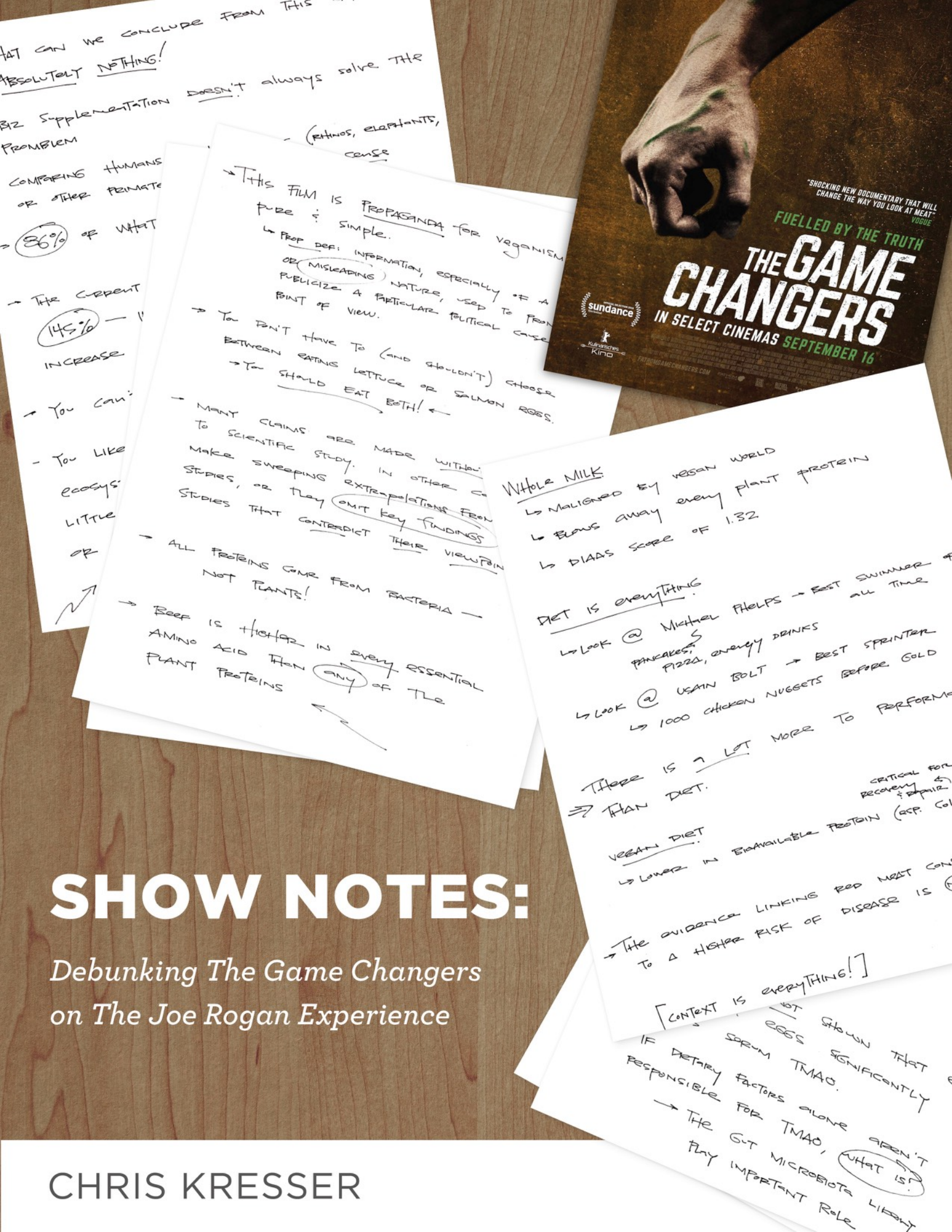

SHOW NOTES:

Debunking The Game Changers on The Joe Rogan Experience

CHRIS KRESSER

What's the best diet for optimal health? I don't believe that there's just one diet that can suit the needs of every individual, but I do believe there are some characteristics that all healthy diets share:

- They're ancestral, or based on the nutrient-dense, whole foods our bodies are evolved to thrive on
- They minimize processed, inflammatory junk
- They include both plant *and* animal foods

A recent document called *The Game Changers* makes the opposite claim: namely, that a plant-based diet is optimal, especially for athletic performance, while animal products are harmful for health.

The Game Changers follows James Wilks—a combative instructor for the U.S. military and a former UFC fighter—as he adopts a vegan diet. On November 19, 2019, I appeared on the *Joe Rogan Experience* to debunk the claims put forth by Wilks and his collection of experts and celebrities. Ahead of my appearance, I conducted extensive research on the *real* impact of a plant-based diet over an omnivorous, ancestral diet. I'm sharing that research and my show notes with you now in hopes that it helps clear up some of the misconceptions on vegan diets.

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GENERAL COMMENTS AND INTRODUCTION

The Game Changers is an agenda-driven film, not an objective analysis of an optimal diet for athletes

- Executive producers include Jackie Chan, Louie Psihoyos, and James Cameron and his wife Suzy Amis Cameron. (1)
- James Cameron is an Academy Award-winning director. But he and his wife are also the founders of Verdient Foods, a pea protein company. Cameron is part of a $140 million joint investment partnership, with the goal of becoming the largest organic pea protein company in the United States. (2) He is not a dispassionate observer.
- Suzy Amis Cameron is also starting a chain of vegan schools across the United States. (3)
- Medical experts in the film are all prominent plant-based diet advocates with books, products, and careers/livelihoods in this field, including Drs. Dean Ornish, Caldwell Esselstyn, Aaron Spitz, and Robert Vogel.
- It is not strange to have vegan experts talk about veganism, nor is it strange that vegan experts would invest in products they believe in.
- But it's important to understand that the **purpose of this film is to advocate for a plant-based diet**. It's not an objective analysis of the science related to these topics, it hasn't been peer-reviewed, and it plays very fast and loose with the science (we'll discuss this more later).
- **This film is propaganda for veganism, pure and simple**. Propaganda definition: "Information, especially of a biased or misleading nature, used to promote or publicize a particular political cause or point of view." (4)
- Not all propaganda is bad … but let's just be clear that this isn't scientific.

> This film is propaganda for veganism, pure and simple. Propaganda definition: "Information, especially of a biased or misleading nature, used to promote or publicize a particular political cause or point of view."

Veganism is akin to a religion

- There's a saying that applies here: **"You can't fight faith with facts."** No matter how strong the critiques against a film like *The Game Changers* are (and there have already been many good ones), it won't change the minds of "Vegangelicals."
- As Leon Festinger, author of *When Prophecy Fails*, once said, "**A man with a conviction is a hard man to change**. Tell him you disagree and he turns away. Show him facts and figures and he questions your sources. Appeal to logic and he fails to see your point."
- An example of how this plays out: The American College of Lifestyle Medicine (ACLM) is offering CEUs to medical professionals that watch *The Game Changers* and take a quiz. The ACLM was founded by Seventh-day Adventists (SDA) at Loma Linda University. This is ridiculous given how unscientific the film is. It's a great example of how agenda-driven the film is.
- SDA founder Ellen G. White taught that meat was a toxic substance and flesh meat should be discarded for moral, spiritual, and physical purity.
- SDA has influenced dietary guidelines for over 100 years. **Adventist Lenna Cooper co-founded the American Dietetic Association (ADA) in 1917**. She was an acolyte of Dr. John Harvey Kellogg, one of the founders of the breakfast cereal industry (Corn Flakes, anyone?), and she wrote textbooks and other materials that were used in dietetic and nursing programs not only in the United States, but around the world, for more than 30 years.
- Plant-based diet (PBD) advocates claim to be "pro-science," but rarely acknowledge these strong religious ties between organizations like the ADA and SDA church.
- They also ignore evolutionary biology, comparative anatomy, and anthropological research all suggesting that animal products are an important part of the human diet.

Veganism promotes—rather than breaks down—industrial agriculture and "Big Food"

- Many vegans are motivated by concern for the planet. But one of the biggest ironies of a PBD and some of its advocates is that it **promotes/supports industrial agriculture**.
- Cameron has a pea protein powder company. Pea protein powder (and other protein powders like soy) are **ultra-processed foods made from industrial**

> *The Game Changers* had a big budget, a very capable production team, and is full of celebrities. It's a well-made film and their choice to feature James Wilks, who starts as a skeptical omnivore, and ends up going vegan, was effective. But the film is full of misleading statements, half-truths, flat-out falsehoods, flawed logic, and absurdities.

monocrops. These are high-margin products that Big Food makes a lot of money off of.

- Even meat-packing companies like Cargill, JBS, Tyson, etc. are redefining themselves as "protein companies" so they can sell these ultra-processed protein powders and capitalize on the growing vegan movement.
- The same is true of fake meat companies like Impossible Foods and Beyond Meat, and lab meat companies. These products all require industrial monocrops as inputs, and according to some analyses (discussed below), they are **less environmentally friendly than holistically managed beef**.

This is a very slick, well-done film that will mislead a lot of people

- *The Game Changers* had a big budget, a very capable production team, and is full of celebrities. It's a well-made film and their choice to feature as the protagonist/narrator of the film James Wilks, a retired professional mixed martial artist who starts as a skeptical omnivore, and ends up going vegan, was effective.
- But the film is full of misleading statements, half-truths, flat-out falsehoods, flawed logic, and absurdities.

The gorilla analogy

- One of my favorites: "I mean, look at a gorilla. A gorilla will fuck you up in two seconds. Yeah. What does a gorilla eat?"
- You know what will "fuck you up" even faster? A human with a gun who eats food from McDonald's! A gun is a tool invented by humans. How did we get

smart enough to invent tools? Most scientists believe that it was because we started eating meat and fish and cooked tubers, which are more energy-dense and easier to digest and absorb than plants.
    - Nicotinamide is a brain-trophic nutrient in meat. (5)
    - Animal foods played a critical role in human evolution. (6)
    - Meat and Lower Paleolithic food processing techniques had an impact on chewing (and evolution) in humans. (7)
    - Humans scavenged marrow from large animal bones long before they began hunting—the high fat content (particularly docosahexaenoic acid, or DHA) of marrow may have contributed to brain growth and "what made us human." (8)
    - Eating cooked tubers may have led to humans' large brains. (9)
- Comparing humans with other primates and other herbivores and elephants doesn't make any sense. Humans have relatively large brains and small guts compared to our primate relatives. We also use tools and cook our food (e.g., we eat cooked steak with a fork and knife, rather than tearing it from the bones of a dead animal).
- Gorillas have big large intestines that help them break down fiber, seeds, and other hard-to-digest plant foods. Humans don't. Instead, we have big small intestines, which suggest adaptation to energy-dense foods like meat and cooked starches.
- A gorilla eats up to 40 to 60 lb. of plant matter a day, which consumes more than half of their waking hours. (10) Even if humans could eat that much plant matter, and spend that amount of time eating, they wouldn't be able to absorb the nutrients because we have a very different anatomy than a gorilla.

The peanut butter sandwich

- Here's another gem: early in the film, Wilks says "a peanut butter sandwich has about as much protein as three ounces of beef or three large eggs."
- I laughed out loud at this one. For a peanut butter (PB) sandwich to have the same quantity of protein as 3 oz. of beef or three eggs, you'd have to use 5 Tb of PB. That's almost one third of a cup! Who uses one third of a cup of PB to make a PB sandwich?

> For a peanut butter sandwich to have the same quantity of protein as 3 ounces of beef or three eggs, you'd have to use 5 tablespoons of PB. That's almost one third of a cup! Who uses one third of a cup of PB to make a PB sandwich?

(Also, that's 500 calories, for anyone who's counting.)

- That's kind of like saying you can get the same amount of calcium (Ca) by eating 33 cups of baby spinach as you can from drinking one 8-oz. glass of milk.
- Also, the PB example completely ignores the issue of protein quality. Protein quality is a function of amino acid profile and bioavailability. Scientists use a scale called the Digestible Indispensable Amino Acid Score (DIAAS) to rate proteins using these criteria. Higher is better. Beef's score is 1.10, egg is 1.13, and PB is … 0.46. (11)
    - The DIAAS score for medium-rare beef steak is 1.39. (12)
    - The DIAAS score for whole wheat is 0.20, and for oats it is 0.43 (the authors expressed these values as percentages rather than decimals, so in the article, the DIAAS score for wheat is expressed as 20, and for oats, 43). (13)
- So, even if you did make a PB sandwich with one third of a cup of PB, the quality of the protein you'd get from that would be far inferior to what you'd get from eating beef and eggs.
- We can talk much more about protein quality—and why it's so important—later.

Lettuce has more antioxidants than salmon or eggs

- Wilks: "The antioxidants Dr. [Scott] Stoll was talking about, I found almost entirely in plants, which have on average 64 times the antioxidant content of animal foods. Even iceberg lettuce has more antioxidants than salmon or eggs."
- And a serving of salmon has **716 times more selenium** than iceberg lettuce, and **provides over 100 percent of the Recommended Dietary Allowance (RDA) of vitamin B12 (vs. 0 percent for iceberg lettuce)**. So what? (Source: **Nutritiondata.com**).
- I have no qualms with lettuce. I have always advocated a diet that contains whole plant and animal foods—in part for this reason. It's true that plants are the primary source of non-nutrient antioxidant compounds, such as carotenoids and polyphenols.
- However, Wilks' statement completely ignores the important role of nutrient antioxidants, such as preformed vitamins A, E, and K, copper, zinc (Zn), selenium, and coenzyme Q10 (CoQ10). These are typically found in the highest amounts in animal products.

