just comparing apples to oranges when protein intakes are different; this is more like comparing grains to goat meat. Literally.

The Paleo diet may indeed be the best plan, but it's hard to know for sure without direct comparisons that match macronutrients and calories.

Conclusion & recommendations

What does the Paleo diet get right?

Despite the faulty evolutionary theory it's based on, in the end, **the Paleo diet likely gets more right than it gets wrong.**

- **Paleo-style eating emphasizes whole foods, lean proteins, vegetables, fruits, nuts, seeds, and other healthy fats, which is a massive improvement over the average Western diet.**
- **Paleo-style eating has been extremely effective for improving several chronic diseases.** That alone is a huge plus.
- **Paleo-style eating has made us more aware of how processed and crappy a lot of our 21st century food is.**

However, we need more rigorous (and carefully matched) trials before we can reach any definitive conclusions.

What are the challenges?

Despite its obvious benefits over the typical Western diet, the Paleo diet has some flaws.

- **The evidence for excluding dairy, legumes, and grains isn't (yet) strong.** So as a nutrition coach, I can't say it's a one-size-fits-all prescription. Certainly, some people should avoid dairy and gluten, and keep legume and grain consumption more modest. But most of us can improve the way we look, feel, and perform without completely eliminating these foods.

- **The evolutionary arguments don't hold up.** The human species isn't simply a collection of adaptations to life in the Paleolithic era. We are an ever-evolving accumulation of inherited characteristics (and microorganisms) that have been switched, reconstructed, lost, and reclaimed since the first prokaryotes came to life on Earth. This evolution has continued over the past 10,000 years — and won't stop anytime soon.

- **In the broader sense, strictly following a list of "good" and "bad" or "allowed" and "not allowed" foods tends to be problematic for most people.** Generally, this approach leads to anxiety and all-or-nothing thinking. Maybe it makes us feel more confident and (falsely) sure of ourselves in the short term. But it's less effective over the long-term — because ultimately, it decreases our consistency.

This may explain why we are seeing the Paleo diet *itself* evolve.

It's evolution, baby

Many Paleo advocates have recently come to appreciate and

encourage the addition of moderate amounts of starch (albeit a more limited variety of options than I would prefer), as well as some dark chocolate, red wine and non-grain spirits (such as tequila), and grass-fed dairy.

These additions make life much more pleasant. They make healthy eating more attractive and achievable.

In fact, this new “leniency” may partly explain why the Paleo diet continues to gain traction in mainstream nutrition circles.

Because in the end, moderation, sanity and your personal preferences are more important than any specific food list, anti-nutrient avoidance, or evolutionary theory.

What to do today

Consider the good things about ancestral lifestyles. This includes fresh food, fresh air, lots of movement, good sleep, and a strong social network. How could you get just a little bit of these in your life today?

Think about how you could move along the spectrum — from processed 21st century life and food — to choices that are a little more in tune with what your ancient body needs and loves.

Learn a little more about your ancestors. Evolution is cool. Dig into your roots: Where did your people come from? What were their ancestral diets? (23AndMe will tell you how much of your DNA is Neanderthal.)

Keep it simple and sane. Doing a few good things pretty well (like getting a little extra sleep or fresh veggies) is much better than trying to get a lot of things "perfect".

Stay critical and informed. Avoid dogmatic or cultish thinking. Be skeptical. Look for evidence. Question everything. Primal eating is a super cool idea and may turn out to be more or less right; just keep your late-evolving prefrontal cortex (aka your thinky brain) in the game as you consider all the options.

Help your old body (and your trillions of little buddies) do their jobs. Our bodies are resilient. We didn't get to be one of the dominant species on the planet by being fussy, delicate flowers. Nevertheless, think about how you can nourish your body optimally in order to give your body and microbiome the best chance of surviving *and* thriving.

CARB CONTROVERSY:

The pros and cons of a low carb diet.

By Brian St. Pierre, MS, RD

Ask almost anyone what they need to do to lose a few pounds, and they'll probably say: "Cut back on the carbs." As a nutrition coach, I've heard it hundreds of times.

While the low carb movement has waxed and waned in popularity since the Atkins revival of the late 90s and early 2000s, most folks now assume that carbohydrates are inherently fattening.

Health-conscious diners order bunless hamburgers, skip the baked potato side dish, and send the bread basket back to the kitchen.

(Or don't, and feel guilty about it.)

In the past few years, I'll bet you've heard (or thought) at least one of the following:

- Carbs spike your blood sugar and insulin, which slathers on the body fat.
- Carbs, especially sugar and grains, cause inflammation.
- Carbs are not an essential part of the diet like fat and protein.

Seems simple and logical. Which is the problem.

These simplistic statements about "good foods" and "bad foods" ignore biological complexity and the bigger picture.

Let's look closer.

Do carbs increase insulin levels?

Yes, they do.

Does increased insulin after meals lead to fat gain?

No.

(Insulin's actually a satiety hormone — in other words, it makes you feel full — so the idea that on its own it leads to fat gain doesn't make sense.)

Are carbs really inflammatory?

That depends. Are we talking about processed corn syrup? Probably. But if we're talking about whole grains, not really.

Are carbs less important than protein, fat, and the many micronutrients that contribute to our health?

Well, if you're talking about processed carbs, the answer is a resounding yes. But if you're talking about whole, minimally processed carbs, that's a different story.

Can a low-carb diet work to help people lose weight?

Of course it can.

Is it because it is low in carbs?

Maybe. Maybe not.

Can eating an appropriate amount of carbs actually help you look, feel and perform your best?

You bet it can.

The problem with *not* eating carbs

As a weight loss strategy, cutting carbs (while reducing the total number of calories) clearly works pretty well for some people. If it didn't, then Atkins would have never been popular in the first place.

Here's the thing, though: **Carb reduction costs us.**

You see, **most of us require some level of carbohydrates to function at our best over the long term.**

Sure, we can cut carbs *temporarily* if we need to lose weight quickly. But for most of us, keeping carbs too low for too long can have disastrous consequences.

This is especially true for those of us who work out.

If you're sedentary, your carb needs are lower. So you might be able to get away with more restriction.

But if you like to exercise regularly and enthusiastically, restricting your carb intake too drastically can lead to:

- decreased thyroid output
- increased cortisol output
- decreased testosterone
- impaired mood and cognitive function
- muscle catabolism
- suppressed immune function.

In other words: Your metabolism might slow, your stress hormones go up and your muscle-building hormones go down.

You feel lousy, spaced-out, sluggish, cranky... and maybe even sick.

Most vexing of all: **You probably don't even lose that much weight in the long term.**

If you're interested in the details and some research, read on. If you just want to know what to do, skip to the end.

Decreased thyroid

In order to function properly and to maintain an appropriate metabolism, our body produces an important hormone called T3. T3 is the most active thyroid hormone and is incredibly important for blood glucose management and proper metabolic function.

Low T3 levels can lead to a condition called euthyroid sick syndrome, in which people are constantly cold and sluggish. (Imagine your metabolic "body motor" idling at a slower speed.)

A landmark study, known as the Vermont Study, found that T3 is very sensitive to calorie and carbohydrate intake. **When calories and carbs are too low, your T3 levels drop.**

In addition, the Vermont Study found that another hormone, *reverse* T3 (rT3), is *also* sensitive to calorie and carbohydrate intake. Reverse T3, as the name implies, inhibits T3.

Getting enough carbs can lower reverse T3. Not eating enough carbs will increase it, thus blocking the important work of T3.

The Vermont Study is far from alone. Other research confirms that ketogenic (ultra-low carb) diets reduce T3 levels as rapidly as starvation.

Additional studies show that when calories are held constant (in this case at 2100 calories), reducing carbohydrates from 409 g to 202 g and then to 104 g significantly reduced serum T3 levels (from 91 to 86 to 69 ng/dL respectively).

Finally, French researchers examined four calorically equal diets (2800 calories in this case), lasting 1 week each. Two of these diets contained 250 grams of carbs, which is a fairly typical proportion. The low-carb diet included 71 grams of carbs, and the high-carb diet included 533 grams of carbs.

T3 levels were equal on the normal and high carb diets (ranging from 163.3 to 169.5 ng/100 mL). However, on the low carb diet they fell to 148.6 ng/100 mL on average. And of course, rT3 correspondingly rose on the low carb diet, but not on the standard or high carb diets.

Thyroid hormones are important for more than just weight loss; they also have profound effects on our overall health and energy levels.

Thus, when you don't eat enough, and/or eat enough carbs while training:

- T3 goes down
- Reverse T3 goes up, further blocking T3
- You feel like crap, and eventually your training sucks

If you're active, you *need* adequate energy and carb intakes for a healthy thyroid.

Cortisol up; testosterone down

Research consistently shows that **people who exercise regularly need to eat enough carbs or their testosterone will fall while their cortisol levels rise.** This is a sure-fire recipe for losing muscle and gaining fat.

Incidentally, it's also a marker for excessive training stress.

In a study in *Life Sciences*, men who ate a high carbohydrate versus a low carbohydrate diet for 10 days had higher levels of testosterone and sex hormone binding globulin, and lower levels of cortisol.

A few years later, another study took this research a step further. This time the subjects included men and women who exercised regularly. And in addition to considering the effect of their diet on hormones, researchers put them through some performance tests.

Once again, **when the subjects ate a low carb diet, their testosterone (and other anabolic hormones) went down, while their cortisol went up.**

And, after following a low carb diet for just *three* days, only two of the six participants were able to complete the cycling test! Meanwhile, when following the higher carb diet for three days, all six participants were able to complete the test.

In 2010, researchers reconsidered the same question — this time in relation to intense exercise. In this particular study, subjects eating the low carb diet (where 30% of their calories came from carbs) saw a drop of 43% in their testosterone to cortisol ratio. Not good. Meanwhile, the control group (who got 60% of their calories from carbs) saw no change in their testosterone/ cortisol ratios.

Thus inadequate carbohydrate intake can:

- **decrease testosterone (which no one wants); and**
- **increase cortisol (which no one wants); while**
- **negatively affecting performance (which no one wants).**

Carbohydrates and women's hormones

We now know that **eating too low-carb for too long can cause significant disruptions to many hormones.**

This seems especially true for women, whose bodies may be more sensitive than men's to low energy or carbohydrate availability (perhaps because of the evolutionary importance of having enough body fat and nutrients to sustain a pregnancy).

While organs like our gonads or thyroid make hormones, Mission Control of our hormone production system is the central nervous system (CNS), i.e. the brain.

Our hypothalamus and pituitary glands, which sit in the brain, are exquisitely sensitive to things like energy availability and stress (which can include life stress and exercise stress).

The hypothalamus and pituitary work together with other glands such as the adrenal glands. This partnership is often known as the hypothalamic-pituitary-adrenal, or HPA, axis.

Thus, when women don't eat enough calories or carbohydrate — or even when women eat enough calories but not enough carbohydrate — they face **hypothalamic amenorrhea.**
This means disrupted hormones and stopped — or irregular — periods

because of the HPA's response to perceived starvation and stress.

In hypothalamic amenorrhea, hormone levels plummet, and the cascade is felt throughout the system. You end up with low levels of luteinizing hormone (LH), follicle-stimulating hormone (FSH), estrogen, progesterone, and testosterone.

In addition, we've already seen that not eating enough carbohydrate tends to increase cortisol levels. When cortisol rises, it signals your HPA axis to further decrease pituitary activity. Not good.

Your HPA axis regulates functions such as stress response, mood, digestion, immune system, libido, metabolism and energy levels.

And your pituitary in particular is responsible for synthesizing and secreting growth hormone, thyroid stimulating hormone, prolactin, LH, FSH and other incredibly important hormones.

With all this said, here's the takeaway message: Many women try to eat low-carb, wanting to be healthier.

Yet because low-carb diets can significantly disrupt hormone production, women with too-low carb intakes — especially active women — can face:

- a stopped or irregular menstrual cycle;
- lowered fertility;
- hypoglycemia and blood sugar swings;
- more body fat (especially around the middle);
- loss of bone density;
- anxiety, depression, and other mental health issues;

- chronic inflammation and worse chronic pain;
- chronic fatigue and disrupted sleep; and
- a host of other chronic problems...

...ironically, this is the exact opposite of what they wanted in the first place.

Muscle loss

When we think about building muscle, we usually think of protein. But research shows that lowering carb intake can affect your muscle mass *even* if protein remained constant.

In other words, even if you're guzzling protein shakes or eating steak 5 times a day, you could be losing muscle if you aren't getting enough carbs.

A recent study from the Netherlands compared three diets:

- a high carb diet (85% carbs);
- a medium carb diet (44% carbs); and
- a low carb diet (2% carbs).

All diets had the same total calories and the same amount of protein — 15%. (Yes, a little low, but more or less adequate.)

The result? For starters, pretty consistent with other research.

- T3 levels and reverse T3 levels stayed the same with high and moderate carbohydrate intake.
- T3 levels and reverse T3 went down on the low-carb diet.

But here's the interesting wrinkle: In this study, the researchers also measured urinary nitrogen excretion to see how the diets affected protein breakdown.

In this case, **the low carb diet *increased* muscle breakdown, because severely low carbs lowered insulin levels.**

Again, you'd assume that protein intake would determine muscle breakdown. And you might assume — based on what you've heard — that having higher insulin is always "bad".

In fact, **insulin is crucial for building muscle.**

When you get enough carbs to meet your needs, you replenish muscle glycogen and create an anabolic (building-up) hormonal environment. You get strong and buff. That's good.

Conversely, when you don't eat enough carbohydrate, muscle glycogen is depleted and a catabolic (breaking-down) hormonal environment is created, which means more protein breakdown and less protein synthesis. This means slower muscle growth — or even muscle loss.

Putting it all together

The bottom line? **Not eating enough carbohydrates can lower T3 levels, disrupt cortisol to testosterone ratios, interfere with a woman's delicate hormone balance, contribute to muscle loss, and prevent muscle gains.**

Definitely not what most of us want!

But wait a minute.

Even if all of this is true, aren't low carb diets better for fat loss?

And aren't fat-adapted athletes performing just as well as athletes who eat a lot of carbs?

Low carbs are not better for fat loss

The logic seems so clear and appealing: *High carbs lead to insulin which leads to fat storage. Low carbs keep insulin low, which should get you effortlessly lean while you enjoy chicken wings, salmon, eggs, and butter.*

Indeed, many people who try low-carb dieting are initially pleased by an immediate weight loss... which is mostly water and glycogen. So, in the short term, it *seems* like low-carb diets are superior.

But does long-term evidence support low-carb dieting?

Research says no. **Over the long haul, any differences between low-carb and other diets even out.**

Protein: The hidden success factor

Most studies that suggest low-carb diets are superior suffer from a common methodological flaw: They usually don't match protein intake between groups. This means that the low carb group often ends up consuming significantly more protein.

We know that getting plenty of protein has many advantages:

- protein has a higher thermic effect — our bodies have to "rev up" to digest it (you'll know this if you've ever gotten the "meat sweats" after a big steak);

- protein makes people feel fuller, longer; and
- protein helps people retain lean mass.

In other words, the big "secret" might be a *high protein diet* rather than a *low carb diet.*

So let's play fair and look at a study where protein was matched. In this study, subjects who ate a moderate carb diet (40% calories from carbs) reported significantly better mood, and **lost about the same amount of weight as those on a ketogenic low-carb diet** (5% calories from carbs).

Actually, the group who ate a moderate amount of carbs showed a small (though not statistically significant) tendency to lose *more* body fat as compared to those on a low carb diet (5.5 kg vs 3.4 kg in 6 weeks).

Both diets improved insulin sensitivity. However, the ketogenic diet also increased LDL cholesterol and inflammatory markers and subjects who were on it felt less energetic.

Thus, in this study:

- moderate carb eaters felt better
- moderate carb eaters lost about the same amount of weight, maybe even a little more
- both types of eaters improved insulin sensitivity
- the low carb dieters ended up with worse blood work and inflammation

Makes you wonder why low carb gets so much hype, doesn't it?

Especially considering that a recent review of long-term low carb

versus low fat diets — the largest of its kind so far — found that both low carb *and* low fat diets reduced people's weight and improved their metabolic risk factors. In this review, both diets had about the same weight loss, changes in waist circumference, and measurements of several metabolic risk factors (blood pressure, blood glucose, insulin).

Still, it would be great to understand more about what makes low carb diets "work" at all. One recent study asked: Do low carb diets work because they restrict carbs or because they tend to increase protein?

Over the course of one year, the researchers compared four different conditions:

1. normal protein, normal carbohydrate
2. normal protein, low carbohydrate
3. high protein, low carbohydrate
4. high protein, normal carbohydrate.

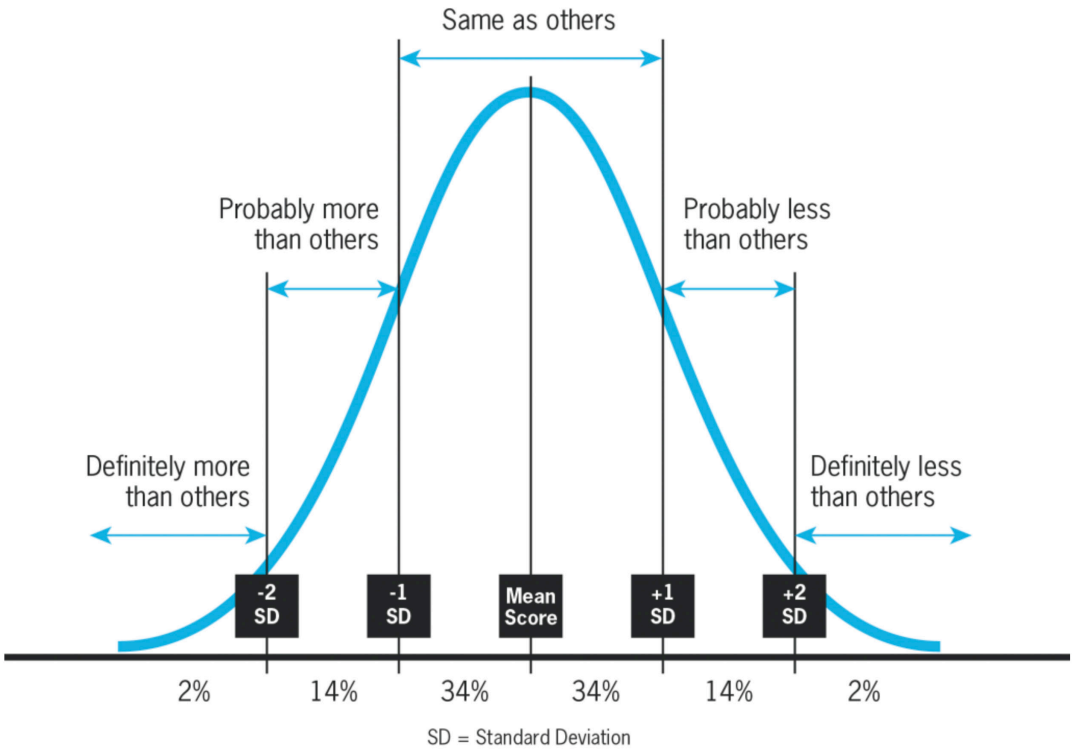
Interestingly, **the two groups eating the high protein lost the most weight.**

And the real kicker? **Varying the levels of fats and carbs seemed to make no difference to body composition.**

Who needs carbs? Who doesn't?

As our name implies, at Precision Nutrition we don't believe in one-size-fits-all dietary recommendations.

Like most things, carbohydrate requirements fall on a bell curve.



Most people do best with some carbs.

- **About 70% of you will do really well with PN's standard hand-size portion guidelines.** (See our Calorie Control Guide for more.)

- **Around 25% of you will do really well increasing or reducing your carb servings by just a little bit.** This is what we call eating for your body type, and we outline our recommendations here.

A few people do best with high carbs.

- About 2.5% of the population — people who are ultra-endurance athletes, and a few other outliers — will thrive when eating incredibly high amounts of carbs. (We're talking ≥ 70% of their total calories).

A few people do best with low carbs.

- In fact, ketogenic diets are actually prescribed for people with epilepsy, as they seem to reduce their symptoms and cut down on seizure frequency. There is also preliminary evidence that ketogenic diets benefit other neurological disorders, such as Parkinson's disease and Alzheimer's disease.

- Very sedentary people, as well as people who are extremely metabolically dysregulated (e.g. metabolic syndrome, diabetes), may benefit from a lower-carb diet for a while as part of an overall transition towards more activity and healthier metabolism.

A unique specimen: The low-carb athlete

You might have been wondering about that remaining 2.5% of successful low-carbers.

While rare, these ultra-low-carb people do exist. Even in athlete trials, where the vast majority of participants do better on high carb diets versus low carb diets, you'll almost always find a few who perform better on a low carb regime.

This study on competitive cyclists offers a perfect example. While the authors concluded that endurance wasn't generally affected by a high-

fat, low-carb intake — at least after athletes became adapted to it — individual responses to this diet did vary enormously.
Two of the five participants got tired sooner when eating low-carb (taking 48 and 51 minutes to conk out, respectively). But one participant actually got *better* by 84 minutes on the low carb diet.

The data are clear: Each athlete — each person — is unique when it comes to carbohydrate requirements.

While on average the performance of the cyclists did not vary whether they were eating high carb or high fat diets, there was one interesting difference, highlighted by the study authors in a review study done twenty-one years later.

After a week of adaptation to the low-carb diet, most cyclists felt that they could more or less perform normally... except for their sprint capacity, which *never* seemed to recover while restricting carbs.

If you are a high-performing athlete, this might be especially important to keep in mind. Even in extreme endurance sports, sprint capability can be vitally important. Especially as you're nearing that finish line.

But before we get too carried away in the opposite direction and start carb loading, let's remember this basic truth: Most of us are not elite athletes.

So while studies will show that on average athletes tend to perform better with higher carb intakes, this is not a universal rule. There is always individual variability.

What this means for you

Sometimes, we get so caught up in fad diets that we forget to look at the evidence. But fad diets are mostly bad diets.

For many years, we thought the secret to maintaining our weight was to eat lots of carbs and reduce our fat intake. Just think of the old Food Guide Pyramid with grains at the bottom and oils at the top.

Low-fat, high-carb didn't work for most of us. People felt deprived and hungry; they "cheated" with "fat-free", high-sugar treats; and they ended up eating a lot of rice cakes.

Then the pendulum swung, people hopped on the low carb, high fat bandwagon, and it was party time with almond butter, bacon, and heavy cream.

Unfortunately for most of us, low carb doesn't work so well, either.

Strict diets aren't the answer

If your eating plan isn't working for you, it's tempting to make it more restrictive. You might assume that if you aren't losing fat going kinda low-carb, you should go full ketogenic.

But more restriction almost never works.

Don't take your nutrition to extremes — unless you have extreme goals. Strategic moderation, as unsexy as that sounds, is the only sustainable method.

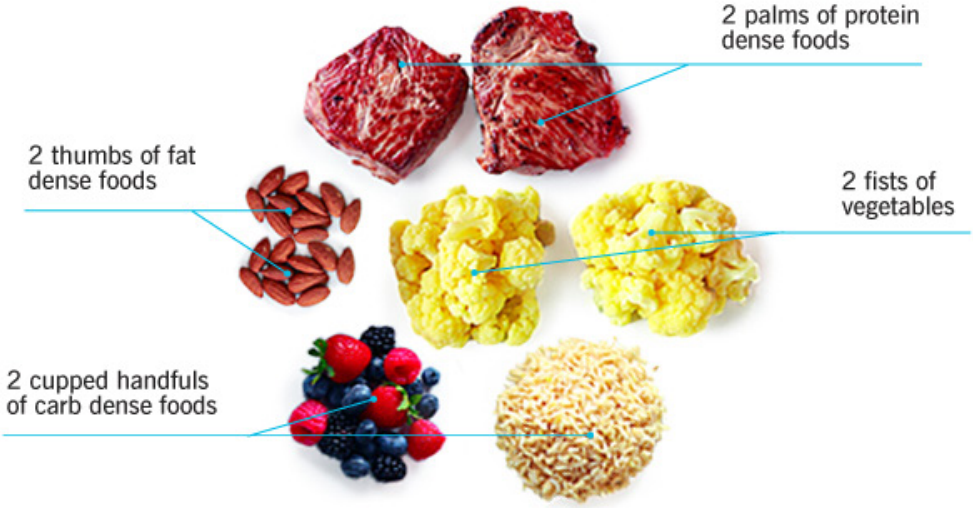
Most of us need some carbs

Most of us will look, feel, and perform our best when we balance a reasonable amount of lean protein, quality carbs, and healthy fats.

Our standard portion size recommendations aren't just what we think is best. They're what we *know* is best, based on careful research and our experience with over 100,000 clients to date.

Portions for women.

(See our Calorie Control Guide for details.)



Portions for men.

(See our Calorie Control Guide for details.)

Experiment & have fun

Our recommendations let you be flexible, enjoy the high-quality foods you love, and adjust your intake to your own experience, goals, and unique needs.

Don't like rice? Fine. Try another carb source.

Don't like beef for your lean protein? How about eggs?
Need more carbs to support your athletic performance? Cool. Add another few servings and see how it goes.

Curious about balancing your blood sugar by dialing back the carbs just a little bit? Great — give it a go, monitor your glucose levels, and see how you feel.

YOU are unique. Your body is unique.

Your individual carb requirements depend on your:

- **goals** (fat loss, muscle gain, maintenance)
- **genetics** (different body types, medical conditions)
- **carb source** (refined versus minimally processed)
- **activity level** (sedentary, weight-training, endurance athlete).

Keep it simple

Don't overly restrict; don't over-think it; don't waste time with "carb math".

Enjoy a wide variety of minimally processed, whole and fresh foods.

Observe how you look, feel, and perform.

Decide what to do based on the data you collect about yourself, not on what you think you "should" do.

The only "rules" come from *your* body and *your* experience. Don't follow a dietary prescription for anyone else's body.

And above all, for most active people, **carbs are your friend!**

THE KETOGENIC DIET: DOES IT LIVE UP TO THE HYPE?

The pros, the cons, and the facts about this not-so-new diet craze.

By Krista Scott-Dixon, Ph.D. and Helen Kollias, Ph.D

If you believe the buzz, ketosis — whether via the almost-zero-carb ketogenic diet or via ketone supplements— can curb appetite, enhance performance, and cure nearly any health problem that ails you. Sound too good to be true? It probably is.