- For example, a serving of salmon contains more than 100 percent of the RDA for selenium, vs. 0 percent in a cup of shredded iceberg lettuce. It also has more Zn, copper, and CoQ10 than lettuce. (14, 15)
- Two eggs contain more vitamin A than a cup of shredded iceberg lettuce. They also have more copper, Zn, selenium, and vitamin E than lettuce. Two pastured egg yolks also contain about 75 mcg of vitamin K2, a relatively recently discovered form of vitamin K with unique effects.
    - One egg has 74 retinol activity equivalents (RAE) or 260 IU of vitamin A (16); 1 cup of shredded lettuce has 18 RAE and an estimated 361 IU of vitamin A (17), but this is misleading because carotenoids are very inefficiently converted into vitamin A in the body.
        - "Bioavailability of carotenoids in raw vegetables is estimated to be 5–10% for humans and rats, while it may be as high as 50% when dissolved in oils." (18)
- A single serving of six oysters meets the RDA for Zn for an entire week, and copper for four days. (19)
- Likewise, I could just as easily say that salmon and eggs have far more protein and far higher levels of healthy fats and essential vitamins and minerals than lettuce.
- This is another misleading, straw man argument. You don't have to (and shouldn't) choose between eating lettuce or salmon/eggs. You should eat both.

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The gladiator thing > anecdote vs. science

- The film claims that Roman gladiators were so tough and badass because they ate a diet of barley and beans instead of meat. They referred to studies of gladiator bones, which suggest this. (20)
- First, most gladiators were slaves who were taught to fight at a special school, and then made to fight to the death. Their life expectancy was about two years. Their nickname, hordearii (which means "barley eaters"), was not a compliment; it was an epithet. They were being fed the cheapest possible slave diet—not exactly something to aspire to.
- Second, the same studies established that gladiators carried extra fat, on purpose. A layer of fat around the chest and abdomen provided an additional

layer of armor around their vital organs, protecting them against superficial wounds. This allowed them to endure more wounds before they died, which made for better sport.

- How did they train so hard and still build up an extra layer of fat? They ate a ***ton*** of carbohydrates, primarily barley, legumes, and dried fruit. So, if you want to add fat, this is a good approach!
- Third, even if gladiators did follow a vegetarian diet, so what? This is anecdotal, not scientific. I could just as easily tell you about the diets of elite, world-record-breaking athletes like Michael Phelps and Usain Bolt.
- Phelps eats 12,000 calories a day, including three slices of sugar-coated French toast, three ham and egg sandwiches, three chocolate chip pancakes, energy drinks, and an entire pizza. (21)
- Bolt famously ate over 1,000 chicken nuggets during the 2008 Beijing Olympics, where he set a new world and Olympic 100m record of 9.69s. (22, 23)
- Does this mean Phelps' and Bolts' diets are "optimal" for performance? Should the average weekend athlete eat this way?

Sloppy with the science (almost certainly intentionally)

- Many claims are made without reference to scientific studies. In other cases, they make sweeping extrapolations from small studies, or they omit key findings from studies that contradict their viewpoint.

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The protein and muscle mass study

- An example of this is one peer-reviewed study they cite on protein: "And when it comes to gaining strength and muscle mass, research comparing plant and animal protein has shown that as long as the proper amount of aminos acids are consumed, the source is irrelevant."
- I don't disagree, but consuming the proper amount of amino acids when you're eating only plants isn't easy without including protein powders.

- Also, if you read the full text of that study (which they know virtually nobody will do), it says "as a group, vegetarians have lower mean muscle creatine concentrations than do omnivores, and this may affect supramaximal exercise performance." (24)

The Dean Ornish animal protein study claim

- Another example is Dean Ornish's claim: "People who eat a diet that's high in animal protein have a 75 percent increased risk of premature death from all causes, and a 4 to 500 percent increased risk of death from most forms of cancer, prostate, breast, colon cancer, as well as type 2 diabetes."
- That is a shocking claim. I wish he would have provided a reference! No reputable studies support those numbers.
- The most well-controlled studies—which adjusted for other dietary confounders as well as physical activity, smoking, alcohol, and social class—showed an increase of cancer risk of 16 percent, and even that has been challenged. (25)
- For diabetes, low-carb and keto diets (which are high in animal protein) have been found to significantly reduce the risk of diabetes, not increase it. (26)

The vitamin B12 claim

- Wilks says: "It turns out that B12 isn't made by animals, after all. It's made by bacteria that these animals consume in the soil and water. Just like with protein, animals are only the middlemen. Before industrial farming, farm animals and humans could get B12 by eating traces of dirt on plant foods or by drinking water from rivers or streams. But now, because pesticides, antibiotics, and chlorine kill the bacteria that produce this vitamin, even farm animals have to be given B12 supplements."
- First, B12 is made by bacteria, but animals don't get it by consuming soil and water. They get it from their own gut bacteria. In cattle, bacteria in their rumen make B12 (cobalamin) by converting trace elements of cobalt found in the grasses and forbs they eat. Since cattle are foregut fermenters, that cobalamin is absorbed by the cattle's small intestines and bio-concentrated in their livers. If there is any B12 in the soil, it's from the manure of animals.
- Primates like humans and gorillas also have bacteria in our gut that make B12. But we are hindgut fermenters, which means that we poop out any B12 that is made in our guts. Gorillas and chimps can access the B12 they produce because they are coprophagic—they eat their own poo.

(27) Unless you want to eat your own poo, you can't access any B12 that your body makes.

- There is **zero** evidence that B12 is fed to cattle, nor is there any evidence that humans have ever been able to meet their need for B12 by consuming soil or water. Just ask Jack Norris, RD, a vegan dietitian who wrote a detailed, scientifically referenced post about B12 where he confirms this information. (28)

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- Wilks also says: "And up to 39 percent of people tested, including meat eaters, are low in B12. As a result, the best way for humans to get enough B12, whether they eat animal foods or not, is simply to take a supplement."
- Again, no reference was cited. This is completely at odds with many recent studies showing huge differences in rates of B12 depletion or deficiency between vegans, vegetarians, and omnivores. A 2003 study by Hermann et al. using a more sensitive marker of B12 depletion, Holo-TC, found depletion in 11 percent of omnivores, 77 percent of vegetarians, and 92 percent of vegans. (29)
- A 2010 study using serum B12, a much less sensitive marker of deficiency, found 7 percent of vegetarians and 52 percent of vegans were B12 deficient, vs. less than 0.5 percent of omnivores. (30) You can find these studies and more at **kresser.co/b12**.
- The lab range for homocysteine (Hcy) often goes up to 15 nmol/L, but studies have shown that an Hcy level of 10 to 15 nmol/L is a substantial risk factor for heart disease, and the relationship is linear—the higher the Hcy, the higher the risk. (31)
- Nine of 10 comparisons of Hcy found higher levels in vegetarians than omnivores, and higher levels in vegans compared to vegetarians. (32)
- Average Hcy levels among vegetarians were 13.9 and vegans 16.4, compared to 11.3 for omnivores. This puts most vegetarians and vegans in a range that carries a significant risk of cardiovascular disease (CVD). In fact, "the prevalence of hyperhomocysteinemia among vegetarians may actually be higher than that among non-vegetarians already diagnosed with heart disease." (33, 34)

- B12 supplements do not always solve the problem. In one study that recruited vegans from a summer camp in the Netherlands, those who took supplements still had a serum B12 level of 192 on average, which is deficient. (35)
- Also, we now know that the dose of B12 in a supplement needs to be 100 times higher than the RDA of 2.4 µg/day to be effective (approximately 250 µg/day), and that in deficiency states, it should be 200 times higher (approximately 500 µg/day). (36)
- This is yet another example of how disingenuous and misleading their use of "science" is.

THE KEY POINTS OF THE FILM

The film makes four primary arguments:

- A vegan diet is optimal for athletic performance.
- Most athletes who convert to a vegan diet thrive.
- Animal protein is harmful for athletic performance and increases the risk of disease and death.
- Our human ancestors followed a predominantly plant-based diet.

Within each argument are several "sub-arguments." Let's look at each category in depth.

IS A VEGAN DIET OPTIMAL FOR ATHLETIC PERFORMANCE?

Protein and Carbs

Are carbohydrates required for all types of exercise?

One of the first claims in the movie is that carbohydrates are required for energy during exercise.

- Dr. James Loomis says: "The actual energy for exercise comes mainly from carbohydrates in the form of glycogen that we store in our muscles. And when we sacrifice those carbohydrate calories for protein calories in our diet, what ends up happening is you will develop really chronic carbohydrate or glycogen depletion. And what does that lead to? Well, it leads to chronic fatigue and loss of stamina."

> The type of fuel an athlete needs depends on the type of activity. Explosive, glycolytic activities like MMA, basketball, etc.—most will do better eating more carbohydrates. But in endurance activities like cycling or long-distance running, fat can be burned as the primary fuel source.

- The type of fuel an athlete needs depends on the type of activity. Explosive, glycolytic activities like mixed martial arts, basketball, etc.—most will do better eating more carbohydrates.
- But in endurance activities like cycling or long-distance running, fat can be burned as the primary fuel source. And in fact, there's some evidence that very-low-carb (VLC) diets like keto may protect against exercise-induced muscle and organ damage. (37)
- There are several examples of endurance athletes following low-carb (LC) or keto diets. Zach Bitter, and ultramarathon runner, follows an LC diet and sometimes a keto diet, and he recently crushed the 100-mile world record with a 6:48-minute mile pace. Then he kept running to set the 12-hour record. (38)

All protein comes from plants > animals are "just the middlemen"

- Wilks: "I was surprised to learn that all protein originates in plants. Cows, pigs, and chickens, it turns out, are just the middlemen."
- I was surprised to learn that, too! Because in fact, all proteins come from bacteria, not plants. Bacteria take up nitrogen from the atmosphere, and are consumed by plant roots when they feed on carbon. Bacteria also die and their necromass provides free amino acids that are taken up by plants.
- Bacteria in cattle's rumen convert carbs to short-chain fatty acids, which they use for energy. Bacteria die in the

> All proteins come from bacteria, not plants.

rumen and are also consumed. So, cattle (and other ruminants) get their protein from bacteria.

- This also explains why the levels of amino acids (the building blocks of protein) are so much higher in meats than they are in plants:
- Animals are the "middlemen" that convert the nutrients in plants that are inedible to humans (like grasses and forbs) into highly bioavailable and concentrated sources of protein that our bodies thrive on. That's the whole point!
- They do this for other nutrients, too. For example, animals convert a portion of the beta-carotene that they get from eating grass into retinol, the active form of vitamin A. While humans can convert some beta-carotene from plant foods into retinol ourselves, that conversion is limited. And for people with certain genes, that may not happen much at all. (**39**)
- What's more, the difference between the amount of a nutrient like beta-carotene that is listed in a food and the amount that you actually absorb can be huge. Studies have shown that you absorb only about 10 percent of the beta-carotene in raw vegetables. (**40**)
- Also worth pointing out is that high doses of carotenoids saturate uptake and conversion mechanisms, which means that eating more beta-carotene won't necessarily lead to higher levels of retinol in the blood. (**40**)
- This explains the results of a study, which showed that dietary retinol decreased the risk of hip fractures in women, but dietary beta-carotene didn't. (**41**)
- It's far better for us to consume retinol directly—which is found only in the meat, milk, and organs of animals.

Vegetarian athletes get more than enough protein

- Wilks: "In fact, the largest study to compare the nutrient intake of meat eaters with plant eaters showed that the average plant eater not only gets enough protein, but 70 percent more than they need." (**42**)
- This one is going to require a lot of unpacking …

What is Wilks referring to by "enough protein"?

- The study Wilks linked to measured protein intake and compared it against the RDA.

- The RDA for protein is currently 0.8 g/kg. However, a more recent and thorough statistical analysis of data used to determine RDA suggests it should be 1.0 g/kg. (43)
- Also, the RDA doesn't represent the optimal protein intake—it's merely the amount we need to eat to avoid malnutrition. In other words, **it's the bare minimum**.
- Another issue is that the RDA was determined using outdated nitrogen balance studies, which underestimate dietary protein requirements.
- A newer method called the **indicator amino acid oxidation (IAAO) technique** provides a more accurate estimation of protein needs. IAAO suggests that **1.2 g/kg is a more appropriate RDA** for healthy young men, older men, and women. (44, 45, 46)
- In the study Wilks referenced, which is the largest analysis of protein intake in vegetarians done to date, median protein intake for strict vegetarians was 71 g/d. Assuming a minimum necessary intake of 1.2 g/kg (a sedentary, healthy person), that **would only be enough protein for an adult who weighs less than 130 lb**. (47)
- If you weigh more than 130 lb., and/or if you're an athlete who requires more protein, and/or if you're trying to lose weight or improve cardiometabolic risk factors—all of which require higher protein intakes—a vegetarian diet won't provide enough, according to this study.

Athletes need more protein than the RDA

- Wilks acknowledges that athletes need more protein than the RDA: "But athletes need more protein than most people do."
- Unfortunately, he fails to explain just how much more athletes need—it turns out to be ***a lot*** more.
- The American College of Sports Medicine, the Academy of Nutrition and Dietetics, the Dietitians of Canada, and the International Society of Sports Nutrition (ISSN) all recommend **1.2 to 2.0 g/kg** to optimize recovery from training and to promote the growth and maintenance of lean mass when caloric intake is sufficient. (**Examine.com**)
- What's more, many studies suggest that higher amounts of protein are more effective for muscle building. The most thorough meta-analysis on this topic to date found that the **average amount of protein required to maximize lean mass is about 1.6 g/kg, and some people need upwards of 2.2 g/kg.** (**Examine.com**)

- IAAO studies in athletes found different numbers: on training days, **female athletes required 1.4 to 1.7 g/kg** the day following a regular training session, and **male endurance athletes required 2.1 to 2.7 g/kg**; two days after their last resistance-training session, **amateur male bodybuilders required 1.7 to 2.2 g/kg**. (Examine.com)
- This puts the range of protein intake for the most effective muscle gain and recovery at **1.4 to 2.7 g/kg, with the best results at the higher end of this range**.
- If we say 2.1 g/kg, that's close to 1 g/lb of bodyweight. For a 200-lb. athlete, that's 200 g of protein per day. **This is much harder to obtain on a plant-based diet**—unless you use protein powders extensively (which many plant-based athletes, like Patrik Baboumian, do).
    - An example of what a person's daily food intake would need to look like to offer 200 g of protein:
        - 3 cups of cooked lentils: 51.6 g of protein, 660 calories
        - 3 slices of silken tofu: 34.8 g of protein, 312.6 calories
        - 3 cups of chickpeas: 43.2 g of protein, 801 calories
        - 3 oz of almonds: 18 g of protein, 516 calories
        - 2 cups of quinoa: 16.2 g of protein, 444 calories
        - 10 tb of peanut butter: 35.5 g of protein, 957 calories
        - Total: 199.3 g of protein, 3,690.6 calories
- It's also worth pointing out that if an athlete is **trying to bulk up and maximize muscle gain**, eating **even higher amounts of protein (up to 3.3 g/kg)** won't increase muscle synthesis above what they can get with 2.7 g/kg, but it **may help them to minimize the fat gain** that typically occurs on a hypercaloric diet. (Examine.com)

Optimal protein intakes for fat loss are higher, too

- They don't talk about this in the film, but 70 percent of Americans are overweight and 40 percent are obese. (48) So, any discussion of optimal protein intakes must take this into consideration.
- Several meta-analyses involving

> 70 percent of Americans are overweight and 40 percent are obese. Any discussion of optimal protein intakes must take this into consideration.

people with overweight or obesity suggest that **1.2 to 1.5 g/kg is an appropriate daily protein intake range to maximize fat loss**. (**Examine.com**) This is higher than even the modified RDA of 1.2 g/kg, and is well above the average intake for vegetarians in the studies referenced on *The Game Changers* film website.

- It's also true that a large body of evidence has shown that higher protein diets (in the range of 25 percent of calories) improves several cardiometabolic risk factors, including waist circumference, body weight, body mass index (BMI), blood pressure, lipid profiles, fasting insulin, and satiety.

Older adults also need more protein

- Sarcopenia, or impairment of physical function, is the primary cause of age-related frailty in the elderly.
- Frailty is associated with a higher risk of having disabilities that affect your ability to perform daily activities, having to go to a nursing home, and experiencing fractures, falls, and hospitalizations.
- There's a saying in medicine: "Break your hip, die of pneumonia." Sarcopenia is associated with a greater risk of premature death and reduced quality of life. It's not a minor issue; more than 40 percent of men and 55 percent of women over the age of 50 have sarcopenia. (**Examine.com**)
- So, preserving muscle mass is critical to reducing morbidity and mortality in the elderly. Low protein intake is associated with frailty and worse physical function.
- Also, as we age, muscle mass becomes less sensitive to the anabolic effects of protein. So, older adults need higher amounts of protein with each meal to achieve maximal muscle protein synthesis (MPS).
- Most research suggests **1.2 to 1.5 g/kg is a good target range for the elderly**. (**Examine.com**)

So do pregnant women

- There's some evidence with the IAAO method that the RDA for pregnant women should be about 1.66 g/kg during early gestation (weeks 11–20) and 1.77 g/kg during late gestation (weeks 32–38). (**Examine.com**)
- Meta-analysis of 16 studies found that increasing protein beyond the RDA during pregnancy led to a 34 percent lower risk of lower gestational rate, a 32 percent lower risk of low birth rate, and a 36 percent lower risk of stillbirth. (**Examine.com**)

- Likewise, lactating women should aim to consume at least 1.5 g/kg of protein daily. (**Examine.com**)
- This is all significantly above the 0.8 g/kg/d mentioned in the film, and above the average vegetarian protein intake in the study they referenced.

But isn't it dangerous to eat so much protein?

- This is a common myth propagated by vegans.
- It's true that very-high-protein diets can cause kidney problems in people with preexisting, chronic kidney disease. However, just because a low-protein diet can be therapeutic for those with kidney disease, doesn't mean a high-protein diet causes kidney disease in the first place.

> Just because a low-protein diet can be therapeutic for those with kidney disease, doesn't mean a high-protein diet causes kidney disease in the first place.

- There is an upper limit to the body's ability to metabolize protein (studies suggest that this limit is around 35 percent of total calories), but the brain has specific mechanisms that regulate the desire for protein, and these mechanisms are difficult to override through willpower alone. (**49**)
- While very-high-protein diets cause some changes in kidney function—such as an increase in glomerular filtration rate (GFR) and an increase in the size and volume of glomeruli, which are the functional filtration units of the kidneys—these changes are a normal adaptive response to additional protein in the diet, not a pathological condition. (**50**)
- For example, one study found that no significant changes were seen in protein intake ranges of 1.28 to 2.8g/kg of bodyweight. (**51**)

What about high protein (especially animal protein) and bone health?

- Higher protein intakes are correlated with better bone health in multiple studies, even though high-protein diets are generally net acid forming. (**52**)
- In fact, animal protein in particular (the most acid-forming food of all) has been associated with better bone health. (**53**, **54**)

Is the same amount of protein in lentils/a PB sandwich and beef/eggs?

- Wilks: "For example, one cup of cooked lentils, or a peanut butter sandwich has about as much protein as three ounces of beef or three large eggs. But what about the quality of the protein? I'd always heard that plant-based protein was inferior."
- I laughed out loud at this one. For a PB sandwich to have the same *quantity* of protein as 3 oz. of beef or three eggs, you'd have to use 5 Tb of PB. That's almost one third of a cup! Who uses one third of a cup of PB to make a PB sandwich? (Also, that's 500 calories, for anyone who's counting.)
- Three ounces of cooked ground beef = 23 g of protein. To get this amount from cooked lentils, you'd have to eat over a half pound of them.
- These are disingenuous comparisons. It's kind of like saying you can get the same amount of Ca by eating 33 cups of baby spinach as you can from drinking one 8-oz. glass of milk.

Protein quality is just as important as protein quantity

- In the film, Wilks says: "But what about the quality of the protein? I'd always heard that plant-based protein was inferior."
- Dr. Loomis responds: "Proteins are strings of amino acids, and there's some amino acids our bodies can't make. Those are the essential amino acids. So, we have to get them from food. And one of the arguments about animal-based proteins being superior is that plant-based proteins aren't complete. So, you're not going to get all the amino acids. And that's a fallacy as well."
- Then Wilks says: "Again, I was surprised to discover that every single plant contains all the essential amino acids in varying proportions. And when it comes to gaining strength and muscle mass, research comparing plant and animal protein has shown that as long as the proper amount of amino acids are consumed, the source is irrelevant."
- **These statements are misleading half-truths. Protein quality is a function of amino acid profile and bioavailability, and plant proteins are inferior to animal proteins on both counts.** This is

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Protein quality is a function of amino acid profile and bioavailability, and plant proteins are inferior to animal proteins on both counts.

not controversial; it's well-established in the scientific literature and is accepted by major health and governmental organizations around the world. It's reflected in protein quality scales like protein digestibility-corrected amino acid score (PDCAAS) and DIAAS.

Amino acid profile of plant vs. animal proteins

- **Dr. Loomis's statement is a straw man fallacy.** No credible person has ever argued that plant proteins are inferior because they don't contain all the essential amino acids (EAAs). The claim, which is backed by science, is that **plant proteins have lower amounts of EAAs that are important for building muscle**.
- Proteins in food are made up of a combination of 20 amino acids (AAs). Our bodies can manufacture 11 of these, which means we don't have to get them from food. These are referred to as non-essential AAs. The other nine cannot be made in the body, and thus have to be consumed in the diet. They are referred to as EAAs.
- MPS depends on all 20 amino acids, but the EAAs play a disproportionate role. In particular, the EAA leucine is thought to more strongly activate anabolic signaling and MPS than other AAs. (**55**)
- In addition to having lower amounts of leucine, many plant proteins have limiting AAs. This means that the levels of certain AAs are so low that they can interfere with protein synthesis. For example, lysine is a limiting AAin grains like wheat and rice, and methionine and cysteine tend to be limiting AAs in legumes.
- I created a chart comparing the EAA profile in beef to several plant proteins: white beans, soybeans, peas, and rice. You can see it at **kresser.co/amino**. What you'll see is that beef is higher in every EAA than any of the plant proteins. The single exception is that soybeans are slightly higher in tryptophan than beef. Also note that a single serving of beef meets the RDA for three of the nine AAs; none of the plant proteins get even close.

> Beef is higher in every essential amino acid than any of the plant proteins.

Can athletes get enough EAAs from plant foods?

- It's possible to combine different plant proteins with different AA profiles to achieve a more complete protein. Beans and rice is a classic example: Rice is poor in lysine, while soybeans are poor in methionine. When combined, they are better than one or the other.
- Similarly, the AA profile of a 70:30 pea:rice protein powder blend is close to animal proteins. However, now you're getting into highly processed protein powders vs. real, whole foods.
    - 8 oz of beef top sirloin steak = 49.6 g of protein (**56**)
    - 1 cup of cooked, unsalted white beans contains 17.4 g of protein
        - You would need to eat 2.85 cups of white beans to get the same amount of protein as an 8-oz beef steak.
    - 1 cup of cooked, unsalted lentils contains 17.9 g of protein (**57**)
        - You would need to eat 2 ¾ cups of lentils to get the same amount of protein as an 8-oz steak.
    - 1 cup of cooked, unsalted chickpeas contains 14.4 g of protein (**58**)
        - You would need to eat nearly 3.5 cups of chickpeas to get the same amount of protein as an 8-oz steak (sounds like a recipe for major digestive discomfort …).
- Animals concentrate EAAs so you get a lot more of them in a smaller amount of food. You'd have to eat an insane amount of plant proteins to get the equivalent amount of EAAs that you get from animal proteins. This is why many vegan athletes, including some featured in the film, use a lot of protein powder.
- Protein powders isolate plant proteins, so the source is more concentrated. To do this, fats, phytates, oligosaccharides, and fiber have to be removed from the peas, wheat, soybeans, or other plant proteins.
- Various processes can be used to do this, from hexane-based solvents, to alkaline extraction–isoelectric precipitation, salt extraction-dialysis, and micellar precipitation. The processes may include additional chemical solutions (e.g., sodium hydroxide, also known as caustic lye), centrifuging, freeze-drying, and or ultrafiltration. Does this sound natural? **These are ultra-processed foods**. And they don't contain the other essential nutrients that animal proteins contain.

It's not how much protein you eat, it's how much you absorb

- The bioavailability of a protein refers to how much of it is digested and absorbed.
- Scientists now use a scale called DIAAS to rate the bioavailability of proteins. This scale not only takes into account the AA profile of a protein, but it also accounts for how much protein is absorbed after it has left the small intestine.

Whole milk, which is much maligned by the vegan world, blows away every plant protein (and other animal proteins too) with a DIAAS score of 1.32.

- Higher is better on the DIAAS. All the animal proteins that have been tested—milk, beef, chicken, and egg—are higher than all the plant proteins that have been tested. Going back to Wilks' comparison of a PB sandwich with eggs and beef: **beef's score is 1.10, egg is 1.13, and PB is … 0.46**.
- If we exclude protein powders and look at only unprocessed, whole foods, the highest scoring unprocessed plant score is **chickpeas at 0.83**. Compare this with the lowest scoring animal protein, **chicken breast, at 1.08**. (59)
- Whole milk, which is much maligned by the vegan world, blows away every plant protein (and other animal proteins, too) with a score of 1.32. (59)

Plant proteins are missing other important nutrients for athletic performance

- Vegans have lower levels of muscle **creatine**, a non-essential nutrient that is supplied by meat and contributes to strength and power performance. (60, 61)
- Giving vegetarians creatine supplements during a strength training routine increases their strength more than supplemented omnivores, which suggests that a **vegetarian diet impairs strength potential**. (62)
- Vegetarian athletes also have lower levels of muscle **carnosine**. Carnosine helps maintain a normal pH in muscles by buffering the hydrogen ions created when muscles generate energy. (63)
- **Beta-alanine** is the rate-limiting precursor to forming carnosine, which is found primarily in animal foods like meat, fish, and poultry. Vegans may need to supplement with beta-alanine to maintain sufficient muscle carnosine levels.