Wouldn't it be awesome if butter and bacon were "health foods"?

Maybe with a side of guacamole and some shredded cheese on top?

"I'm doing this for my health," you could purr virtuously, as you topped your delectably marbled, medium-rare steak with a fried egg.

Well, many advocates of the ketogenic diet argue exactly that: By eating a lot of fat and close to zero carbohydrates you too can enjoy enhanced health, quality of life, performance, brain function, and abs you can grate that cheese on.

So, in this article, we'll explore:

- **What are ketones, and what is ketosis?**
- **What, exactly, is a ketogenic diet?**
- **What evidence and scientific research supports the ketogenic diet?**
- **Do ketone supplements work?**
- **Is the ketogenic diet or ketone supplementation right for me?**

How to read this article

If you're just curious about ketogenic diets:

- Feel free to skim and learn whatever you like.

If you want to change your body and/or health:

- You don't need to know every detail. Just get the general idea.
- Check out our advice at the end.

If you're an athlete interested in performance:

- Pay special attention to the section on athletic performance.
- Check out our advice for athletes at the end.

If you're a fitness pro, or interested in geeking out with nutritional science:

- We've given you some "extra credit" material in sidebars throughout.
- Check out our advice for fitness pros at the end.

It all started with the brain.

If you've called Client Care at Precision Nutrition, you might have spoken to Lindsay.

Aside from being an incredibly helpful and friendly voice on the other end of the phone, Lindsay is also a tireless advocate for a health condition that has shaped her life in many ways: epilepsy.

Epilepsy is an ancient brain phenomenon, known to medicine thousands of years ago. To manage it, our Neolithic ancestors drilled holes in one another's skulls, perhaps trying to let the bad stuff out — a practice known as trepanation.

Around 400 BCE, the ancient Greek doctor Hippocrates observed a

man who had seizures for five days. On the sixth day, he noted, as the patient "abstained from everything, both gruel and drink, there were no further seizures."

About 1,400 years later, in 1000 CE, the famous Persian physician Avicenna — who coined the term "epilepsy", from the ancient Greek verb epilambanein (to seize or attack, as the neurological condition caused seizures), speculated that "overfeeding" might be a risk factor for epilepsy.

By 1911, a pair of Parisian doctors were trying fasting as a treatment for children with epilepsy, and in the United States, physical culturist Bernarr McFadden was claiming that fasting for three days to three weeks could cure anything.

Despite not having the tools and insight of modern neuroscience, these and other people who explored fasting and dietary prescriptions for neurological disorders were on to something.

We now know that there may be a dietary connection — not just between epilepsy and what we eat (or don't), but also with many other brain disorders.

Unfortunately, fasting isn't fun. We evolved with a pretty strong aversion to starvation, and our brains and GI tracts have lots of ways to make sure we eat enough.

Which raises the question:

Could we get the health benefits of fasting another way?

In other words:

Could there be “fasting without fasting”?

In 1921, two things happened.

One: Endocrinology researcher Rollin Woodyatt noted that the same chemical environment happened with both starvation and a diet that was very low in carbohydrates and very high in fat.

Two: Dr. Russell Wilder wondered:

Could a person get the health benefits of fasting without actually fasting?

He and other doctors at the Mayo Clinic experimented with what Wilder called the “ketogenic diet” during the early 1920s. Not only did children with epilepsy seem to improve overall with this type of diet, they seemed to think and behave better as well.

Proven by several notable medical authorities, a ketogenic diet as a treatment for childhood epilepsy found its way into medical textbooks by around 1940, and stayed there throughout the 20th century.

In 2016, aging, contact sports, and modern warfare now present us with new populations of people whose brains might benefit from a ketogenic diet:

- people with neurodegenerative disorders (such as multiple sclerosis, Parkinson’s, and Alzheimer’s); and
- people with traumatic brain injury (TBI) from events such as explosions or concussions.

First the brain, then the body.

There was another group of people who became curious about ketogenic diets some time in the 1980s and 1990s: bodybuilders and physique athletes.

These folks weren't too concerned about brain health or longevity. They wanted to be *ripped*.

The ketogenic diet seemed like a magic bullet: a way to eat butter, bacon and cream, and still get abs.

Today, what's old is new again.

Physique- and performance-conscious people, as well as people looking to maximize lifespan and life quality, have rediscovered this old-school dietary paradigm and are wondering:

- **Could a ketogenic diet help me perform better?**
- **Could a ketogenic diet help me live longer?**
- **Could a ketogenic diet help me look great on the beach?**

The answer?

It depends. (Don't you hate that? But it's true.)

To understand why, we'll look at:

- **the science of ketosis;**
- **what a ketogenic diet looks like in "real life";**
- **who it might work for (and might not work for); and**

- **what this means for you.**

Let's start by clarifying just what a ketogenic diet is.

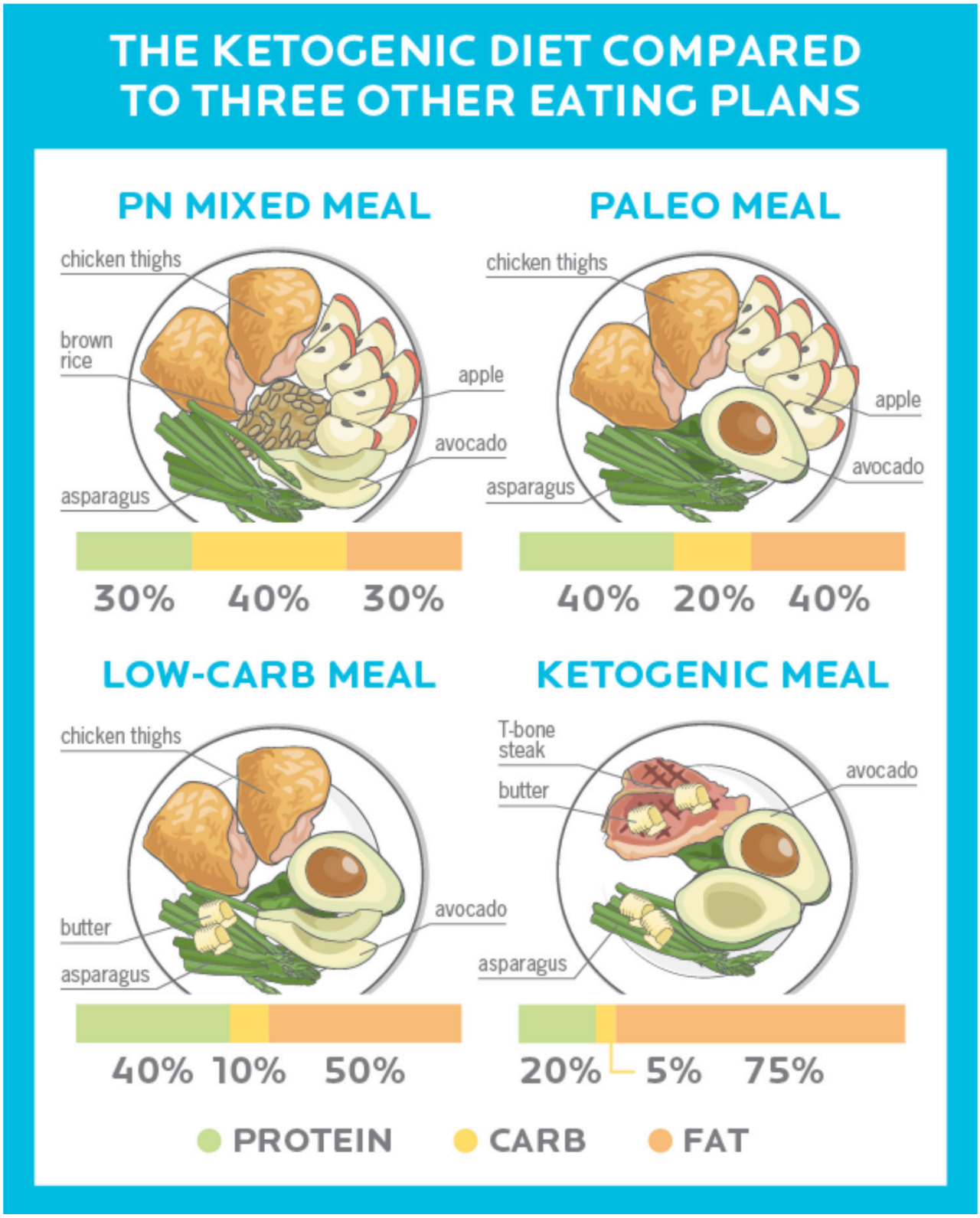
What does a ketogenic diet look like?

It might be hard to translate "low carb, high fat" into everyday foods.

To give you a better idea of the ketogenic diet in real life, here's a comparison:

	Protein	Carb	Fat
PN Mixed Meal	~30%	~40%	~30%
Paleo Meal	~40%	~20%	~40%
Low-Carb Meal	~40%	~10%	~50%
Ketogenic Meal	~20%	~5%	~75%

And here's what that might look like translated into meals.


THE KETOGENIC DIET COMPARED TO THREE OTHER EATING PLANS
PN MIXED MEAL
chicken thighs
brown rice
apple
avocado
asparagus
30% 40% 30%
PALEO MEAL
chicken thighs
apple
avocado
asparagus
40% 20% 40%
LOW-CARB MEAL
chicken thighs
butter
avocado
asparagus
40% 10% 50%
KETOGENIC MEAL
T-bone steak
butter
avocado
asparagus
20% 5% 75%
PROTEIN
CARB
FAT

Notice a few things.

Protein

For the first three meals, protein is more or less the same, with a little variation.

Ketogenic diets, on the other hand, include less protein — usually closer to 10 or 20 percent of total daily intake.

Extremely low in carbohydrates

The Precision Nutrition plate suggests high-fiber, slow-digesting carbohydrates, such as whole grains, beans and legumes, fruits, and starchy vegetables.

The Paleo plate may contain slightly fewer carbohydrates (early human diets often had plenty of them), but eliminates the grains and beans / legumes.

The “low carb” plate will have fewer carbohydrates than the first two, but still have a small amount, likely from vegetables.

The ketogenic meal shoots for near-zero carbs. Most estimates suggest around 10-15 grams of carbs a day. To give you an idea of what this looks like, that’s about one fist-sized portion of cooked carrots, or about 10-15 grapes. For the whole day.

Very high in fat

The Precision Nutrition plate suggests about 1-2 thumb-sized portions of fat-dense foods (like nuts, cheese, avocado, olive oil, etc.) per meal, depending on body size, activity level, and goals.

The Paleo and low-carb plates may be roughly similar, with a little variation. We might call all three of these “moderate fat”. Indeed, some indigenous diets (aka variations on the “Paleo” concept) are often quite low in fat, especially saturated fat.

The ketogenic meal, on the other hand, is high fat — even up to 90 percent of total energy intake. That means if you’re eating a 500-calorie spinach and mushroom salad, you get about 2 thumb-sized pieces of chicken breast on top, and then pour about 3-4 glugs of olive oil on top… Yum yum!

Highly restrictive

A ketogenic diet is the most restrictive and limited of all four of these styles of eating. **Here’s what you can eat on a ketogenic diet:**

A small amount of protein, such as:

- Meat
- Poultry
- Fish
- Seafood
- Eggs

A large amount of high-fat foods, such as:

- Avocado
- Coconut and coconut milk or oil
- Olive oil and any other oil

- Nuts and nut butters
- Bacon
- Egg yolks
- Butter
- Cheese

A very small amount of very-low-carbohydrate vegetables, such as:

- Leafy greens
- Brassicas: broccoli, cauliflower, brussels sprouts, cabbage
- Asparagus
- Cucumber
- Celery
- Tomatoes
- Peppers
- Mushrooms
- Zucchini

Here's what you *can't* eat on a ketogenic diet:

- Most dairy (except high-fat items like butter and certain cheeses)
- Fruit
- Grains
- Beans and legumes
- Starchy vegetables (such as sweet potatoes)

- Slightly-sweet vegetables such as winter squash, beets, or carrots
- Most processed foods (with the notable exception of pork rinds)

So, let's recap:

Ketogenic menus:

- Vary in the proportion of protein but are generally low.
- Stay as close to no-carb as possible.
- Are very high in fat.
- Are very limited in food choices.

So why go to all this effort?

Well, for particular groups of people, ketosis may indeed be helpful.

(For other people, of course, it may not be helpful... and it may be actively harmful. We'll talk more about that in a moment.)

To understand why this is true, let's look at how ketosis actually works.

What is ketosis?

The role of ketones

Ketones are a group of organic compounds with a specific structure.

The term "ketone" was actually coined around 1850 by German chemist Leopold Gmelin, along with the term "ester". (See? Not as new as you'd think!)

We can use two types of ketones as energy sources, acetoacetate and D-β-hydroxybutyrate. (The β sign means "beta".)

Our body can make ketones through a complex biochemical pathway.

The pathway to ketosis

Put very simply, when the conditions are right (for instance, during starvation or fasting, or when our carb intake is very low):

- Our body releases fatty acids from our stored body fat.
- These fatty acids enter other cells.
- Fatty acids are combined with co-enzyme A to form acetyl-CoA chains.
- These chains move into the mitochondria (our cells' energy factories).
- The chains are broken down into acetyl-CoA units by a sequence of reactions known as β-oxidation.
- Chemical magic happens.
- Acetyl-CoA forms your friends the ketones: acetoacetate and

β-hydroxybutyrate, along with acetone (the same smelly stuff in your nail polish remover).