- **Taurine** is a sulfur-containing AA that reduces muscle damage and improves recovery after exercise. Vegans have been shown to consume almost no taurine in the diet (64). Taurine is not an EAA because it can be synthesized from cysteine and methionine in the presence of vitamin B6. However, vegans tend to have lower levels of B6, methionine, and cysteine than omnivores, which makes taurine deficiency more likely. (65, 66, 67)
- Vegans consume less **Ca** than omnivores and other vegetarians. Canadian vegans have been shown to consume only 578 mg/d compared with the 950 mg/d and 875 mg/d of omnivores and ovo-lacto vegetarians, respectively. This explains why studies have shown vegans at higher risk of fracture. (68, 69, 70). (**Click here** to get more references.)
- It's worth noting that **Ca supplements don't have the same benefits as dietary Ca**. In fact, Ca supplements have been shown to cause an increased risk of CVD and kidney stones in many studies. See **kresser.co/calcium** for info. It's also worth noting that some of the highest plant-based sources of Ca on paper, like spinach, also contain oxalates, which significantly reduce Ca absorption. You have to consider bioavailability.
- **Zinc** is important for cell growth and repair, protein metabolism, exercise recovery, and hormone production (including testosterone). Although Zn is found in many plant foods, as with Ca, those foods contain nutrient inhibitors that reduce Zn absorption. This explains why the Institute of Medicine (IOM) has suggested that vegetarians might need to consume up to 50 percent more Zn than non-vegetarians. A meta-analysis showed that vegetarians and vegans have significantly lower Zn intakes and blood levels. (71, 72)
- Vegetarians and omnivores often have similar levels of **serum iron**, but levels of ferritin—the long-term storage form of iron—are lower in vegetarians than in omnivores. This is significant because ferritin depletion is the first stage of iron deficiency. Also, female vegans have lower iron stores than omnivores, and are more prone to iron-deficiency anemia. (73, 74, 75, 76)
- On paper, **vegans and vegetarians often have similar or even higher iron intakes than omnivores—but their blood levels are lower**. For example, among Australian men, iron intake among vegetarians and vegans was 29 to 49 percent higher than omnivores, but their serum ferritin concentrations were barely half that of omnivores. A study of 75 vegan women in Germany found that 40 percent of them were iron deficient, despite average iron intakes that were above the recommended daily allowance. (77, 78)
- How can this be? As with Zn and Ca, **bioavailability is critical with iron**. The bioavailability of the iron in plant foods (nonheme iron) is much lower than in

> Overall, most studies have not shown a significant difference in performance between vegetarian and omnivorous diets when it comes to cardiorespiratory/endurance activities.

animal foods (heme iron). Plant-based forms of iron are also inhibited by other commonly consumed substances, such as coffee, tea, fiber, and Ca supplements. This explains why vegetarian diets have been shown to reduce nonheme iron absorption by 70 percent and total iron absorption by 85 percent. (79, 80)

- **Vitamin B12** is required to maintain your red blood cells, nerves, and DNA. When you don't absorb enough B12 from your food to make red blood cells, your body's oxygen capacity decreases, along with your endurance. A 2003 study by Hermann et al. using a more sensitive marker of B12 depletion, Holo-TC, found depletion in 11 percent of omnivores, 77 percent of vegetarians, and 92 percent of vegans. (81)
- B12 supplements do not always solve the problem. In one study that recruited vegans from a summer camp in the Netherlands, those who took supplements still had a serum B12 level of 192 on average (deficient).

What do peer-reviewed studies tell us about vegetarian/vegan diets and performance?

- Overall, most studies have not shown a significant difference in performance between vegetarian and omnivorous diets when it comes to **cardiorespiratory/endurance activities**. This could explain why one of the few athletes in the film who is still thriving after a vegan diet is Scott Jurek, a distance runner. We also have other examples like Rich Roll, also an ultra-endurance athlete.
- However, there's a caveat: **few studies specifically compare a vegan diet** (rather than a broader vegetarian diet) **with a diet that contains meat**. This is significant because vegetarian diets may contain protein from eggs and dairy, which as we've seen, score very highly on the DIAAS. Dairy and eggs are also rich in other nutrients that would be lacking in a vegan diet, like choline, retinol, Ca, B12, etc.

- In contrast, most observational and intervention studies show that omnivores outperform vegetarians in strength/power activities. (**82**, **83**, **84**, **85**) Again, most of these studies compare a diet with meat to a ovo-lacto vegetarian diet. If the studies compared an omnivorous diet with a vegan diet, the differences may have been even more substantial.
- Some studies have also shown that omnivorous athletes recover more quickly than vegetarian athletes. This is consistent with the observation that many athletes who switch to a vegan diet get seriously injured within a couple of years. (**86**)

What does Baboumian eat each day to meet his protein needs?

- Let's look at an **example of an athlete from the film** to see how a vegan diet plays out in real life for someone who participates in strength building.
- Don't agree with everything Bobby Geist says in the video, especially around plants being toxic, but it's revealing.
- At 2:29, we see that Baboumian starts with a bunch of supplements: multivitamin, nutritional yeast, Zn, glucosamine, magnesium, Ca, B12, and iron. I have nothing against therapeutic supplementation when necessary, but it's best to get daily nutrients from food.
- At 5:35, we see Baboumian's first protein shake: soy protein powder, creatine, and beta-alanine. This is interesting. Baboumian must be aware of the studies showing lower muscle creatine and carnosine levels in vegans. We discussed this earlier.
- His post-workout nutrition occurs at 7:30. He has a smoothie with soy or pea protein powder, glutamine, beta-alanine, creatine, and dried greens.
- His first solid food meal of the day, at 11:20, is fried falafel, French fries, soy sausage, fried peppers, and tomatoes.
- It goes on to compare with Robert Oberst's diet. He eats a lot of meat in addition to carbohydrates like rice and pasta. I'm not suggesting this is a perfect diet, but it illustrates the difference.

Do plant-based dieters really have better bone density?

- The film implies that people on vegetarian or vegan diets have higher bone density than omnivores: "We found in the cross-section of the bone very high bone mineral density, which indicated intense training and high-quality diet to build up strong muscles and strong bones. This diet gave the gladiators a nickname, hordearii, which means barley eaters. We know different food

sources give different amounts of strontium in the bones. High strontium levels in vegetarians, low strontium levels in carnivores."

- But what do actual, peer-reviewed studies tell us about differences in bone mineral density (BMD) between vegetarians and omnivores?
- The largest and best meta-analysis on this topic was published in the journal *Nutrition Review* in 2018. It discarded a lot of lower-quality studies that had been done previously, and ended up with 20 studies with 37,134 participants. (**87**)
- What did they find? Vegetarians were 34 percent more likely to suffer a fracture than omnivores, and vegans were 43 percent more likely.
- BMD at the femoral neck, a strong predictor of fracture risk, was 2.5 percent lower in vegetarians and 5.5 percent lower in vegans. The difference wasn't statistically significant in vegetarians, but it was in vegans.
- BMD at the lumbar spine was 2.3 percent lower among vegetarians and 7 percent lower among vegans when compared to omnivores. The difference wasn't statistically significant in vegetarians, but it was in vegans.
- Vegans and vegetarians age 50 and up were at the greatest risk of bone breaks and lower BMD in this study, suggesting that nutrient deficiencies accumulate and have a greater impact over time. (Or it may just suggest the elderly are more susceptible.)

WHAT ARE THE EFFECTS OF A VEGAN DIET ON PERFORMANCE?

Framing the discussion …

- The key question is not whether it's *possible* to thrive on a vegan diet as an athlete, but whether it's *likely*.
- There are always outliers, but the exceptions don't make the rule. Just because Rich Roll and Scott Jurek can run centuries and excel on a vegan diet, doesn't mean you can.
- Many non-dietary factors influence athletic performance, including genetics, epigenetics, stress, sleep, work ethic, talent, coaching, etc. These are significant.
- Look at Michael Phelps, the best swimmer of all time, and Usain Bolt, the best sprinter of all time. As I mentioned earlier, Phelps eats pancakes, pizza, French toast, energy drinks, etc. Bolt ate 1,000 chicken nuggets in Beijing before he won the gold medal and broke records. Diet isn't everything.

You also have to consider what diet vegans were switching from

- In the film, many athletes who switched to a vegan diet were previously eating a ton of junk food, by their own admission. Kenny Stills, NFL wide receiver: "On away games, we always eat fried chicken, we eat Popeyes. I love fried chicken, I love Popeyes, and I'm going to eat Popeyes every time." Bryant Jennings, boxer: "My early years growing up in Philly, the only thing we knew was spinach in a can, collard greens, and Popeyes, KFC, everybody frying chicken."

> Look at Michael Phelps, best swimmer of all time. Usain Bolt, best sprinter of all time. Phelps eats pancakes, pizza, french toast, energy drinks, etc. Bolt ate 1,000 chicken nuggets in Beijing before he won the gold and broke records. Diet isn't everything.

- If someone switches from a junk food, standard American diet (SAD) to a vegan diet, and they feel better (at least initially), can we be sure that it's because they removed animal products? Or is it possible they feel better because they stopped eating fried and highly processed food?
- What might have happened if they switched to a "nutrivore" diet with plenty of nutrient-dense animal and plant foods? Would they have done better than they did on a vegan diet? Yes, this is plausible.

Most athletes who are now vegan didn't start that way

- We know through studies of epigenetics that our health as adults is powerfully influenced (if not primarily determined by) our early childhood nutrition, our mother's diet while we were in utero, and even our parents' and grandparents' choices before we were conceived.
- Virtually all the athletes in the film (and other prominent plant-based athletes) achieved their initial success on an omnivorous diet. Only a few were vegetarian for their whole lives, and I'm not aware of a single one that was vegan for their entire lives.
- Likewise, I'm not aware of any high-level, elite athlete who was born to a mother that was vegan during pregnancy and lactation.

- This is highly significant because of the documented risks of veganism during pregnancy and lactation, and during early childhood and adolescence, especially if it's not well-planned.
- We have to consider not only the immediate effects of our dietary choices, but the intergenerational effects. Even if a female adult athlete does okay on a vegan diet, what will the impact of that choice be on her children, both as kids and as adults? And what will the impact be on her children's children?

The "vegan honeymoon"—the common trajectory once an athlete goes vegan

- If you study what happens to many athletes that go vegan, you see a common trajectory. Initially, their performance stays the same or may even improve for a short time. But after a while (anywhere from three to 12 months, typically), you see a significant decline in performance and well-being. I've also seen this to be true with many of my patients, some of whom are high-level athletes, and others who aren't.
- What's happening here? Several factors are at play. First, it depends on what diet they are switching from. If they were eating a lot of processed crap before, they might feel and perform better, at least initially, by going vegan. They're removing a lot of foods that would impair performance, and adding a lot of whole foods that would help it.
- Second, deficiencies in both macronutrients like protein and micronutrients like B12, Zn, iron, Ca, retinol, vitamin D, creatine, carnosine, etc. take time to develop because these nutrients are stored in the body. Exactly how long it takes depends on genetics, health status, how well they've designed the diet, and the demands of their sport/activity.
- I'll give you two examples. Alpha-linolenic acid (ALA) is a plant-based omega-3 fatty acid. It can be converted into eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), the long-chain omega-3 fatty acids that provide the significant health benefits of omega-3s. But this conversion is poor in humans. Only about 5 to 10 percent of ALA gets converted into EPA and 2 to 4 percent into DHA on average. But these averages obscure significant individual variation in the ability to make the conversion. Some studies have shown estimated conversions from ALA to DHA of less than 0.1 percent and a conversion to EPA plus DHA combined of less than 0.4 percent efficiency overall. (**88**, **89**)

- What's more, the conversion of ALA to DHA depends on Zn, iron, selenium, and B6—nutrients that vegetarians and vegans are less likely than omnivores to get enough of. This may explain why vegans have a 50 percent lower EPA and nearly 60 percent lower DHA than omnivores. (90)
- The second example is retinol. While humans can convert some beta-carotene from plant foods into retinol ourselves, that conversion is limited. And for people with certain genes, that may not happen much at all. A single serving of liver per week would meet the RDA of 3,000 IU. To get the same amount from plant foods, you'd have to eat two cups of carrots, one cup of sweet potatoes, or two cups of kale every day. One study showed that dietary retinol decreased the risk of hip fractures in women, but dietary beta-carotene didn't. (41, 91, 92, 93)
- With this in mind, it's easy to explain the "vegan honeymoon" trajectory that happens for many people.

Does beetroot improve your bench press?

- Wilks: "Controlled studies show that simply drinking beet juice before training allows subjects to cycle 22 percent longer, and bench press 19 percent more total weight."
- This "controlled study" he references is nothing of the sort. It's a research article seeking to substantiate this claim. The first line of their conclusion was "To date, few studies have examined the effects of supplementation with beetroot juice on short-duration high-intensity exercise efforts and observations so far will need confirmation in future studies." (94)
- And even if it is true, so what? They're just telling us again that eating plant foods is beneficial, which I agree with.

What about the athletes in the film? Aren't they examples of success?

- Certainly, there are amazing athletes in the film. Anyone who is competing on a global level in any sport deserves respect and admiration. But the key question here is whether these athletes are examples of the core argument of the movie, which is that a vegan/plant-

> The key question here is whether these athletes are examples of the core argument of the movie, which is that a vegan/plant-based diet improves athletic performance (and animal protein harms it). I think the answer is no.

based diet improves athletic performance (and animal protein harms it). I think the answer is no.

- The film is quite disingenuous in their portrayal of many of the athletes in the film, either omitting key information or simply misleading viewers. Let's look at some examples.

PATRIK BABOUMIAN (STRONGMAN)

- If you watch the film, you come away with the idea that Baboumian is one of the top strongmen in the world. They emphasize his "multiple world records including the front-hold, keg lift, log lift, and super yoke."
- However, while certainly impressive, Baboumian is not a world-class strongman. He hasn't even been invited to the top strongmen competitions like Giants Live, World's Strongest Man, or the Arnold Strongman Classic. Many of his best lifts wouldn't qualify as minimum weights for the world strongman competitions. A lot of his "world records" are regional in nature.
- Baboumian's top deadlift weight of 627 lb. is not competitive on the world stage. In his weight class of around 250 lb., the current world record is 970 lb.
- He now appears to be injured or retired. There has been no activity on his Wikipedia page since 2015. (**95**)

MORGAN MITCHELL (SPRINTER)

- Mitchell is an Australian sprinter who was a former champion in the 400m. She went vegan in 2014.
- In 2017, she finished in 26th place at the World Championships.
- Mitchell no longer runs the 400m because she's too slow. Her 2019 400m time was slower than 10 American 9th grade girls. (**96**, **97**)

KENDRICK FARRIS (WEIGHTLIFTER)

- Farris went to the Olympics in 2008 and 2012, and built his strength/career before he went vegan. In 2008, his total weight was 262 kilos (between snatch, clean, and jerk) in the 85 kg weight class.
- In 2016, he was in a higher weight class (94 kg, which is 20 lb. heavier), but he lifted less weight, 255 kg.
- He hasn't competed since he went vegan.

NATE DIAZ (MMA)

- A big deal is made in the film about how Diaz, a plant-based fighter, beat Conor McGregor, an omnivore. Diaz is not vegan; he eats fish and eggs.

- McGregor was cutting down to 155 lb. to fight another opponent, who withdrew at the last minute. Diaz was fighting at 170 lb., so McGregor had to try to regain that weight in one week. This is very difficult to do, and it decreases aerobic capacity.
- In a rematch four months later, McGregor won.

BRYANT JENNINGS (BOXER)

- Jennings went vegan at the end of 2013. His record was 17-0 before going vegan, and 7-4 after going vegan.

NFL SUMMARY

- Thanks to Tennessee Titan Derrick Morgan's wife, Charity, Morgan transitioned to a vegan diet in early 2017. The couple convinced several other Tennessee Titans to make the change as well.
- A 2018 report stated that 11 players on the Titans adhered to a plant-based eating plan. **The report didn't mention that in 2019, 5 of those players are out of the NFL and most didn't sustain a vegan diet.**

DERRICK MORGAN (NFL LINEBACKER)

- Morgan went vegan in 2017. He had knee and shoulder injuries in 2018. He was unable to recover from these injuries, and retired in 2019 at the age of 30.
- When he retired, Morgan was quoted in *Forbes* as saying, "I'm at a time where, physically and mentally, it doesn't make a lot of sense to continue."

GRIFF WHALEN (NFL WIDE RECEIVER)

- Whalen went vegan in the 2013/2014 season. He got injured in 2015. He was waived, signed, and waived by several teams between 2016 and 2019. He signed with a CFL team in 2019, and then was released. It appears he is not playing professionally now.

BRIAN ORAKPO (NFL LINEBACKER)

- Orakpo went vegan in 2017. He sustained injuries in 2018, and he retired in 2019.

JURRELL CASEY (NFL DEFENSIVE END)

- Casey is not vegan; he still eats fish.

NIMAI DELGADO (BODYBUILDER)

- Delgado built muscle on dairy, eggs, and whey—all very highly rated on the DIAAS.

DOTSIE BAUSCH (CYCLIST)

- Bausch was a seven-time U.S. champion before going vegan. She became vegan in 2009, and won a silver medal in 2012. She retired after that. She appears to have done well for at least three years on a vegan diet.

SCOTT JUREK (ULTRA-MARATHONER)

- Jurek appears to be doing very well on a plant-based/vegan diet.
- That said, a Belgian dentist shattered his 2015 Appalachian Trail record without getting injured (unlike Jurek), while eating 10,000 calories a day of pizza, potato chips, lots of candy, M&Ms, and granola bars. There's a lot more to performance than diet!

> There's a lot more to performance than diet!

What about plant-based athletes not in the film?

TIM SHIEFF (ENGLISH FREERUNNER)

- Shieff won the 2009 Barclaycard World Freerun Championship. He went vegan in 2012.
- He started eating eggs and fish again in 2018 after experiencing severe health problems, including "digestion issues, depression, fatigue, brain fog, lack of energy," and "waking up stiff" in his joints. "I couldn't do push-ups without getting injured," he said. He even did a 35-day water fast.
- Shieff was originally featured in *The Game Changers*, but was dropped from the film after he started eating animal foods again.
- I'll be interviewing him on my podcast on December 4 and releasing the episode early in 2020.

CAM NEWTON (NFL QUARTERBACK)

- Newton switched to a vegan diet in February 2019. He had the worst season of his career. He had minus-2 yards on five carries in the first two games this year. He rushed for more than 33 yards in a game only once in his last nine starts.
- He also developed a Lisfranc injury in his foot, which hasn't responded to treatment, will likely require surgery, and may be career-ending. An article on ESPN speculated that the Panthers are going to release him. (**98**)
- An article in The Charlotte Observer speculated that Newton's vegan diet was harming his performance and impairing his recovery. "Go back to 2015 Cam, badass Cam. He was a pescatarian," said Chris Howard, a certified nutritionist and strength and conditioning coach from Waxhaw. "Salmon, shrimp, you get a lot of good fats and complete proteins. In fact, (fish) is one of the best protein sources there is. Now you take away the most valuable part of that

(diet), and … there's just no way around it: He can't recover as well with less nutrients, with less calories and with less muscle mass. It's just not going to happen." (**99**)

- The vegan diet is lower in bioavailable protein, especially collagen, which is critical for recovery and repair.
- Newton also lost at least 10 lb. For a high-level athlete like him, losing this much weight can affect energy and ability to recover from injuries. A 250-lb. highly active person needs almost 4,000 calories. It's hard to get that on a vegan diet.

> A vegan diet is lower in bioavailable protein, especially collagen, which is critical for recovery and repair.

NOVAK DJOKOVIC (TENNIS PLAYER)

- Djokovic went dairy-free, gluten-free, and nightshade-free and became the best athlete in the world.
- After he went vegan, his ranking dropped to number 22, the lowest since he was a teenager. Then he added some meat and fish back in, and his ranking went back to number one.
- As of 2019, he has a serious shoulder injury.

ILYA ILYIN (WEIGHTLIFTER)

- Ilyin is a vegan weightlifter who has been more successful than Kendrick Farris (two-time Olympic champion in the same weight class).
- He was later stripped of his titles after his samples retested positive for anabolic steroids. Could this be why he wasn't included in the film?

ALEX MORGAN (SOCCER PLAYER)

- Morgan went vegan in 2019. In an article in Yahoo! Sports in July 2019, she was quoted saying: "I'm knocking on wood right now, but I haven't had a serious injury [since her last, which was before going vegan] and I credit that to my diet." (**100**)
- But literally on the same day that *The Game Changers* premiered (September 16, 2019), she announced a season-ending knee injury. Oops. (**100**)

CARL LEWIS (TRACK AND FIELD ATHLETE)

- Lewis switched to a vegan diet in 1990, and had great results in 1991.
- He built his body/speed with a diet containing animal products. But after 1991, he became progressively less consistent, got injured, and retired. That's a good example of the "vegan honeymoon."

DAMIAN LILLARD (NBA POINT GUARD)

- Lillard went vegan for five months, and then added animal protein back into his diet due to excessive weight loss. "I did it, but I started to lose a little bit too much weight with all the games and practices and all that," Lillard said on a podcast. "I had to balance it out, so now I've been mixing it up a little bit more, having vegan meals, still mixing it up with other stuff." (**101**)

KYRIE IRVING (NBA POINT GUARD)

- Irving had season-ending injuries in 2015 and 2018.
- He missed at least 15 games because of injuries in three of the last four seasons.

MICHAEL PORTER (NBA POWER FORWARD) AND JONTAY PORTER (FORMER COLLEGE BASKETBALL PLAYER)

- The Porter brothers are exceptional, gifted athletes that seemed destined for bright careers in the NBA.
- Raised vegetarian, they then switched to a full vegan diet.
- Michael has been plagued with back injuries, and has played only three college games.
- He was still drafted by the Denver Nuggets, had back surgery, and hasn't played a single game in his rookie season.
- He tried to make a comeback this summer, but suffered a knee injury.
- Michael's younger brother Jontay was also expected to go pro, but he tore his anterior cruciate ligament (ACL) and medial collateral ligament (MCL) in college. Six months later, he tore his ACL again. He was not drafted by the NBA.

ARIAN FOSTER (NFL RUNNING BACK)

- Foster was a very successful NFL player who shocked the NFL by announcing on Twitter that he was going vegan in July 2012. "Officially a vegan now. We'll see how far this goes."

- By November 2012, he was already not 100 percent vegan. In a Houston Chronicle article, he said "I just wanted a piece of chicken. It wasn't like temptation. I felt like I could use one." (102)
- In 2013, he added fish and chicken back to his diet because he was struggling. According to his nutritionist: "But the volume of food you have to eat as a vegan is pretty large. If you need 5,000 calories a day, that's a lot of plants." (103)

TONY GONZALEZ (NFL TIGHT END)

- Back in 2007, Hall of Fame tight end Tony Gonzalez went vegan. Three weeks later: "The 100-pound dumbbells he used to easily throw around felt like lead weights," the article says. "I was scared out of my mind," (Gonzalez) said. He had lost 10 lb. Gonzalez ended up adding small amounts of animal protein back to his diet. (104)

GERALD MCCOY (NFL DEFENSIVE END)

- McCoy, a former vegan, says: "The explosiveness wasn't sustainable because I didn't have that extra oomph that I needed, because of the lack of the type of protein I was taking in, so I just added a little bit of animal protein back in my diet and it's given me that oomph back." (105)

DAVID JOHNSON (NFL RUNNING BACK)

- "The Arizona Cardinals star running back went full vegan ahead of the 2017 season, which led to his dramatic—and unwanted—weight loss." (106)

SERENA AND VENUS WILLIAMS

- They are not vegan all the time; they still eat animal protein.

ATHLETES PERFORMING WELL ON A VEGAN DIET

- Scott Jurek from the film, and Rich Roll
- Nineteen elite athletes in various sports (107)

Why do so many vegan athletes get injured?

- Adequate protein is essential to prevent and recover from injuries. As

> Adequate protein is essential to prevent and recover from injuries.

already noted, the range of protein intake for the most effective muscle gain and recovery is **1.4 to 2.7 g/kg**, with the best results at the top of that range. If an athlete is injured and a muscle is immobilized, the recommended range for recovery is higher, with **2 g/kg as a minimum**. Inadequate protein intake **slows wound healing and increases inflammation**. (108)

- But quality of protein is critical, too. According to ISSN, proteins consumed should be rich in leucine to promote MPS: "Acute protein doses should strive to contain **700–3000 mg of leucine** and/or a higher relative leucine content, in addition to a balanced array of the essential amino acids (EAAs)." **Most plant-based proteins are low in leucine**. (109)
- **Collagen is also a concern on a plant-based diet**. Collagen is the most abundant protein in our body. It's found in our connective tissues, tendons, ligaments, and bones, and it helps provide these tissues with strength, structure, and elasticity.
- **Collagen has several benefits for preventing and recovering from injuries**. It reduces post-exercise inflammation. It promotes joint health. It reduces injury to the ligaments and tendons. It helps maintain nitrogen balance, which keeps the body in an anabolic state. It speeds up exercise recovery. And it helps maintain muscle creatine levels (creatine is made up of glycine, methionine, and arginine; collagen is 20 percent glycine and 8 percent arginine). (110, 111, 112, 113, 114)
- **Collagen is found in animal foods**. The best sources are bone broth, cold-water, fatty fish, gelatinous cuts of meat (oxtail, shank, etc.), and egg yolks. Collagen can be synthesized in the body from nutrients found in plant foods, but consuming it directly provides far greater quantities.
- This amount and quality of protein (including specific AAs like leucine and specific proteins like collagen) is difficult to obtain on a vegan diet without consuming protein powders. **Vegan athletes who aren't planning carefully will be at higher risk of injuries.**
- **Calorie intake is another consideration**. Studies have shown that **MPS is downregulated by 20 to 30 percent** even in a moderate caloric deficit. Other studies have shown that "negative energy balance" (not eating enough calories to support activity levels) interferes with wound healing and exacerbates muscle loss. Given examples of vegan athletes above who lost weight on a vegan diet, this is almost certainly a factor. (115, 116, 117)
- Other nutrients that are critical for preventing and recovering from injuries that tend to be low in a vegan diet include **long-chain omega-3 fats, Zn, vitamin D, Ca, and retinol**.