- Ketones are released by the liver into the blood.
- Almost any cell that needs energy can grab it from these circulating ketones. Again, our brain will be the greediest for these nummy little molecules.

Let's take an even deeper look

The shape and orientation of molecules is important.

Stereoisomers are molecules with the same chemical makeup, but different shapes and configurations. You can imagine your right hand as a "stereoisomer" of your left: they both share the same components, just arranged differently.

Shape and orientation matter to molecules and their actions, just like having right-handed and left-handed gloves or shoes matters.

The ketone D-β-hydroxybutyrate is not the same as its stereoisomer L-β-hydroxybutyrate.

This difference in molecular configuration matters for several parts of the conversion process.

For instance, when D-β-hydroxybutyrate is converted back to acetyl-CoA, its intermediate form D-β-hydroxybutyrate-CoA isn't the same thing as L-β-hydroxybutyrate-CoA (an intermediate of β- oxidation).

Each stereoisomer uses different enzymes for conversion, much like each lock has its own unique key.

This difference also matters for ketone supplementation (see below).

You want to supplement the right stereoisomer, rather than a random pile of ketone types. Usually in test tube chemistry, you get a mix of stereoisomers (often around half one type, and half another type), unlike our body, which only uses and makes one version.

Ketosis happens when blood ketones are higher than normal either through dietary changes (which lead to very low blood glucose) or through supplementation (independent of blood glucose concentrations).

Some people like to think of ketone bodies as the fourth energy source for humans (in addition to carbohydrates, fats and proteins).

That's technically true, but the alcohol in booze (aka ethanol) can also be used for energy. Just because we *can* metabolize something doesn't always mean we *should*.

Let's take an even deeper look

Ketosis, which just means having more ketone bodies than normal, should not be confused with **ketoacidosis**, which is a potentially dangerous metabolic situation of uncontrolled ketosis.

Normally, our body is very good at self-regulating.

If it senses acid levels rising (as happens in ketosis), it responds by buffering with more alkaline molecules (such as bicarbonate), changing

blood levels of CO_2, absorbing hydrogen ions, or telling the kidneys to excrete more dihydrogen phosphate and ammonium ions.

However, if for some reason our body can't compensate, and blood pH drops below about 7.35 (in other words, becoming more acidic), we're in trouble.

This usually happens in diabetics and alcoholics, since their normal metabolic mechanisms may not work properly.

For the average healthy person, dietary ketosis or even brief fasting is generally safe.

How do we get into ketosis?

Method 1: Ketogenesis

We can make our own ketone bodies naturally, through the process of **ketogenesis**.

Our ancestors kicked off ketogenesis the good old fashioned way: by starving. About 72 hours into starvation, ketogenesis is happening and you're in ketosis. Congratulations!

Ketosis is essentially an effect of fasting. This means that many of the health effects of fasting may be due to ketosis itself, rather than something like energy restriction.

Let's take an even deeper look

Interestingly, how quickly ketosis happens varies by age and species.

Other mammals don't seem to go into ketosis nearly as quickly as humans (your friendly neighborhood hibernating bear or squirrel who doesn't eat for weeks to months at a time? No ketosis.)

Babies, on the other hand, go into ketosis within a few hours of not eating.

This may have to do with our energy-hungry human brains. About 20 percent of our overall energy intake is devoted to feeding our brains. Although bears and squirrels are clever enough to get into the garbage, they don't have brains as large as we do.

It seems that ketogenesis is a human backup system that provides enough energy (via ketone bodies) to the ol' noggin in times of starvation.

And it may be this particular evolutionary adaptation — which perhaps began as a way to keep the thinking factory upstairs working when food was scarce — that also enables the brain-benefiting effects of the ketogenic diet.

Stored glucose (our sugar-based fuel) is actually rather heavy. We don't carry around much of it. Our body prefers to store most of our excess energy as body fat.

When we eat normally, our brain gets enough energy from glucose that can easily pass the blood-brain barrier.

When we stop eating, we run out of stored glucose (as glycogen)

within 2-3 days (faster if we're active), and have to find some other fuel source.

By the way, the relative heaviness of stored glycogen is why many people report fast weight loss on a ketogenic or low-carb diet: their body has dumped a little extra weight in the form of glycogen and water (which tags along with glycogen in a 3 parts water to 1 part glycogen ratio). Unfortunately, this water and glycogen comes right back once we start eating normally again.

Method 2: A ketogenic diet

Most people frown on starving children with epilepsy, so a ketogenic diet is the next best thing.

By cutting off the body's carbohydrate (aka glucose) supply, but providing energy and nutrients in the form of fat (plus a little protein), we can get the same effects as straight-up starvation: ketosis.

As with starvation, it usually takes some time to get into ketosis once we stop eating carbs.

Let's take an even deeper look

Many people like to measure their ketosis with Ketostix, which test for ketones in the urine. This is not always a reliable indicator, since all it tells you is whether you're *excreting excess ketones*, not whether you're actually in ketosis *per se*.

In addition, Ketostix only measure the presence of excreted acetoacetate, not the presence of D-β-hydroxybutyrate.

Over time, our body's excretion of ketones can change, even if we're still in ketosis. Therefore, you may see different readings on the Ketostix, regardless of what is actually happening in your body.

Method 3: Supplement with ketones

If ketones are what we want, why not just take them instead of making our own by fasting or cutting out carbohydrates?

Great idea, and totally new... except it isn't.

As early as 1953, there were studies looking into whether we could "artificially" produce ketosis by supplementation.

Today, we know that by supplementing with ketone bodies (usually D-β-hydroxybutyrate or certain esters) you can raise the level of ketone bodies in the blood without being in ketogenesis.

This has a lot of cool possibilities. If ketone supplementation can give us the health benefits of ketosis without us having to fast / starve or follow a very restrictive diet, that could be a win-win.

Unfortunately, we still don't have conclusive human studies on this that would give us clear direction. Check back in 10 years.

Is ketone supplementation effective?

The buzz is that ketone supplements can make you thin and cure whatever ails you. But what you read about in the media or on the interwebs isn't always what scientists actually found in the lab.

If you didn't know better, you'd think ketone supplementation just started. Actually, research on this topic goes back to the 1950s. All of it has been conducted using rats. Here are the findings.

Weight loss

D-β-hydroxybutyrate supplementation made some types of rats eat less and lose weight, but not other types of rats.

Some evidence kinda sorta indicates that D-β-hydroxybutyrate supplementation might activate brown fat (a metabolically active fat that is, in part, responsible for thermogenic adaptations) via the sympathetic nervous system, but there was no follow-up.

Blood glucose regulation

Another showed that ketone supplementation with either 1, 3-butanediol acetoacetate diester or sodium/potassium β-hydroxybutyrate decreased blood glucose with no changes in cholesterol or blood triglycerides (the not-so-great side effects of the ketogenic diet).

Traumatic brain injury

In one study, infusing D-β-hydroxybutryate into adult rats after traumatic brain injuries showed improved energy (ATP) levels.

In another study, D-β-hydroxybutryate didn't improve things and actually caused damage to the blood-brain barrier, even in healthy rats.

Epilepsy

New evidence suggests that it may not be D-β-hydroxybutryate or acetoacetate preventing seizures; rather, it might be the relatively short-chain fatty acids (nanoeic and decanoic acids) in the diets when on a ketogenic diet crossing the blood-brain barrier, inhibiting seizures.

But in another study that exposed rats to high-pressure oxygen containing ketone esters such as R,S-1,3-butanediol acetoacetate diester, the rodents saw increased blood β-hydroxybutryate and decreased seizures.

Cancer

A recent study found that ketone supplementation extended survival in mice with metastatic cancer. But while it's true that most cancers have a highly anaerobic metabolism, this is not universal. If proven to be effective, it's likely that ketone supplementation would be an additional treatment rather than a stand alone treatment for cancer, because of its robust nature.

For now, almost no studies on ketone supplementation have used human clinical trials. So if anyone tells you that ketone supplementation is a miracle cure, ask if you can get some for your pet rat... if it's the right kind of rat.

Will ketosis help me?

Ketogenesis and ketosis are easy to study.

All you have to do is starve people, or feed them a high-fat/low-carb diet, and wait. Then you see if it changes whatever you're interested in fixing.

Since we've known about fasting and ketosis for quite a long time, and it's relatively easy to research, there are probably good reasons why it's not yet considered a miracle cure.

And it's not because Big Pharma or Carbohydrate Corporation or The Cancer Conspiracy have vested interests. (Trust me, we scientists can barely keep the grad students from contaminating the super-purified water by leaving the lid off the jug, never mind organize an evil cabal of ketosis deniers.)

To be fair, the introduction of anti-epileptic drugs in the late 1930s onward did lead to less interest in dietary ketosis as a treatment for epileptic children.

But we don't yet use ketosis (or ketone supplementation) to fix everything from muffin tops to hangnails because:

- For many populations, ketosis has little or no effect.
- It may only work for particular types of people, with particular needs and health conditions.
- It may take too long to see a measurable effect.
- For many people, a ketogenic diet is too hard to consistently follow.

That being said, here are some interesting and promising new avenues for ketosis... as well as some "don't bother" examples.

Probable benefit: Metabolic diseases

We know that fasting is often an effective short-term treatment for metabolic dysfunction such as poor glucose control / early Type 2 diabetes, chronic inflammation, or hypertension.

We don't know for sure yet whether this is because of ketosis or some other mechanism (such as programmed cell death, aka apoptosis).

However, research suggests that in some cases, such as type 2 diabetes, ketosis may be useful as a short-term treatment or a "boost" that helps return metabolic processes back to a more normal and well-regulated state.

In these specific situations, a ketogenic diet or a structured intermittent fasting program done *under close medical supervision for a specific objective, may* be a useful as part of a multi-pronged treatment program *that probably should include other therapeutic tools* such as medication or other well-established health procedures.

Notice all our italics here. What we mean is:

- Don't use ketosis or fasting alone to try to cure stuff.
- Don't use ketosis or fasting just to randomly "get healthy".
- "Medical supervision" does not mean Dr. Google.

Verdict: Could help in some cases, but should be done with a clear purpose and careful monitoring. Not a long-term "cure-all" for most people.

Let's take an even deeper look

Why does ketosis seem to help some types of metabolic dysfunction?

Ketones may help, in part, because they decrease oxidative stress, boost antioxidants and scavenge free radicals.

Oxidation is a natural part of cellular metabolism, but too much oxidation, too fast, without the balance of antioxidants, contributes to many metabolic and other diseases.

Many metabolic disorders are related to this process of oxidation, in which our cells essentially "rust" from the inside. If we can slow and regulate oxidation, it may improve our health and longevity.

Probable benefit: Neurodegeneration and brain injuries

We know ketosis for epilepsy is a win — can ketosis help other types of brain illnesses and injuries?

Recent research suggests that many brain disorders (such as Alzheimer's and Parkinson's, among other neurodegenerative diseases) are related to other metabolic disorders such as diabetes, obesity, non-alcoholic fatty liver disease (NAFLD).

These metabolic and neurodegenerative diseases show common features, such as oxidative stress, mitochondrial dysfunction, and inflammation. In fact, Alzheimer's is now often described as "diabetes of the brain", or "Type 3 diabetes".

The presence of ketones also seems to improve outcomes from traumatic brain injury (TBI). However, right now, most of these studies have been done on rats.

Still, based on what we've seen with epilepsy and rat studies, chances are good that ketones may be a low-risk treatment — and perhaps even a preventive strategy — to improve brain health. See above about getting medical supervision from someone other than Dr. Google.

Verdict: Probably can't hurt, might help people with neurodegeneration and/or mild to moderate brain injury.

Unclear benefit: Longevity

We know that caloric restriction (CR) improves longevity in most organisms studied. We know that intermittent fasting seems to have some of the same benefits, sometimes.

But right now, we don't know if ketosis works the same way.

The real question here is: Who's willing to find out?

Would you stick to a ketogenic diet in the name of advancing knowledge, achieving scientific glory as a "ketonaut"? Most of us wouldn't.

Plus, without a control group (say, your identical twin who lives exactly the same lifestyle as you, in the exact same environment, with only your diets being different), it's hard to know for sure whether your 100th birthday was due to ketosis or something else.

For now, any longevity benefits would be mostly speculative. And your 100th birthday cake would have to be a block of butter.

Verdict: You could try this one and get your next of kin to report back... but most people wouldn't want to.

Interesting, but probably no advantage for most people: Athletic performance

Athletes need fuel to perform.

Could we possibly enable people to tap into their stored body fat more effectively, and require less re-fueling from stuff like sugary energy gels?

Ketosis lets you avoid glycogen depletion (aka bonking, hitting the wall), because you aren't using glycogen as your energy source, so you don't need to take in carbs as you compete. Instead you're using fat and ketone bodies.

You increase fat oxidation, spare glycogen, produce less lactate and use less oxygen at submaximal rates.

All this sounds great, but the exercise physiologists' consensus is that while all these adaptations are true, the problem is that with fat and ketone bodies as fuel, you're not going to go as fast as you can when using with glucose and carbohydrates.

The bottom line for athletes is performance, and so far there is only one very new study showing a small improvement in cyclist's performance with ketone supplementation *combined* with carbohydrate supplementation (compared to just carbohydrate supplementation alone).