ARE ANIMAL PROTEINS/ FOODS HARMFUL?

One of the key claims in the film is that animal products increase the risk of disease and shortened lifespan. But *The Game Changers* makes the same mistake that other films and even scientific studies that advocate plant-based studies make: ignoring the importance of food quality.

> One of the key claims in the film is that animal products increase the risk of disease and shortened lifespan. But *The Game Changers* makes the same mistake that other films and even scientific studies that advocate plant-based studies make: ignoring the importance of food quality.

Not all diets containing animal protein are equal

- The implicit assumption in the film is that the impact of eating animal protein will be the same whether someone is eating a nutrient-dense, whole foods Paleo diet or a SAD.
- In the film, you hear many of the athletes discuss their previous diet before they went plant-based. They talk about not knowing what asparagus was, eating Popeyes and KFC, and subsisting on a junk food diet.
- These people go vegan, and then claim to feel better because they removed meat and animal products. But what if they feel better because they're eating more fresh fruits and vegetables, and not eating fried, processed, and refined foods? In other words, what if they feel better because they're eating a higher-quality diet?
- Observational studies on the effects of animal protein suffer from a similar problem, which is known as the "healthy-user bias." The studies that link red meat consumption with higher rates of heart disease or cancer are a perfect example.
- Because red meat has been perceived as "unhealthy" for so many years, on average, people who eat more red meat are more likely to smoke, drink excessively, be physically inactive, eat fewer fruits and vegetables, and have less education. All of these factors are associated with a higher risk of heart disease and cancer. (**118**)

- Researchers are aware of the influence of these confounding factors, and the better studies try to control for them. But they can't control for all possible confounding factors because our lives are simply too complex.
- As Norman Breslow, a former biostatistician at the University of Washington, once said: **"People think they may have been able to control for things that aren't inherently controllable."**
- **Check out this article for more info.**

When it comes to red meat, context is everything

- Consider two diets. Both contain meat, fish, and other animal products. One is a SAD, where more than 60 percent of calories come from ultra-processed and refined foods like sugar-sweetened beverages, grain-based desserts, pizza, cookies, crackers, etc. The other is rich in non-starchy vegetables and whole fruit, nuts and seeds, and starchy tubers like sweet potatoes, and contains minimal processed and refined foods.
- If I asked 100 people on the street if the health impacts of these diets would be different, I'd wager that the vast majority—if not 100 percent—of people asked would say "yes." And they would be correct.
- Yet films like *The Game Changers* and even most observational nutrition studies assume that the answer is "no." **They make the absurd mistake of grouping all diets that contain animal products together, and do not account for food quality at all.**
- The vast majority of observational studies in the past have focused only on nutrients, isolated food components, or biomarkers—like saturated fats, carbohydrates, calories, low-density lipoprotein cholesterol—abstracted out of the context of foods, diets, and bodily processes.
- This reductionist approach, which philosopher of science Gyorgy Scrinis calls "**nutritionism**," has interfered with nutrition science's ability to provide useful individual and public health guidance. (**119**)
- The upside of nutritionism has been the discovery of drugs, vitamins, and minerals that have saved millions of lives. The downside is that Americans (and people all over the industrialized world) are obsessing over details like the

"Nutritionism" has interfered with nutrition science's ability to provide useful individual and public health guidance.

percentage of fat or carbohydrates they consume, or the amount of a certain food like red meat, rather than focusing on the broader and more important issues, like the quality of the food they eat.

- More recent studies have shown that "nutritionism" is misplaced, and that **the overall quality of the diet is far more important to determining its health impact**.
- Great example: In a recent study led by Dr. Christopher Gardner at Stanford, researchers found that on average, people who cut back on added sugar, refined grains, and processed food lost weight over 12 months—regardless of whether the diet was low-carb or low-fat. (120)
- In fact, newer dietary guidelines—especially in other industrialized countries like Canada—focus **less on specific nutrient recommendations** (e.g., limits for red meat, saturated fat, salt) and **more on the overall dietary pattern** (e.g., consume more vegetables and fruits, fewer sugar-sweetened foods and beverages). (121)

More evidence that food quality matters—a lot

- One of the inevitable results of focusing on isolated foods and nutrients and ignoring food quality is that many observational studies end up comparing two groups of people that are not at all similar, and this casts doubt on the findings.
- Early studies suggested that vegetarians live longer than omnivores. However, these studies compared SDAs—a religious group that advocates a vegetarian diet and a healthy lifestyle as part of their belief system—with the general population.
- That introduces serious potential for healthy-user bias because the members of the SDA church engage in lifestyle behaviors—like not smoking or drinking alcohol, eating more fresh fruits and vegetables, and getting more exercise—that have been shown to reduce the risk of death from CVD and all causes.
- So, we can't possibly know whether the reduction in deaths observed in these studies was related to the vegetarian diet or these other causes; thus, the findings are not generalizable to the wider population.
- If we really want to know whether removing meat and animal products from the diet extends the lifespan, we'd need to study two groups of people: vegetarians/vegans, and health-conscious omnivores (e.g., nutrivores, people following an ancestral diet and lifestyle).
- A nutrivore would be someone who lives a healthy lifestyle (doesn't smoke, doesn't drink excessively, gets plenty of exercise and sleep, etc.) and

consumes nutrient-dense, anti-inflammatory, whole foods like meat, fish and shellfish, organ meat, bone broth, fresh fruits and vegetables, nuts and seeds, and starchy plants.

- Comparing vegetarians with nutrivores would be more like comparing apples to apples. To date, no studies have done this in a rigorous way.
- However, four later studies (the Health Food Shoppers Study, the Oxford Vegetarian Study, the EPIC-Oxford Cohort, and the Heidelberg Study) at least got a little closer to this. They compared vegetarians with a more health-conscious population of omnivores and found that **both groups lived longer than the general population, but there was no difference in lifespan between the vegetarians and healthy omnivores**. (**Check out this article for a full review of the studies.**)
- We also have the 45 and Up Study from Australia. While this study didn't select a healthier omnivore population, as the four studies I mentioned above did, the researchers did a much better job of controlling for confounding factors—like obesity, diabetes, smoking, drinking, and socioeconomic status—that would be likely to influence lifespan. (**122**)
- They found no significant difference in total mortality between vegetarians and omnivores. There was also no difference in mortality among vegetarians, pesco-vegetarians, and semi-vegetarians. This finding is especially notable because the study had such a large sample size (around 250,000 participants).

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Why we need to be cautious with mechanistic research

- Research on nutrition can look at outcomes (e.g., incidence of diseases and conditions like heart attack or osteoporosis or shortened lifespan), and it can also try to determine the mechanisms that drive outcomes (e.g., the idea that cholesterol causes heart attacks because it clogs arteries).
- Both of these types of research are important, but we have to be very careful with mechanisms—especially when the research on outcomes is weak.
- Red meat is a perfect example. Early observational studies suggested that people who eat more red meat have a higher risk of coronary heart disease

(CHD). So researchers started to look for mechanisms to explain this observation. The initial idea was that the cholesterol in red meat clogs arteries like gunk in pipes.

- This turned out to be false. The "gunk in the pipes" theory was overly simplistic, and later studies showed no association between dietary cholesterol and heart disease. In fact, the 2015–2020 Dietary Guidelines for Americans removed the recommendations of setting a limit to the maximum intake of 300 mg/day cholesterol. (They still suggest eating as little cholesterol as possible, but there's no evidence to support this. They're just saving face.) (**123**)
- Then attention switched to saturated fat. Similar idea, that the saturated fat in red meat "clogged the pipes" and increased the risk of CHD. But recent studies haven't supported this. A large review in 2016 involving seven studies and almost 90,000 participants concluded: "Epidemiological evidence to date found no significant difference in CHD mortality and total fat or saturated fat intake and thus does not support the present dietary fat guidelines." (**124**)
- There are 39 other meta-analyses of randomized controlled trials (RCTs) and/or prospective cohort studies that looked at saturated fat and health outcomes, but 35 of 39 did not show significant correlations between fat and any outcome. (**125**)
- A recent paper in *BMJ Evidence-Based Medicine* summarizing 17 separate reviews showed saturated fats have no effect on mortality. (**126**)
- Because evidence on dietary cholesterol and saturated fat is weak, plant-based diet advocates are now switching their attention to other mechanisms, like N-glycolylneuraminic acid (Neu5Gc), trimethylamine–N-oxide (TMAO), heme iron, and heterocyclic amines (HCAs).
- But as we'll see, evidence on these mechanisms is weak and incomplete. And the evidence linking red meat consumption to a higher risk of disease and a shorter lifespan is also not strong. It's like a search for the cause of a problem that isn't actually a problem. As we've seen with dietary cholesterol and saturated fat, the proposed mechanisms often turn out to be wrong or incomplete.

> The evidence linking red meat consumption to a higher risk of disease and a shorter lifespan is not strong.

A recent large review on red meat found that evidence linking it to disease and early death is weak

- A rigorous five-paper review published in the journal *Annals* of Internal Medicine concluded that only "low- or very low-certainty" evidence existed to show that this meat causes any kind of disease—not cancer, not heart disease, not type 2 diabetes. (127)
- **The most exhaustive review of evidence on red meat to date** analyzed dozens of studies covering millions of participants followed for up to 34 years. Results span over 300 pages of content.
- The study looked at RCTs and observational cohort studies and a wide range of outcomes including all-cause mortality, cardiometabolic outcomes, and cancer incidence and mortality.
- The red meat studies used the Grading of Recommendations Assessment, Development and Evaluations (GRADE) system for assessing certainty of evidence. Possible ratings: high, moderate, low, and very low.
- The score tells you the likelihood that the effect seen in studies will be substantially different from the real world. Example: Say a study suggests you'll see five fewer cases of cancer per 10,000 people with lower red meat consumption. If the rating was "high," the real-world effect is likely to be close to what the research shows. If the rating was "very low," the effects seen in the real world may be substantially different than the findings.
- Conventional health establishment and media went absolutely crazy after these findings were published. There were calls for the paper to be retracted and for the U.S. Food and Drug Administration (FDA) to get involved.
- Some criticized the use of GRADE, suggesting that it's more suited to evaluating studies on drugs than nutrition research. But the National Academies of Sciences, Engineering, and Medicine recommends GRADE as one of only a few viable methods for evaluating nutrition studies for the U.S. Dietary Guidelines. (128)
- Critics also pointed out that the lead author was criticized for not reporting that he had previously received money from the meat industry (in 2015).
- However, it's worth noting that several of the critics of this study also have ties to industry. As reported by Nina Teicholz in the *LA Times*, the "True Health Initiative letter signers included five epidemiologists from Harvard's T.H. Chan School of Public Health, which in 2017-18 received hundreds of thousands of dollars from walnut and peanut industry groups." (129)

- Also, one of the studies referenced many times in *The Game Changers* to support the idea that red meat causes inflammation is called "Hass Avocado Modulates Postprandial Vascular Reactivity and Postprandial Inflammatory Responses To a Hamburger Meal In Healthy Volunteers." It was funded by the Hass Avocado Board. (**130**)
- You can't have it both ways. If you propose to discard findings whenever there may be a conflict of interest, you have to discard a lot of findings that apparently support a plant-based diet.

> If you propose to discard findings whenever there may be a conflict of interest, have to discard a lot of findings that apparently support a plant-based diet.

- And none of this changes the findings of the underlying studies that were reviewed in the *Annals* paper. This is why *Annals* is unlikely to retract the studies despite the demands to do so. The editorial pointed out: "Over and over again, they [the authors] stressed that even if the results were statistically significant, **their certainty was low and the absolute differences seen were small and potentially confounded**."
- The editorial also stated "This is sure to be controversial, but it is **based on the most comprehensive review of the evidence to date. Because that review is inclusive, those who seek to dispute it will be hard pressed to find appropriate evidence with which to build an argument.**"
- It's also true that other large reviews of red meat and health outcomes have reached the same conclusion. We'll examine that below.

What have reviews of red meat and cancer found?

- A 2011 meta-analysis of 34 prospective studies on red meat and colorectal cancer (CRC) concluded: "The available epidemiologic data are not sufficient to support an independent and unequivocal positive association between red meat intake and CRC." (**131**)
- While a 2015 meta-analysis did find that processed meat intake was positively associated with the risk of CRC, there was little evidence that unprocessed red meat increased the risk of CRC. This study included only two cherry-picked studies (Health Professionals Follow-up Study and the Nurses' Health Study)—a true meta-analysis includes all available studies. (**132**)

- **No dose-response**: If red meat really did cause cancer, you'd expect to see a continuous increase in cancer rates as red meat consumption increases. But that's not what we see in many cases. In fact, in some studies, you actually see a decrease in cancer rates in the people who ate the most red meat. (133)
- **Healthy-user bias**: Most Americans who eat red meat eat it with a huge bun made of white flour, with a serving or more of other refined carbohydrates (chips, fries, soda) cooked in industrially processed vegetable or seed oils. How do we know that it's the red meat—and not these other foods—that is causing the increase in cancer?
- **Low change in absolute risk**: Even if you ignore everything and accept the World Health Organization report (which classified red meat as a carcinogen) at face value, the change in absolute risk only amounts to about **three extra cases of bowel cancer per 100,000 adults**. Relative risk in the most recent well-controlled study was 16 percent. (134)
- Outside of nutrition research (and even inside, 20 years ago), an increase in relative risk less than 200 to 400 percent was considered indistinguishable from chance. An increase of 16 percent falls well below that threshold. This research wouldn't have been published 20 years ago.
- To put that in perspective, the increase in cancer risk from smoking cigarettes is 1,000 to 3,000 percent. The increased risk of liver cancer from eating moldy food contaminated with aflatoxin is 600 percent. These are worth investigating.
- In a Canadian study of astrological signs, Sagittarians had a 38 percent increased risk of arm fractures compared to those of other signs.

> Context is *everything*.

- **Context is everything**. In all studies of the relationship between red meat and cancer that controlled for vegetables, a greater increase was seen in people not consuming vegetables. (135) Vegetable consumption seems to confer a protective effect. (136)
- Red meats are associated with a variety of cancers, but consumption of fruits/veggies is associated with protection against just as many, (137) and are most protective in cohorts at the highest risk. (138)
- The best summary of evidence is from 2015: **"The state of the epidemiologic science on red meat consumption and CRC is best described in terms of weak associations, heterogeneity, an inability to disentangle effects from other dietary and lifestyle factors, lack of a clear dose-response effect, and weakening evidence over time."** (139)

What are the proposed mechanisms?

- Interestingly enough, they don't focus on the typical saturated fat or cholesterol arguments. Perhaps the filmmakers knew that the evidence no longer supports these arguments?
- Instead, the film claims that animal products are harmful because of inflammatory molecules like Neu5Gc, heme iron, and TMAO. They also claim that meat impairs endothelial function and blood flow.
- Dr. Stoll says: "In animal products, you're getting protein packaged with inflammatory molecules like Neu5Gc, endotoxins, and heme iron. When we consume animal products, it also changes the microbiome, the bacteria that live in our gut, and the bacterial species that have been shown to promote inflammation overgrow and begin to produce inflammatory mediators like TMAO."

Neu5Gc

- Neu5Gc is a monosaccharide that acts as a type of signaling molecule in mammalian cells, and one of its functions is to help the immune system distinguish between "self" cells and "foreign" cells.
- Humans lost the ability to produce Neu5Gc millions of years ago through a genetic mutation, although we still produce the closely related compound Neu5Ac.
- Humans are unique in this respect, because most other mammals still produce Neu5Gc, which is why that compound is found in mammalian meat.
- The theory is that when humans consume red meat and milk products, we incorporate some of this compound into our own tissues, especially tissues that grow at a fast pace, such as fetuses, epithelial and endothelial tissue, and tumors.
- The concern is that most of us also have anti-Neu5Gc antibodies circulating in our blood, and some researchers have suggested that these antibodies react with the Neu5Gc in our tissues to create chronic inflammation, leading to chronic diseases such as cancer.
- **The problem is that researchers are nowhere near proving that hypothesis**. Research is in the very earliest stages, and while some fascinating hypotheses involving this molecule are being generated, the studies needed to confirm or refute these hypotheses are nonexistent.

- A 2003 paper showed that **feeding people large quantities of Neu5Gc didn't cause their levels to rise from baseline**. This suggests that consuming meat that contains Neu5Gc may not actually increase Neu5Gc levels. (140)
- In that same paper, researchers speculated that early childhood exposure to Neu5Gc in cow milk or vaccines, transfer of Neu5Gc from mother to baby, or a preexisting immune response may be required for Neu5Gc to make its way into human cells.
- In the absence of conclusive evidence one way or another, it can be helpful to remember that red meat has been part of the human diet for much of our history, and remains an important dietary element of many healthy cultures.
- For example, the traditional diet of the Maasai was composed almost entirely of red meat, blood, and milk—all high in Neu5Gc—yet they were free from modern inflammatory diseases. If Neu5Gc really caused significant inflammation, the Maasai should've been the first to know, because they probably couldn't have designed a diet higher in Neu5Gc if they tried. (141, 142)
- So, while this is an interesting hypothesis, there are already some glaring issues, and it is nowhere near proven.

> "It can be helpful to remember that red meat has been part of the human diet for much of our history, and remains an important dietary element of many healthy cultures.

Heme iron

- Studies show that heme iron contributes to the formation of N-nitroso compounds (NOCs) and toxic aldehydes, both of which can play roles in initiating CRC. (143)
- **But context is everything**. Eating chlorophyll-rich foods (like leafy greens and other plant matter) along with iron-rich animal foods cancels out any potentially harmful effect of heme iron. (144)
- Eating fruits and vegetables attenuates oxidative capacity of heme iron and reduces absorption of iron in the gut. (145) Consumption of dietary antioxidants is shown to reduce the risk of gastric cancer. (146) **Heme iron intake is a proxy for a crappy diet and non-heme iron intake is a proxy for a**

whole-foods diet in the general population—another example of healthy-user bias.

- This was evident from a comprehensive meta-analysis of heme iron studies. Fang et al. looked at all the significant studies that had been done on this topic up to 2015. Conclusion: "With respect to heme iron intake, **we found a significant association only in the studies that were based on American cohorts**." In the Netherlands, Canada, France, Italy, Japan, and Sweden, **no association was found**. Just in America, where the major source of heme iron is KFC, McDonald's, and Burger King. (147)
- What's more, this analysis only showed an association between heme iron intake and CVD incidence—not CVD mortality or total mortality. (147)
- Also important to note is that it's relatively easy to get your iron levels tested: iron panel + ferritin. I do this with all of my patients. When iron levels are high, there are many steps you can take—and you usually don't need to stop eating red meat. You may need to cut down on organ meats and shellfish, but these are rich in other nutrients. So you could do blood donation.

TMAO

- **You need to be cautious about a mechanism when research on outcomes doesn't support it**. If red meat consumption elevates TMAO, and elevated TMAO increases the risk of heart disease, we'd expect to see higher rates of heart disease in people who eat more red meat. **Most large studies don't show this for fresh red meat**. (148)
- Previous studies have shown that free carnitine (in supplement form) and choline bitartrate (in supplement form) elevate serum TMAO levels. In fact, Zhu et al. probably used choline bitartrate in their 2017 paper specifically because they knew it would maximally increase serum TMAO levels. Mean TMAO reached 27 µmol/L in vegans/vegetarians and 37 in omnivores. (149)
- **But research has not shown that eating red meat and eggs significantly increases serum TMAO.** Miller et al. in 2014 showed that you need to eat four eggs to raise TMAO, and the maximum rise was less than three to six in some subjects and 10 to 15 in the others (far less than the rise seen with choline

> Research has not shown that eating red meat and eggs significantly increases serum TMAO.

supplements in the Zhu study). Two subjects seemed to get a response from two to three eggs, but most didn't. When they did, it was under 10 µmol/L. (150)

- A 1999 study tested the effects of 46 different foods on the urinary excretion of TMAO in six human volunteers. **Eggs had no effect on TMAO excretion compared to a light control breakfast, yet 19 out of 21 types of seafood tested did**. In fact, **halibut generated over 53 times as much TMAO as eggs!** (151) This figure from the study illustrates the difference.
- **How do we reconcile this with the fact that seafood intake is consistently associated with a lower risk of CVD and total mortality?** If eating foods that increase TMAO is harmful, and seafood increases TMAO more than any other food, why don't we see a huge increase in heart attacks and early death in people who eat more seafood?
- **Even if eating certain foods temporarily increases TMAO, that doesn't mean that eating these foods increases TMAO levels persistently over time.** In fact, the original TMAO paper published by Dr. Stan Hazen's group in the *New England Journal of Medicine* in 2013 said: "the high correlation between urine and plasma levels of TMAO argues for effective urinary clearance of TMAO." (152)
- In other words, **even if eating food does increase total TMAO levels, most people are able to quickly and efficiently clear that TMAO from their blood by excreting it in the urine**. This makes it doubtful that dietary factors alone explain chronic elevations in TMAO.

> If dietary factors alone aren't responsible for TMAO, what is? The gut microbiota likely play an important role.

- If dietary factors alone aren't responsible for TMAO, what is? **The gut microbiota likely play an important role**. High serum TMAO levels are more about which gut microbes you have and less about how much choline and carnitine you consume. Previous work by Dr. Hazen's group has shown that people with higher levels of *Prevotella* bacteria in their gut produce higher levels of TMAO. (153)
- In a study by Romano et al. in 2017, mice colonized with choline-metabolizing bacteria had much higher levels of TMAO, while mice with the same bacteria unable to metabolize choline had virtually undetectable TMAO. (154)

- Additionally, preliminary data from Dr. Federico Rey's lab has shown that in humans, low serum choline tends to be associated with high TMAO, and vice versa.
- This suggests that those with high TMAO are very likely harboring some form of SIBO—further explaining the connection between SIBO and CVD. A 2017 study confirmed that TMA is only absorbed in the small intestine. Moreover, an acute dose of rifaximin, the antibiotic most commonly used to treat SIBO, can reduce serum levels of TMAO. (155)
- This also suggests that what you eat along with meat impacts TMAO production. This explains why a study of people on a Paleo diet did not see an increase in TMAO levels. (156)
- **Diabetes and metabolic syndrome also likely play a role via at least two mechanisms. The first is enhanced conversion of trimethylamine to TMAO in the liver**: An enzyme called FMO3 carries out this conversion. FMO3 activity is upregulated in cases of insulin resistance and insulin deficiency. (157)
- **The second is poor kidney function**. This is at least partially supported by data in the *NEJM* paper. Those with the highest levels of TMAO had an average GFR of 69 mL/min. According to National Kidney Foundation guidelines, a GFR between 60 and 89 mL/min is indicative of a reduced capacity to filter blood through the kidneys. (158)
- **One in three Americans have prediabetes and more than 30 million Americans have diabetes**. (159, 160) Many Americans also likely have disrupted gut microbiota due to their SAD, which is rich in "acellular carbohydrates" that have been shown to adversely affect the gut flora. So, even if studies show that "average" meat eaters in the United States have higher TMAO levels, that doesn't mean that it's the meat on its own that is causing the higher TMAO.
- **And we still have the glaring issue that epidemiological studies don't show an increase in CVD in people who eat more fresh red meat or eggs**. We discussed studies on red meat earlier. For eggs, a meta-analysis of prospective studies involving 474,000 participants followed from eight to 22 years published in the *British Medical Journal* found no association between higher egg consumption (up to one per day) and CHD or stroke. (161)
- An analysis of data from the National Health and Nutrition Examination Study found an inverse association between egg consumption and stroke, and a cohort study from Japan found that consumption of animal products including eggs was associated with a reduced risk of death from stroke. (162, 163)

- **So, this is another case of a mechanism being used to explain a problem that doesn't exist (i.e., red meat intake causing heart disease).**

HCAs and NOCs

- The film didn't mention two other mechanisms that have been proposed to explain the association between red meat and cancer: heterocyclic amines (HCAs) and NOCs.
- HCAs are formed when meat is cooked at high temperatures, and they can also damage the gut lining. NOCs are formed from myoglobin, which can damage the gut lining.
- **But again, context is everything**. Cruciferous veggies and spices reduce the formation of HCAs, and cooking meat at lower temperatures (stewing, low-temp roasting, etc.) lowers them, too. And eating chlorophyll-rich green vegetables prevents myoglobin from being turned into NOCs. (**164**, **165**, **166**)

Does eating meat ruin your gut microbiota?

- The film claims that consuming meat disrupts the gut microbiome. They typically reference a couple studies, which showed that a VLC diet (approximately 5 percent of calories from carbs) leads to decreases in key species of protective bacteria and decreases in butyrate production. (**167**, **168**)
- However, any proposed effects on the microbiome from eating meat don't come from the meat itself, but from eating less plant matter. I have long argued that both anthropological and modern clinical research suggests that the optimal human diet contains both plants and animals. This is one reason I'm not a big fan of the carnivore diet long term. So, again, context is everything.
- We have evidence that supports this. A 2019 study published in *PLoS* One found "an unexpectedly high degree of biodiversity in MPD [modern Paleo diet] subjects, which well approximates that of traditional populations" like the

I have long argued that both anthropological and modern clinical research suggest that the optimal human diet contains both plants and animals.

Inuit, Hadza, and Matses (Peru). Higher microbial diversity is associated with a lower incidence of disease and many other health benefits. (169)

- Other studies have shown that the microbiota of ancestral populations who consume both whole plant and animal foods and very little processed/refined food are much healthier than the microbiota of people following an industrialized diet. (170)

Does eating chicken and fish cause cancer?

- It's so easy to cherry-pick studies to support your point of view. You have to look at the totality of the evidence.
- Wilks: "Cancer has been linked to other animal foods as well. Research funded by the National Cancer Institute found that vegetarians who had one or more servings per week of white meat, like chicken or fish, more than tripled their risk of colon cancer."

> It's so easy to cherry-pick studies to support your point of view. You have to look at the totality of the evidence.

- They're referring to a six-year prospective study performed in an SDA cohort from 1976 to 1982. (171)
- That's a perfect example of healthy-user bias. Since SDAs are supposed to be vegetarian, those who eat meat are likely to engage in other behaviors perceived to be unhealthy.
- Much better and larger analyses on the effects of chicken and fish on cancer have been done. For example, in 2017, a very large meta-analysis of 16 prospective studies with 2.4 million participants found **no increase in cancer risk from consuming fish or poultry**. (172)
- According to the American Cancer Society itself: "As for other animal products, organizations that do comprehensive evidence reviews to make dietary recommendations currently do not recommend against poultry (like chicken and turkey, ground or fresh), fish, or dairy." (173)

Does eating dairy products cause cancer?