It seems that combining ketones with carbs, rather than exclusively using one or the other, might offer some benefit.

Cutting Edge Research:

Carb + Ketone Supplementation Improve Aerobic Performance

A recent study compared the effect of drinking just carbs to drinking carbs + ketones in male and female elite cyclists.

After not eating overnight (about 16 hours) the cyclists came to the lab and drank either a carb drink or a carb + ketone (c + k) drink.

Carb drink:

- 40% dextrose
- 40% fructose
- 20% maltodextrin

C + k drink

- 60% dextrose
- 40% ketone ((R)-hydroxybutyl (R) -3-hydroxybutyrate ketone ester).

Total amount of substrate in both drinks were 573 mg/kg body weight. The cyclists drank half of their drink, rode for 1 hour at 75% of their max power output. Then they drank the other half of their drink and biked as far as they could in 30 minutes.

After a week, the cyclist repeated the experiment with the opposite drink.

Results

When drinking the c + k drink the cyclists biked, on average, 2 percent

(400 meters) farther longer over the 30 minutes.

There were some metabolic differences to note in with the c+k drink:

- less lactate
- more fatty acids in the blood
- more D-β- hydroxybutyrate

Bottom line: Supplementing with a combination of carbohydrates and ketones may improve performance in aerobic competitions.

Verdict: Some intriguing possibilities, particularly for aerobic performance, but to date there very little evidence to improve overall athletic performance.

No real advantage: Losing fat

Oh, insulin, you naughty monkey! You have been getting yourself in so much trouble lately!

Low-carb advocates in the late 1990s and early 2000s thought maybe they had stumbled on the key to fighting flab: insulin. Insulin is mainly a storage hormone: Its job is basically to help nutrients get into cells.

The low-carb / insulin hypothesis, dramatically oversimplified, went like this:

- Insulin makes stuff go into cells.
- Stuff that goes into fat cells makes us fat.
- If we don't help stuff go into cells, then we won't get fat. We might even lose fat.

- Carbs (in their digested form of glucose) stimulate insulin release.
- Therefore eating fewer carbs = less body fat.

Now, this theory did have some merits.

For one thing, it got some of us unhooked from processed sugary and starchy treats, and thinking more about fiber content and healthy fats.

Unfortunately, insulin is not the only player. There's never only one player in the team sport and complex system that is your body.

Nor does insulin act alone. Energy storage is governed largely by our brain, not a single hormone.

The other upside to the low-carb approach was that people often ate more protein and more fat. When we eat protein and fat, we release satiety hormones, particularly CCK, which is one of the main hormones that tells us we're full.

More protein and fat means we're often less hungry. Which means we eat less. Which means we lose fat. It's the "eating less" part (not the insulin part) that actually matters.

On top of this, if you'll recall, carbohydrates are relatively heavy to store. Lower the carb intake, and our body will eventually release some water and glycogen.

Result: Weight loss. Magic!

Yet being in ketosis doesn't seem to have any special advantage for losing body fat (rather than just weight), especially if we consider the lifestyle and behavior aspect to this.

You *may* find it easy to eat less when all you can eat is protein and fat. But after a while, you may grow tired of bringing your own whole salmon to parties, and wonder what the other 95% of the grocery store is up to. You may start to have fantasies about a threesome: you, Oreos, and chocolate sauce. Not only that, you may be getting some serious scurvy and other nutrient deficiencies.

For women in particular, lowering carbohydrate intake seems to have negative effects.

Women's bodies go on high alert faster when they sense less energy and fewer nutrients coming in. Many women have found that the low-carb diet that worked great for their husband not only didn't work for them, but it knocked out their menstrual cycle on the way out the door.

Verdict: We don't recommend the ketogenic diet for sustainable fat loss.

Let's take an even deeper look

As part of the carb-insulin hypothesis, people thought that maybe metabolism would also increase during ketosis.

A recent study looked at whether or not there was a significant increase in metabolic rate when going from a high-carbohydrate diet (48% carbohydrate) to a ketogenic diet (6% carbohydrate), with protein being the same (around 16-17%).

With this dietary change, insulin went down while fatty acids and ketone bodies went up. Basal metabolism (energy expenditure) went up by about 100 kcal per day.

Seems obviously good — but not so fast.

Figuring out what this *actually* means is complicated.

Researchers had to correct metabolism based on body weight, which as you've read, tends to drop when water is lost on low-carb diets.

The authors concluded that while there was a small increase in metabolism initially, that disappeared over the four weeks while insulin levels were still low.

So their study didn't support the insulin-carb hypothesis.

Is protein actually the key factor?

The authors of the study think that differences found in other studies comparing high and low-carb diets are because of differences in *protein* intake rather than *carbohydrate* intake in those studies.

Protein promotes satiety and takes the most energy to digest and absorb, so differences in weight loss may be net calories *absorbed*, rather than decreases in insulin or increases in metabolism.

Definitely no advantage: Gaining lean mass

As you may have read above, insulin is mainly a storage hormone. It's also considered an **anabolic hormone**. As in building things. As in getting swole.

For the most part, we need insulin — along with other hormones, such as growth hormone and testosterone — to create an anabolic, muscle-building environment. Trying to build muscle while in ketosis is like stepping on the gas and the brake at the same time.

However, as with athletic performance, we may discover that there

is some benefit to supplementary ketones while building muscle. We don't know yet.

Verdict: Build muscle with a more appropriately anabolic diet that includes carbohydrates (particularly around training), and supplement with ketones if you want to experiment.

What this means for you

If you're a "regular person" who just wants to be healthy and fit:

Enjoy reading about ketosis if you like. Try it, if you're curious. But you can be perfectly fit, lean, and healthy without it.

Don't believe everything you read on the internet. (Except this article, of course.) Remember that the plural of "personal anecdote" is not "scientific data". Be a critical reader and consumer.

If you're an athlete:

Know your body and the demands of your sport. Unless you're an ultra-endurance athlete, becoming fat-adapted or adopting a ketogenic diet probably won't improve your performance.

Don't add stress. Training is a good stress, but still a stressor. Fasting and restricting energy (i.e. calories) or a particular nutrient are also stressors. Stress adds up. Don't add nutritional stress from a stringent diet to the mix, particularly if you're female.

Make meeting your nutritional needs your priority. If you're active, you need more fuel and nutrients than the average person. Rather than taking stuff *out* of your diet, look for where you can *add* good

stuff *in*: protein, vitamins, minerals, fiber, fatty acids, phytonutrients, water, etc. from whole, minimally processed foods.

If you're a fitness professional / nutrition coach:

Understand the basics of ketosis, ketogenic diets, and ketone supplementation. Know when, how, and for whom ketosis might be appropriate. If in doubt, learn more from trusted medical and research sources — which, again, does not include random people of the Internets.

Help people understand as much as they need to understand in order to make an informed choice, with your guidance. Your clients will likely have questions. Prepare your answers in advance.

Refer out: If you think a client might benefit from a ketogenic diet or ketone supplementation for a health condition, work with their doctor to support things like meal planning and keeping a food journal that looks for correlations between diet and how they feel.

Stay within your scope of practice. Remember: Unless you're licensed for medical nutrition therapy, you're not authorized to prescribe any type of diet for medical conditions. Don't tell your client that they should go on a keto diet to cure their diabetes.

If you have a specific health problem that a ketogenic diet (or ketone supplementation) may help with:

Consult your doctor first. Discuss any research findings or potential dietary modifications with someone who actually went to med school. If you're on any medications, make sure nothing you do will interfere with their effect.

Carefully monitor and track any dietary modifications. First, you want to stay safe; second, you want to know if what you're doing is having any effect. So decide how you'll know if your dietary changes are "working", and track those indicators closely.

Consider coaching. Again, nutrition coaches are generally not qualified to offer medical nutrition therapy. However, they do know how to make fat and protein taste delicious, and how to help you organize your shopping and meal planning habits. For this and any other dietary modification, it helps to get some guidance.

WILL A HIGH-PROTEIN DIET HARM YOUR HEALTH?

The real story on the risks (and rewards) of eating more protein.

By Helen Kollias

Will too much protein damage my kidneys? Cause cancer? Reduce my lifespan? At Precision Nutrition we're always getting questions (from fitness pros and clients) about the risks of a high-protein diet. In this article we'll set the record straight and share why protein isn't the villain it's made out to be.

Maybe you're a protein promoter.

You buy protein powder in "bucket with a handle" format. You know the protein counts of every food you eat.

After every workout, you jam those amino acids into your cells. You swear you can feel them getting swole.

Or maybe you're a protein avoider.

Maybe you've heard bad things.

Like: *Protein will damage your kidneys.*

Or: *Protein will give you cancer.*

Or simply: *We all eat too much protein.*

Maybe you want to lose fat. Or gain muscle. Or be healthy.

You just want to do the right thing and eat better. But with conflicting information about protein, you don't know what to think.

Or, if you're a fitness and nutrition coach, you're wondering how the heck to clear up the confusion about protein among your clients.

Let's get into it.

In this article, we'll explore:

- What are high-protein diets?
- What does the evidence say about high-protein diets and health?
- Does protein source matter?
- How much protein is right for me?

How to read this article

If you're just curious about high-protein diets:

- Feel free to skim and learn whatever you like.

If you want to change your body and/or health:

- You don't need to know every detail. Just get the general idea.
- Check out our advice at the end.

If you're an athlete interested in performance:

- Pay special attention to the section on athletic performance.
- Check out our advice for athletes at the end.

If you're a fitness pro, or interested in geeking out with nutritional science:

- We've given you some "extra credit" material in side bars throughout.
- Check out our advice for fitness pros at the end.

Why protein?

A quick intro if you aren't a nutrition pro:

- Protein is one of the three main **macronutrients** that makes up the food we eat. (The other two are fat and carbohydrate.)
- Protein itself is made up of **amino acids**.
- **Amino acids are the building blocks** for most stuff in our bodies. They're like Legos that can be broken down and re-assembled in different ways.
- Unlike extra fat (which we can store very easily on our bums and bellies), **we don't store lots of extra amino acids**. Protein is always getting used, recycled, and sometimes excreted.
- If we don't get enough protein, **our body will start to plunder it from parts that we need**, such as our muscles.
- So **we have to constantly replenish protein** by eating it.

We need protein.

Protein is so important that without it, we die or become seriously malnourished. (This protein-deficiency disease is known as kwashiorkor, and we often see it in people who have suffered famines or who are living on a low-protein diet.)

All your enzymes and cell transporters; all your blood transporters; all your cells' scaffolding and structures; 100 percent of your hair and fingernails; much of your muscle, bone, and internal organs; and many hormones are made of mostly protein.

Hence, protein enables most of our bodies' functions.

Put simply, you are basically a pile of protein.

No protein, no you.

How much protein do we need?

Short answer: It depends.

Let's look first at the current Recommended Daily Allowance (RDA).

The RDA for protein is 0.8 g/kg (0.36 g/lb) — the more you weigh, the more protein you need:

- A **150-lb** (68 kg) person would need 68 x 0.8, or about **54 grams of protein a day**.
- A **200-lb** (91 kg) person would need 91 x 0.8, or about **73 grams of protein a day**.

That generally works out to about 10 percent of daily calories coming from protein.

However.

RDAs were originally developed as a way to prevent malnutrition — to represent the minimum amount of a nutrient we need to *not die* **(or get sick).**

"You're not dead" is not the same thing as "You're kicking ass."

The RDA for *surviving* **may be different than what we need to** *thrive***.**

The RDA is also a very general recommendation. It doesn't take other things into account, such as:

- How much total energy (i.e. calories) we eat or need
- Our carbohydrate intake
- When we eat the protein
- Our biological sex
- Our age
- How active we are
- What activities we do
- How "eco-friendly" various protein sources are

The Institute of Medicine (US) suggests a huge range in individual protein requirements — from 0.375 g/kg to 1.625 g/kg body weight (0.17 to 0.74g/lb body weight).

In other words, our hypothetical 150-lb person might have protein needs ranging from 26 to 111 grams per day.

Well that narrows it down nicely, doesn't it!?

Let's take a deeper look: Amino acids

Protein in our food is made up of many different building blocks, or amino acids.

Most people focus on Recommended Daily Allowance (RDA) for total protein, but they don't think about how much of each amino acid they might need.

If your diet isn't varied enough, you may be eating enough total protein, but not enough of a specific essential amino acid.

Every day, you need this much of these essential amino acids:

- 14 mg/kg of histidine
- 19 mg/kg of isoleucine
- 42 mg/kg of leucine
- 38 mg/kg of lysine
- 19 mg/kg of methionine + cysteine
- 33 mg/kg of phenylalanine + tyrosine
- 20 mg/kg of threonine
- 5 mg/kg of tryptophan
- 24 mg/kg of valine

Of course, you don't need to spend hours in your kitchen with an eyedropper of lysine solution, carefully calibrating your intake.

Just eat a variety of protein-rich foods and let nature do the rest.

What does a high-protein diet look like?

People often assume that “high protein” means “low carbohydrate”. In fact, you can eat more protein without making any drastic changes to other things in your diet.

Many types of diets can be considered high-protein. “High protein” is a bit of a relative concept; there’s no clear rule.

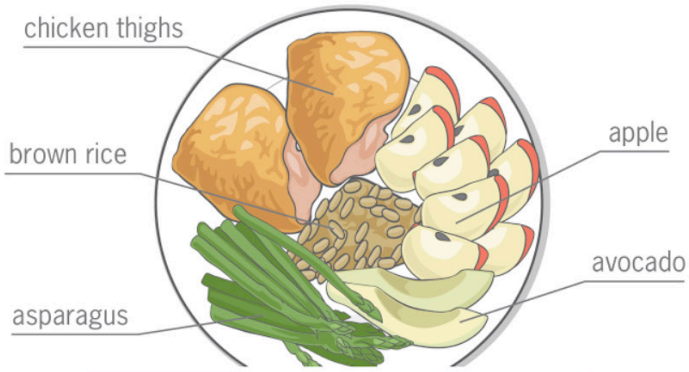
The average protein intake for adults in the US is about 15 percent of calories coming from protein. The Institute of Medicine suggests that up to 35 percent of total calories is an OK proportion of protein for healthy adults.

And most researchers would say that once you get more than 25 percent of total calories from protein, you’re in “high protein” territory.

Here’s what high- and low-protein diets might look like for a given meal.

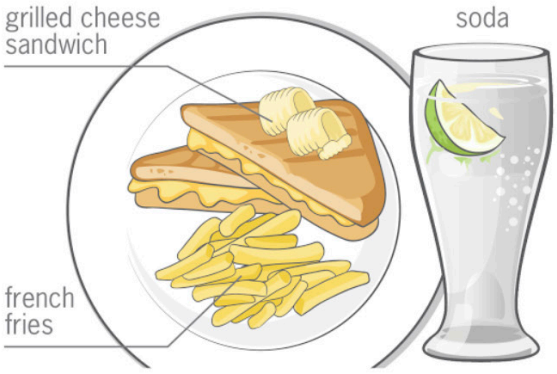
PROTEIN CONTENT IN THREE TYPES OF MEALS

PN MIXED MEAL



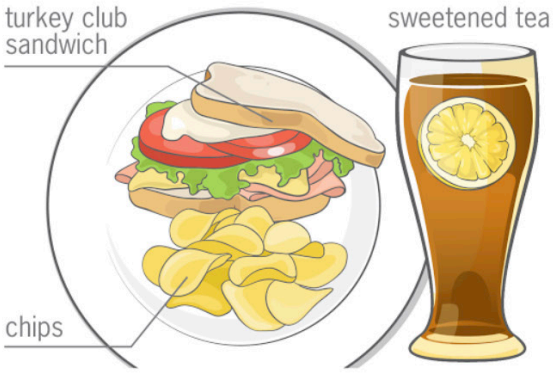
30% 40% 30%

LOW-PROTEIN MEAL



9% 53% 38%

TYPICAL AMERICAN MEAL



17% 46% 37%

PROTEIN CARB FAT

PrecisionNutrition

The upper tolerable limit (UL) of something tells you how much you can eat without having health problems.

Currently, there's no established UL for protein.

Does that mean you can eat as much protein as you'd like without any negative side effects? No. It just means researchers haven't figured it out yet.

But we do know that **eating up to 4.4 g/kg (2 g/lb) body weight didn't cause any short term health problems** in clinical studies.

Let's take a deeper look: Calculating maximum protein

The Institute of Medicine suggests that high protein intake, where about 35 percent of your calories comes from protein, is safe.

What does that mean in grams per kilogram body weight (or g/lb body weight)?

Say you're 74.8 kg (165 lb) and reasonably active. You need about 2,475 calories per day to maintain your weight.

If you get 35 percent of your total energy intake from protein, you'd be eating about 866 calories from protein each day.

1 gram of protein has 4 calories. So 866 calories is around 217 grams of protein per day.

That's about 1.3 grams per pound of body weight, or 2.9 g/kg.

Will eating a high-protein diet hurt me?

For years, people have been concerned with the safety of eating too much protein.

Will eating too much protein explode my kidneys?

How about my liver? My left femur?

The most common health concerns of eating more protein are:

- kidney damage
- liver damage
- osteoporosis
- heart disease
- cancer

Let's explore these.

Claim: High protein causes kidney damage.

This concern about high protein and kidneys began with a misunderstanding of why doctors tell people with poorly functioning kidneys (usually from pre-existing kidney disease) to a eat a low-protein diet.

But there's a big difference between avoiding protein because your kidneys are already damaged and protein actively *damaging* healthy kidneys.

It's the difference between jogging with a broken leg and jogging with a perfectly healthy leg.

Jogging with a broken leg is a bad idea. Doctors would probably tell you not to jog if your leg is broken. But does jogging *cause* legs to break? No.

That's the same thing with protein and kidneys.

Eating more protein does increase how much your kidneys have to work (glomerular filtration rate and creatinine clearance), just like jogging increases how much your legs have to work.

But protein hasn't been shown to *cause* kidney damage — again, just like jogging isn't going to suddenly snap your leg like a twig.

High-protein diets do result in increased metabolic waste being excreted in the urine, though, so it's particularly important to drink plenty of water to avoid dehydration.

Verdict: There's no evidence that high protein diets (2.2g/kg body weight) cause kidney damage in healthy adults.

Claim: High protein causes liver damage.

The liver, like the kidneys, is a major processing organ. Thus, it's same deal as with kidneys: People with liver damage (such as cirrhosis) are told to eat less protein.

Yes, if you have liver damage or disease you should eat less protein. But if your liver is healthy, then a high-protein diet will not *cause* liver damage.

Verdict: There's no evidence that high-protein diets (2.2g/kg body weight) causes liver damage in healthy adults.

Claim: High protein causes osteoporosis.

Eating more protein without also upping your fruit and vegetable intake will increase the amount of calcium you'll lose in your pee.

That finding made some people think that eating more protein will cause osteoporosis because you're losing bone calcium.

But there is no evidence that high protein causes osteoporosis.

If anything, not eating *enough* protein has been shown to cause bone loss. Bones aren't just inert sticks of minerals — a significant proportion of bone is also protein, mostly collagen-type proteins.

Like muscle, bone is an active tissue that is constantly being broken down and rebuilt. And like muscle, bone needs those Lego building blocks.

Women aged 55 to 92 who eat more protein have higher bone density. So eating more protein improves bone density in people most at risk of having osteoporosis.

(Eating more protein plus adding resistance training: Double win for bone density.)

Verdict: High protein diets do not cause osteoporosis, and actually may prevent osteoporosis.

Claim: High protein causes cancer

Unfortunately, we still don't have conclusive human studies on the cause of cancer and the role of protein.

There are studies that asked people how much protein they ate over their lifetime, and then looked at how often people got cancer. The research shows a connection between protein intake and cancer rates.

But these studies are correlational studies and don't prove that protein is the cause of cancers. Plus, some researchers have gone so far to say that studies relying on subjects to recall what they ate are basically worthless because human memory is so inaccurate.

A big part of the proposed cancer and protein link comes down to confounding factors, like:

- where you get your protein from — plant or animal
- how you cook your protein (i.e. carbonized grilled meat)
- what types of protein you're eating (e.g. grass-fed steak versus a hot dog)

And so on.

In other words, we can't say that any particular amount of protein causes cancer.

Verdict: Limited evidence that protein causes cancer; many other confounding factors.

Let's take a deeper look: Protein and cancer

A study from 2014 looked at protein and cancer risk. It was widely misinterpreted as proof that eating a lot of protein caused cancer.

First, it was actually two studies, one asking people questions and following them for years; and one that fed mice a high-protein diet and implanted them with cancer.

With the human study, researchers looked at people's self-reported protein intake and their rates of cancer over the following 18 years.

They found that people aged 50-65 who ate diets high in animal protein (≥20% of total calories) had a 4-fold greater risk of dying of cancer over the next 18 years compared to people who ate a moderate amount of protein (10-20% of total calories).

(Just so you get an idea, smoking increases your risk of cancer by 20-fold.)

Then, it gets more interesting, because for people over 65, eating more protein decreased cancer risk by more than half. In summary:

Eating more protein from 50-65 years old was associated with a higher risk of death from cancer, but over 65 years old that association was reversed.

The second part of the study is where people really misunderstood what the study had proven.

Researchers fed mice a high-protein diet (18% of total calories), then implanted cancerous cells. They found that the high-protein diet increased tumor size. This is not a surprise, since protein increases IGF-1 (an anabolic protein) that stimulates growth in pretty much all tissues, including cancerous tissue.

Higher protein diets stimulated cancerous growth in mice.

So, while eating more protein might increase the size of existing tumors (depending on what treatment someone is undergoing), this study does not show that high-protein diets *cause* **cancer.**

Claim: High protein causes heart disease.

Eating animal-based protein daily is associated with an increased risk of fatal coronary heart disease (70 percent for men and 37 percent for women), whereas plant-based proteins aren't linked to higher rates of heart disease.

This suggests that where you get your protein from may matter more than how much protein you eat.

However, just like cancer, the link between heart disease and high-protein diets is from questionnaires rather than a double-blind randomized study (the gold standard in research).

There are many confounding factors. For one, consider the type of animal — does seafood cause the same issues as red meat, for example?

We don't yet know the whole story here.

Verdict: Limited evidence that protein causes heart disease and the source of protein is a major confounding factor.

Let's take a deeper look: Protein source

A new study in the Journal of American Medical Association (JAMA) looks not only at protein intake, but where people got their protein from.

More than 131,000 people people were asked:

- how much protein they ate; and
- if it came from animals or plants.

This study took over 35 years to do (starting in the 1980s).

What they found:

Eating more animal protein was associated **with a higher risk of death... if you were also doing something else that was a risk factor.**

Such as:

- smoking
- being overweight
- not exercising
- drinking alcohol
- history of high blood pressure
- low intake of whole grains, fiber, and fruits and vegetables

Eating more plant protein was found to be associated with lower risk of early death.

What does this mean?

You might think at first glance that you should eat less animal protein, since this study seems to say that animal protein is bad for you.

But there's more to it.

If you're doing everything else "right", then eating more animal protein doesn't seem to be a problem.

Likely, it's not the animal protein on its own but a lot of lifestyle things that come with eating more animal protein.

For instance, this study began in the 80s. At that time, nearly every doctor told their patients to eat less fat and meat, and to avoid eggs.

So if you were a somewhat health-conscious person, then you'd likely be eating less animal protein compared to someone who was less health-conscious (or if you went against your doctor's advice) — but you'd also likely be engaging in a bunch of other health-supporting decisions and activities.

The problem with these types of studies, called correlational studies, is that you can never be sure whether the associations are caused by one onto the other or if they're simply happening at the same time.

Protein quality matters

Most people think about how *much* protein, but they don't think all that much about the *quality* of the protein they're eating.

There are huge differences in the chemical makeup of a given protein source, and how valuable that protein is nutritionally.

The higher a protein's quality, the more easily it can give your body the amino acids it needs to grow, repair and maintain your body.

The two big factors that make a protein high or low quality are:

Digestibility:

- How easy is it to digest?
- How much do you digest — *and absorb and use*?

Amino acid composition:

- What amino acids is it made of?

A high-quality protein has a good ratio of essential amino acids, and allows our body to use them effectively.

Amino acid composition is more important than digestibility.

You can have way more protein than you need, but if the protein

you're eating is low in an important amino acid (known as the *limiting amino acid*), it causes a bottleneck that stops everything else from working (or at least slows things down).

High-quality proteins have more limiting amino acids, which means the bottleneck is lessened and our bodies can use that protein source better.

Let's take a deeper look: Measuring protein's worth

Scientists use many ways to calculate protein quality, or how well we might digest, absorb, and use a given protein.

Here are a couple.

Protein Digestibility Corrected Amino Acid Score (PDCAAS)

PDCAAS is calculated using a ratio of limiting amino acids and a factor of true digestibility to give you a value that lets you know how much of a given protein is digestible.

The higher the score, the higher the quality of protein.

PDCAAS is the current gold standard for measuring protein quality, but there are a few other protein quality scoring methods that we cover in the **Precision Nutrition Level 1 Certification** program.

Indicator amino acid oxidation (IAAO)

When we don't have enough of a particular indispensable amino acid, then all the other amino acids, including that indispensable one, will be oxidized (i.e. essentially wasted) rather than used for stuff like repairing tissues.

It's kind of like a team sport: You can't play without the goalie, so all the players sit around twiddling their thumbs, even though they're all great players in their own right.

But if we're getting enough of that particular amino acid, then we won't see all that oxidation. We have a goalie and the rest of the players can play.

So, you want the IAAO score to be low, indicating that all your amino acids are doing their jobs to rebuild you.

Thus far, the IAAO method seems like a very useful way to judge the metabolic availability of amino acids from different protein-containing foods, and to determine total protein requirements for all kinds of people.

New assessment techniques like IAAO are giving us a more precise idea of protein use, which means that we may see recommendations change in the future.

Most likely, based on these recent findings, the RDA for protein will increase — i.e. doctors may tell us to eat *more* protein.

"Complete" and "incomplete" proteins

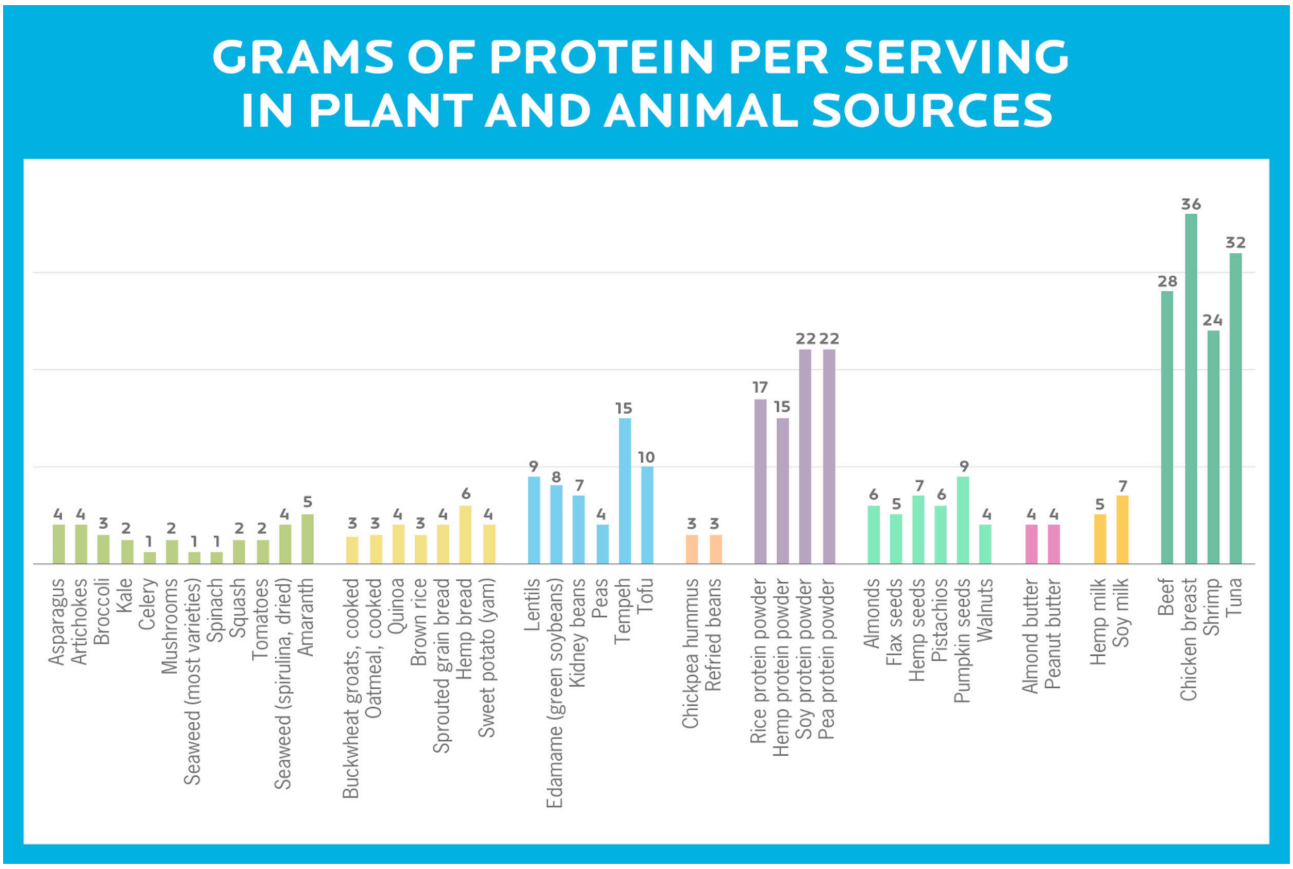
Back in the day, scientists used to talk about "complete" and "incomplete" proteins. If you had a plant-based diet (i.e. vegetarian or vegan), you were told that you had to eat a mix of incomplete proteins (i.e. protein from a variety of plants) at each meal in order to meet your needs.

We now know this isn't true.

As long as you eat a mix of different protein sources, you'll get all the amino acids you need. No need for mealtime protein algebra to make sure you're getting all your amino acids.

That being said, many plant-based sources are less protein-dense than animal sources. So if you choose not to eat animal products,

you'll have to work a little harder to get more protein from a wide variety of plant sources to make up the difference and meet your protein needs.



Animal vs. plant proteins

More and more, it seems that *where* you get your protein has a huge impact on your health.

Eating a high-protein plant-based diet improves health outcomes compared to low-protein diets and high-protein animal-based diets. Again, it comes down to the quality of your protein more than how much protein you're eating.

If you're a diehard carnivore, no worries — just add some more plant protein to your diet. Diversity is good. Hug some lentils today.

Why might you eat MORE protein?

Since we need protein to grow, maintain, and repair our tissues, hormones and immune system, there are times we need more protein.

The standard RDA of 0.8 g/kg is great if you're sedentary and not building or repairing your tissue.

But you may need more protein if you are:

- physically active, either through workouts or your job
- injured or sick
- not absorbing protein normally
- pregnant / breastfeeding
- younger (and growing)
- older (and potentially losing lean mass)

Higher protein diets can also:

- lower blood pressure;
- improve glucose regulation;
- improve blood cholesterol; and
- improve other indicators of cardiometabolic health.

Win all around.

Here are some specific scenarios that might call for more protein.

Protein for athletes

Athletes and active people should eat more protein, but we don't know exactly how much more.

The current recommendations vary from 1.2 to 2.2 g/ kg of body weight.

The International Society of Sports Nutrition says a range of 1.4-2.0 g/ kg is safe and may help with recovering from exercise.

It looks like 2.2 g/kg (1g/lb of body weight) is the highest recommendation, but this shouldn't be confused with the idea that more than 2.2 g/kg is unsafe.

More may not be necessary, but there is little evidence that more is unsafe.

Protein for aging

As you get older, you lose lean mass — both muscle and bone. This affects how long you live, as well as how functional and healthy that life is.

New research shows that most older people, particularly women over 65, need more protein than the current recommendations to slow down muscle loss.

Experts now recommend over 2.0 g/kg of body weight for people older than 65.

Protein for building muscle

The more protein in your muscles, the bigger and stronger your muscles can get. Bodybuilders have long known that there is an "anabolic window" after a workout (24-48 hours) during which muscles are especially greedy for amino acids.

So, if you'd like to build muscle, make sure you eat a protein-rich meal within a few hours after training. Some advanced folks also like to add branched-chain amino acids (BCAAs) or essential amino acids (EAAs) as a during-workout or after-workout supplement.

Here, it seems that a fast-digesting animal protein supplement (whey) is better at getting your body to make more muscle compared to plant-based protein (soy). Of course, you can also just eat "real food" after working out.

Protein for losing fat

Eating protein helps with losing fat, for a few reasons.

1. When you eat more protein, you tend to feel fuller longer.

Protein stimulates the release of satiety (stop-eating) hormones in the gut. So when you eat protein, you naturally tend to eat less, without feeling hungry. (You can test this theory if you want. Go and try to eat an entire plain skinless chicken, or a few pounds of lean fish.)

2. Protein makes your body work to digest it.

Not all nutrients take the same energy to digest. Fat and carbohydrates are pretty easy for your body to digest and absorb, but protein takes more energy to digest and absorb.

If you eat 100 calories of protein, you'll only use about 70 calories of it. (This thermic, or heat-producing, effect of protein is why you sometimes get the "meat sweats" after a big protein-heavy meal.)

3. Protein also helps you hang on to lean mass while you're losing fat.

When you're in a significant energy deficit (i.e. eating less than you burn), your body tries to throw out everything — fat, muscle, bone, hormones, etc. — all the stuff you need. It doesn't tend to throw out just fat and keep muscle... unless you eat lots of protein.

Let's take a deeper look: Protein, lean mass, and energy restriction

A recent study at McMaster University in Canada explored what would happen if people who were on a very low-calorie diet (about 40 percent less than normal energy needs), ate a lot of protein, and worked out hard.

For 4 weeks, a group of young men in their 20s were basically starved, but on a high-protein diet — about 2.4 g/kg.

So, for instance, a 200 lb (91 kg), relatively active young man whose energy needs would normally be 3000 calories per day might get:

- 1800 calories per day (40 percent less than normal)
- 218 grams of protein per day (2.4 x 91 kg)

This means that out of those 1800 calories per day, about 48 percent of them were from protein.

The men trained hard — lifting weights and doing high-intensity intervals 6 days a week.

After 4 weeks, on average:

- **The men gained about 1.2 kg (2.6 lb) of lean body mass (LBM).**

- **They lost about 4.8 kg (10.5 lb) of fat.**

The fact that they lost fat isn't surprising, though that amount of fat loss in 4 weeks is pretty impressive.

What is surprising is that they gained LBM.

There was a control group, who ate more of a normal-protein, low-energy diet — about 1.2 grams of protein per kg (so, for our 200 lb / 91 kg man, that would be around 109 grams per day). This group, on average:

- Gained 0.1 kg (0.2 lb) of LBM
- Lost 3.5 kg (7.7 lb) of fat

This study was only 4 weeks long, and on a specific population group under close supervision, but it's a cool experiment that suggests protein might be able to do some nifty things even under difficult and demanding conditions.

It's particularly useful because it's a randomized controlled trial. In other words, it's not a food questionnaire where you try to remember what you ate last year — it's a direct comparison of two similar groups whose food parameters are being closely monitored.

We don't recommend a highly restrictive, high-protein diet combined with a Spartan-style workout plan as a long-term strategy, but if you want to try something crazy for 4 weeks, see if you can replicate these results!

Why might you eat LESS protein?

Protein and longevity

Everybody is looking for the elixir of life; from 17th century chemists to Monty Python. And for years, living in a semi-starvation state has been shown to increase lifespan in nearly all animals from flatworms to rats to humans.

Looking into it more closely, it looks like restricting protein rather than calories, is the key to longevity.

Protein is *anabolic*: It triggers your body to build more tissues and other body bits. This is great if you want to build muscle, but there's seems to be a downside: Eating protein triggers the body to release and make more IGF-1. In some people, this decreases longevity.

There's a lot of work on lower IGF-1 and longer lifespan in animals (flatworms, rats and mice mostly) and some in people.

But it's more complicated than saying that less protein leads to less IGF-1, which means living longer. There's a genetic component. Some people do better with more IGF-1. In their case, more IGF-1 later in life actually increase lifespan.

And in terms of quality of life and *functional* longevity, a higher protein intake is probably still better. A semi-starved body may indeed live longer... but probably not better.

Age-related muscle loss alone could have serious consequences for metabolic health and mobility.

So: It's difficult to say whether this is a good idea, despite interesting data. We probably need more research to say for sure.

What this means for you

If you're a "regular person" who just wants to be healthy and fit:

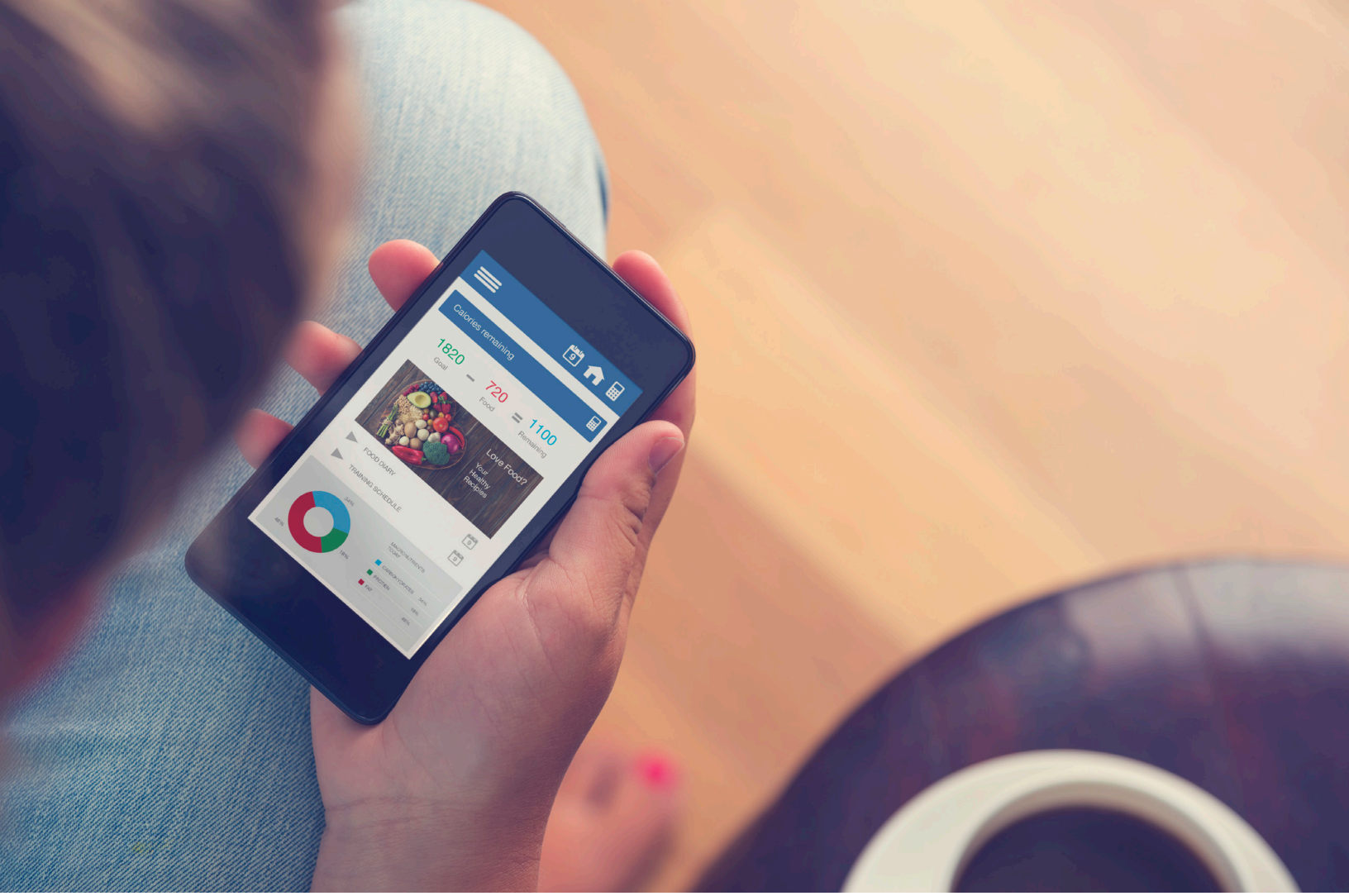
- **Follow Precision Nutrition's portion recommendations.** We suggest a portion of lean protein at every meal, to keep that protein pool full and ready to help your body repair and rebuild.
- **Try different kinds of protein**. Expand your repertoire and menu. This will help you get the best range of nutrients from real food.
- **If you're over 65, eat more protein.** This helps slow down age-related muscle loss, which improves long term health and quality of life.
- **If you're a plant-based eater: Plan your meals carefully.** Without animal products, you'll probably have to work a little harder to get enough protein. You might consider adding a plant-based protein powder to help yourself out.

If you're an athlete:

- **Follow our PN portion recommendations.** We suggest a portion of lean protein at every meal, to keep that protein pool full and ready to help your body repair and rebuild. You may need more than this if you are especially active.
- **Boost your protein intake around exercise.** Eating protein around workouts may improve your body's response to exercise. If you can tolerate whey protein, that's one of the best options. Or, stick with real food.
- **Increase plant based protein sources.** The more the merrier.

If you're a fitness professional / nutrition coach:

- **Understand the basics of a high-protein diet.** Know when, how, and for whom high-protein diets might not be appropriate. If in doubt, learn more from trusted medical and research sources — which, as always, does not include random people of the Internets.
- **Help people understand as much as they need to understand in order to make an informed choice, with your guidance.** Your clients will likely have questions. Prepare your answers in advance.
- **Refer out as needed.** If you think a client might have an underlying health condition, work with their doctor to make sure they don't have kidney or liver disease where a high-protein diet should be avoided.
- **Stay within your scope of practice.** Remember: Unless you're licensed for medical nutrition therapy, you're not authorized to prescribe any type of diet for medical conditions. Don't tell your client with kidney disease that they should go on a high or low protein diet to treat their disease.



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.

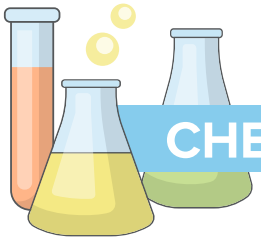
And why (sometimes) the media screws up reporting it.

WHY NUTRITION SCIENCE IS SO CONFUSING

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

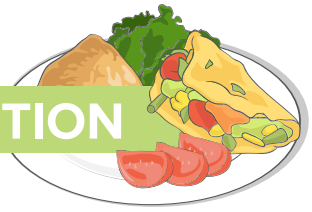
1 NUTRITION RESEARCH IS STILL YOUNG.

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



CHEMISTRY

NUTRITION



<1200 BC

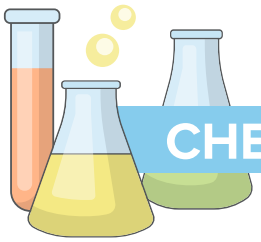
Metals are first recorded and manipulated.

430 BC

Greek philosophers propose the idea of the atom.

300 BC

Aristotle wrongly declares the existence of only four elements.



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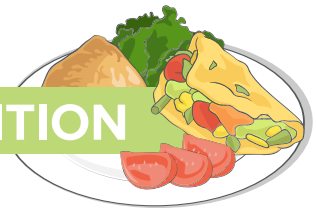


NUTRITION

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.

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

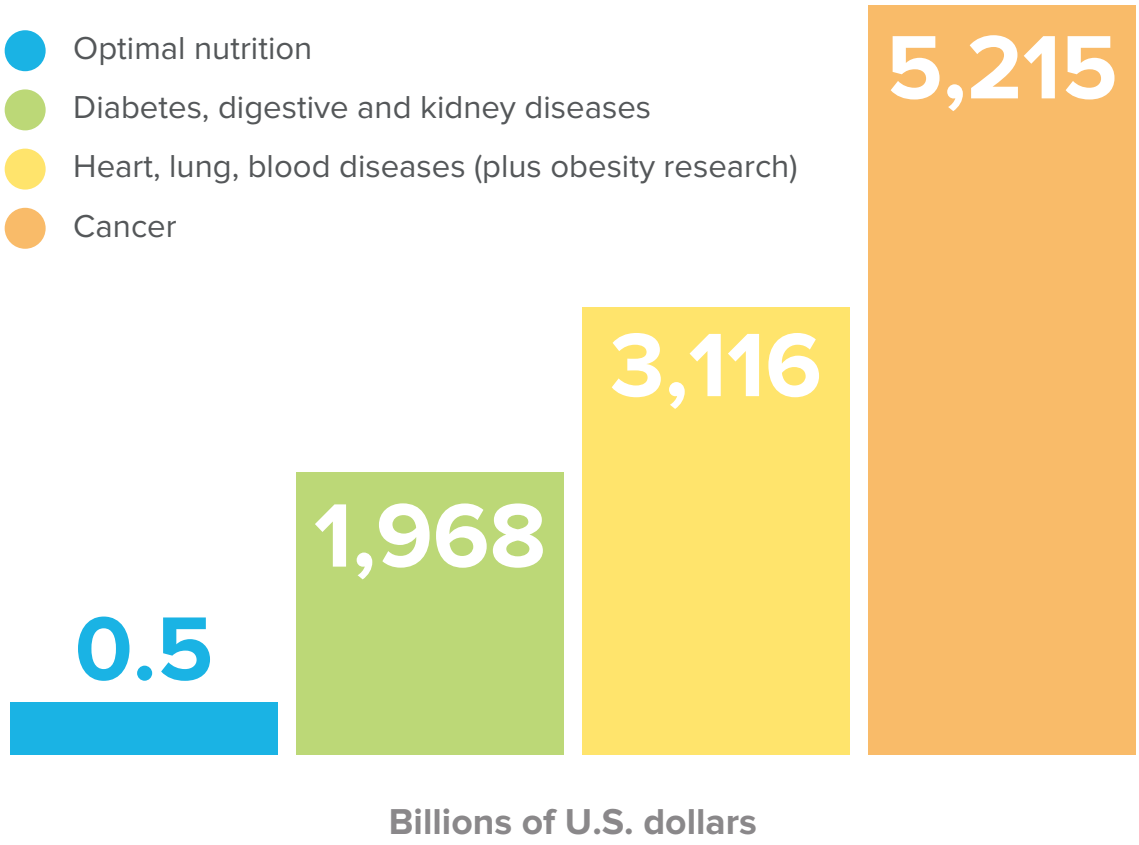
Researchers discover the link between risk of coronary heart disease death and low HDL cholesterol level.

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?"

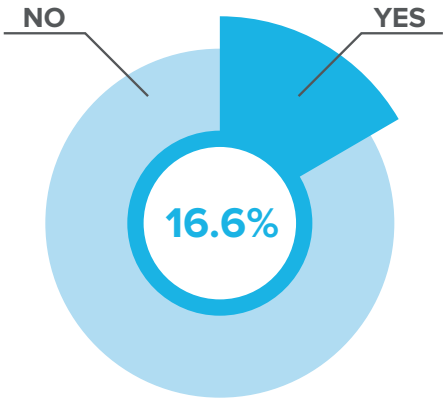
2016 U.S. NATIONAL INSTITUTE OF HEALTH FUNDING BY AREA OF RESEARCH



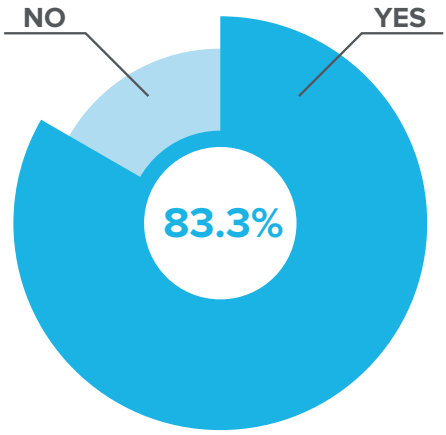
3 OTHER NUTRITION QUESTIONS ARE OFTEN FUNDED BY INTERESTED PARTIES.

Where funding comes from can affect what studies find.

CAN SUGARY DRINKS LEAD TO WEIGHT GAIN?



Studies WITH financial conflict of interest



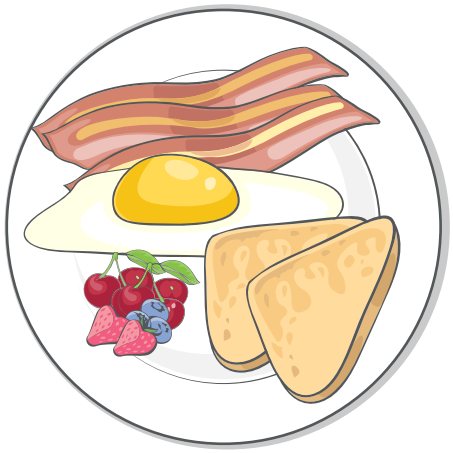
Studies with NO financial conflict of interest

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
CULTURE YOU LIVE IN
YOUR HEALTH
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

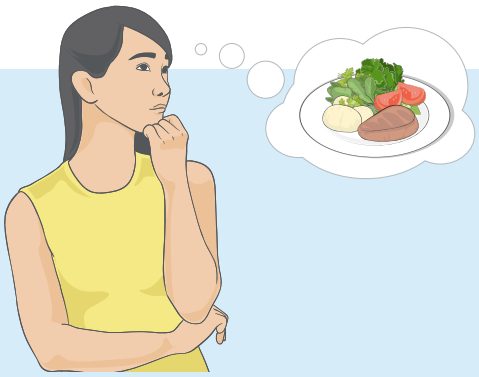


Participation in a study can itself become a confounding variable.

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.

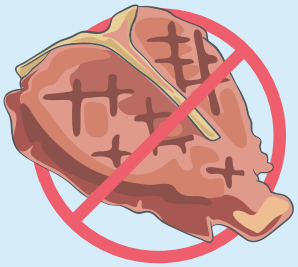
5 MOST NUTRITION STUDIES ARE OBSERVATIONAL.

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.

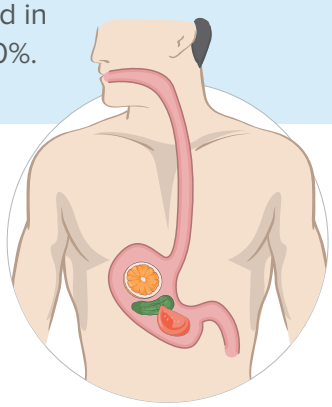


Correlation isn't causation.
Does red meat cause heart disease and cancer, or do people with these chronic diseases happen to eat more red meat? Since an observational study can't account for all variables, it can't answer this question.

6 MEASUREMENT TOOLS ALWAYS HAVE LIMITATIONS.

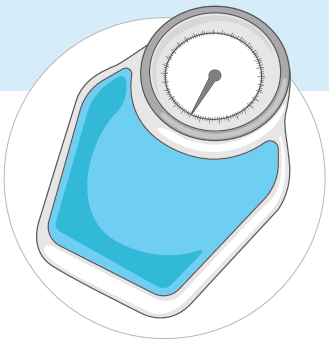
For example, even with a straightforward question like, "How do calories affect our weight?" it's hard to get an answer, because:

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.

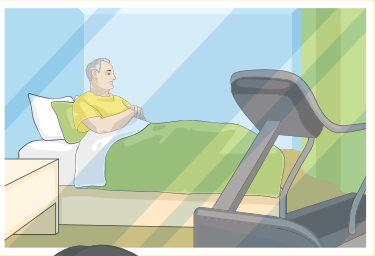
Calorie burn estimates can be off by 3 - 45%.



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?



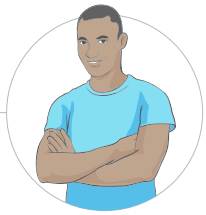
8 YOU CAN NEVER ASSUME A STUDY'S FINDINGS APPLY TO YOU.

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.

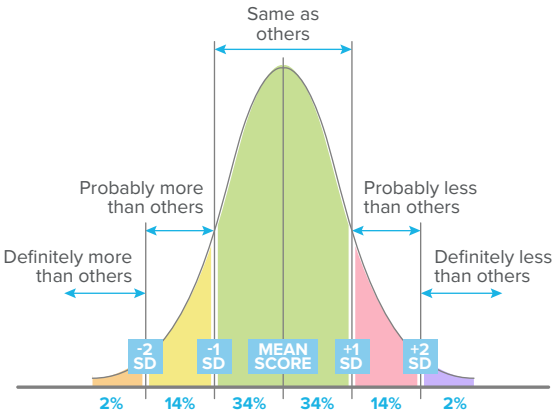
ULTRA FIT

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 had 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.

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