- According to Dr. Walter Willett: "For example, there is accumulating evidence that high consumption of proteins from dairy sources is related to a higher risk of prostate cancer. That chain of cancer causation actually seems pretty clear."

- Again, you need to look at the totality of evidence. Fortunately, in 2019, the largest review ever performed on meta-analyses examining the link between dairy and cancer was done. So, they weren't just reviewing individual studies, they were reviewing meta-analyses. (174)
- Of the 153 meta-analyses they reviewed, "**109 (71%) showed no evidence of a statistically significant association** between dairy consumption and incidence of cancers, **20 (13%) showed decreased risk of cancers** with dairy consumption and **24 (16%) showed increased risk** of cancers with dairy consumption."
- In other words, **84 percent of meta-analyses showed either no association between dairy or cancer, or showed that consuming dairy actually lowered cancer risk!**
- In that same study, when they looked at dairy and prostate cancer specifically, 15 meta-analyses found either no or inverse association, while 13 found a positive association.
- It's also worth noting that most of these studies group all dairy products together: non-fat, low-fat, full-fat, conventional, organic, etc.
- There's reason to believe that this isn't a good idea. Many studies have shown that full-fat **dairy has unique effects/benefits vs. low-fat or non-fat dairy. For example, full-fat dairy is consistently associated with a reduced risk of metabolic disease and CVD**. (175, 176)
- Research suggests that conventional milk has higher levels of antibiotic residue, pesticide residue, and growth hormones than organic milk. Conventional milk is also often higher in prostaglandin, gonadotropin-releasing hormone, and progesterone. These substances could contribute to the risk of cancer. (177)
- A review of 52 clinical trials in 2017 found that dairy products were inversely associated with inflammatory markers. Given that most modern diseases are inflammatory, if dairy is anti-inflammatory, it's highly unlikely that it's a problem. (178)

Inflammation and blood flow/endothelial function

- In the film, Wilks refers to a study suggesting that eating a hamburger impairs blood flow and causes inflammation. "The study that showed that a single hamburger impairs blood flow also showed that it can increase measures of inflammation by 70 percent. In the arteries, inflammation reduces blood flow. In muscles and joints, it can increase soreness and delay recovery."

- This study, which I mentioned previously, is called "Hass Avocado Modulates Postprandial Vascular Reactivity and Postprandial Inflammatory Responses To a Hamburger Meal In Healthy Volunteers"—and it was funded by the Hass Avocado Board! **This is rich because there's a section in the film on industry conflicts of interest in studies on meat**. It's also a very small study with only 11 subjects.
- The study claimed to find that eating a hamburger without avocado increased measures of inflammation and decreased blood flow. But eating a hamburger with avocado mitigated these effects. Even if we take these findings from a study with only 11 people that was sponsored by the Hass Avocado Board at face value, it simply supports my argument that context is everything: eating animal products with plant foods (Paleo-type diet) does not have the same effect as eating animal products in the context of a SAD. (179, 180)

> Eating animal products with plant foods (a Paleo-type diet) does not have the same effect as eating animal products in the context of a standard American diet.

- As additional proof of this, the lead author of this paper published another paper showing that adding a polyphenol-rich spice mixture to hamburger meat led to improvements in endothelial function compared to a hamburger without the spice mixture. However, the methods of these papers have been challenged by other researchers. (181, 182, 183)
- Given the very small sample sizes in these studies, the fact that one of them was funded by Hass Avocado Board, and the fact that their methods have been challenged, it's worth looking at other research on animal protein and inflammation to see if there really is a strong link—especially in the context of a healthy diet.
- First, a controlled study in 2015 with 52 subjects found that dietary proteins—including milk and egg—actually improve endothelial function, and don't increase markers of inflammation. (184)
- Second, two RCTs—a much higher-quality type of study than the Hass Avocado and spice mixture studies—measured inflammation markers in response to increased red meat intake and found that **red meat does not elevate these markers**.

- The first study concludes that increasing red meat consumption by replacing carbohydrates in the diet of individuals without anemia actually reduces markers of inflammation. (185)
- The other study showed that in women with anemia, inflammation markers on a diet high in red meat were not significantly different from those on a diet high in oily fish. (186)
- Third, numerous studies of Paleo diets—which contain both animal protein and plant foods—have found that they decrease markers of inflammation. (187, 188, 189)
- For example, a 2019 meta-analysis of eight Paleo diet RCTs—again, the highest quality of evidence—showed significant reductions in the inflammatory marker CRP and also improvements in CVD risk markers like BMI, waist circumference, blood pressure, and lipid profiles. (190)
- Two other studies found that the Paleo diet is associated with reductions in markers of inflammation (including interleukin 6, one of the markers in the Hass Avocado study, and tumor necrosis factor alpha) and oxidative stress. (191, 192)

The burrito and erection experiments

- Dr. Robert Vogel does an experiment where he feeds NFL athletes a burrito with only plant protein, and then burritos with animal protein, and examines their blood after. Those who ate the animal protein burritos had "cloudier" blood after. He claimed that this was proof that animal protein impairs endothelial function.
- **This wasn't a peer-reviewed study; it was an experiment done in a film.**
- Do we know that "cloudier" blood is bad? How long does the "cloudy" blood last after a meal with animal protein? Is it possible that the cloudier blood just reflects the type of fat consumed (e.g., saturated)? If so, what do actual peer-reviewed studies tell us about the relationship between saturated fat and CVD? As I've discussed earlier, the largest, best-controlled studies don't show harm, and many studies show improvement (e.g., studies on LC diets showing improvements in CVD risk markers).
- Most of the studies suggesting that an LC diet impairs endothelial function are short-term: four weeks or less. A 2009 study that followed subjects for 12 weeks found that an LC diet actually improved endothelial function, whereas a low-fat (LF) diet decreased it. A 2007 study that followed subjects for 52 weeks showed no change in endothelial function on an LC diet. (193, 194)

- **What other lines of evidence suggest that this is a non-issue?** Studies comparing the lifespan of health-conscious omnivores with vegetarians/vegans show no difference. Since heart attack is the number one cause of death, and impaired endothelial function is a proposed mechanism for heart attack, wouldn't we see more death from a heart attack if eating meat (in the context of a whole-food diet) impaired endothelial function?

> Studies comparing the lifespan of health-conscious omnivores with vegetarians/vegans show no difference.

- **High blood sugar has been shown to impair endothelial function.** Likewise, studies examining insulin sensitivity have found that insulin resistance itself causes impaired endothelial function, even in the fasted state. This gets worse after they eat—especially after a high-carb meal. Low-carb diets (which are high in animal protein) improve insulin sensitivity. (**195**, **196**)
- This suggests that a whole-food LC diet that improves insulin sensitivity and lowers blood sugar would improve endothelial function.

The penis ring/erection experiments

- Another experiment in the film is performed by Dr. Aaron Spitz, a urologist. He puts penis rings on NFL players to look at the effects that different meals have on nighttime erections.
- He feeds the players burritos with meat, and then the same burritos but with plant proteins only. Then he measures the frequency, duration, and strength of the erections. He claims that the athletes had up to 500 percent more frequent erections and also an increase in the strength of erections.

> What can we conclude from this experiment? *Absolutely nothing.*

- What can we conclude from this experiment? Absolutely nothing. It was not a peer-reviewed study where other scientists can examine and critique the methods—just like Dr. Vogel's "cloudy blood" endothelial function experiment.
- Studies of the Mediterranean diet have shown that it reduces erectile dysfunction (ED) relative to a low-fat diet (LFD). A Mediterranean diet includes animal products, but it's a WFD. An LFD often includes a lot of

processed and refined carbohydrates. This suggests that diet quality is likely more important than diet quantity when it comes to ED. Indeed, a study in rats found that a Western diet high in processed and refined foods led to significant ED. Another study showed that a diet rich in flavonoid-containing foods reduced ED incidence. Again, diet quality and overall food pattern is the most important factor! (**197**, **198**, **199**)

- Studies have also shown that cardiovascular dysfunction is associated with future ED. This suggests that any diet that improves cardiovascular function—which includes Paleo and other diets containing animal products—will reduce the risk of ED. (**200**)
- What about reproductive health? If meat and animal products were truly harmful for sexual function, we'd expect to see a decrease in reproductive capacity. After all, these are the same system in the body, governed by the same hormones and physiological processes.
- But that's not what we see at all. Let's look first at fertility, which is a strong marker of a diet's overall calorie and nutrient sufficiency. This is especially true for women, for whom reproduction is an energy- and resource-intensive endeavor.
- Several studies have found a higher incidence of menstrual problems and irregularities among vegetarian and vegan women—and the differences can be quite large (i.e., 5 percent in omnivores vs. 20 percent in vegetarians/vegans). (**201**, **202**, **203**)
- We also have a small RCT (higher-quality evidence), which compared fertility markers between women on an omnivorous vs. a vegetarian diet. By the end of the study, seven of nine vegetarian women had ceased to ovulate vs. only one of nine omnivorous women. (**204**)
- What about men? A recent small study found that vegetarian and vegan men had lower sperm count and sperm quality than omnivorous men. Vegans had the lowest sperm motility (33 vs. 51 percent for LO vegetarians and 58 percent for omnivores). It's notable that this study was performed on California SDAs—one of the proposed super-healthy "Blue Zone"populations. (**205**)
- So, when we look at the peer-reviewed evidence on sexual and reproductive function, there's no evidence that eating animal protein in the context of a WFD is harmful, and there's some evidence that it's beneficial relative to vegetarian/vegan diets.

Is a vegan diet safe during pregnancy, nursing, and childhood?

- Both the Academy of Nutrition and Dietetics (AND) and U.S. Department of Agriculture have said that vegetarian and vegan diets are safe during pregnancy, but critical analyses by several researchers have questioned whether these recommendations are based on sufficient evidence.
- One review remarked that **"The evidence on vegan–vegetarian diets in pregnancy is heterogeneous and scant,"** suggesting that more research is needed to answer the question of whether they are, in fact, safe during pregnancy. (206)
- "... the Academy of Nutrition and Dietetics ignores or gives short shrift to direct and indirect evidence that **vegetarianism may be associated with serious risks for brain and body development in fetuses and children. Regular supplementation with iron, zinc, and B12 will not mitigate all of these risks.**" (207)
- Research has shown that the developing fetus is dependent on the mother for B12. **The longer the mother has been a vegetarian/vegan, the greater the chance of deficiency in the infant**. (208, 209, 210, 211, 212)
- A study of **macrobiotic vegan infants** in the Netherlands found **plasma B12 levels "far below those in the control group"** and in the deficiency range. The same investigators showed that **15-month-old infants** in a cohort consuming a macrobiotic diet had **markedly impaired cobalamin status and impaired psychomotor functioning**. (213, 214)
- A study of **Norwegian infants** on a macrobiotic diet (and born to mothers on a macro diet) found that **85 percent were B12 deficient**. (215)
- Another study of Norwegian infants on a macrobiotic diet found that they had **eight times higher methylmalonic acid (MMA) levels and two times higher homocysteine levels** than matched infants on an omnivorous diet. MMA and homocysteine are more sensitive markers of B12 deficiency than serum B12. (216)
- A study of macrobiotic vegans in the United Kingdom found that **55 percent of kids had high urinary MMA** levels, which is indicative of stage 3 B12 deficiency. These **kids were "short in stature and weight**, and decreased stature was associated with high urinary MMA." (217)
- This is alarming because **"the consequences of B-12 deficiency in childhood for brain and body development are extensive, severe, and can be irreversible.** Potential consequences include (among many others) **impaired cognitive development/school performance, depression, weakness, fatigue, nerve damage, and failure to thrive**." (218)

- A study of children in Guatemala with B12 deficiency found that reasoning, short-term memory, and perception were worse than they were in kids who had adequate B12 levels. (219)
- **The harmful effects of a vegan diet can persist into adolescence even after the kids have started to eat animal products**. In the study on macrobiotic infants, most families switched their kids to a vegetarian or even an omnivorous diet, and did so on average, after the child's sixth birthday—but one-fifth of these **kids continued to show impaired cobalamin status**. "Later, this group showed that cognitive functioning continued to be affected in adolescents aged 10-16 y who had been switched to a lactovegetarian or omnivorous diet by their sixth birthday." (220)

> The harmful effects of a vegan diet can persist into adolescence even after kids have started to eat animal products.

- "The most important **associations were between cobalamin status and performance on tests of fluid intelligence**, which involves the use of faculties related to reasoning, abstract thinking, and learning ability. Thus, compromised vitamin B-12 status during childhood « 6 y of age) has **potential negative consequences well into adulthood**." (221, 222, 223)
- A 2005 study in the Netherlands found that **low B12 status in adolescence was associated with poor BMD**, and that this association was strongest in kids who were fed a macrobiotic vegan diet early in life. (224)
- As I said earlier in this document, **B12 supplementation doesn't always solve the problem**. In the Hermann et al. study of well-educated participants recruited from a vegetarian conference in Germany and a vegetarian summer camp in the Netherlands, vegans who took supplements still had a low average B12 level of 192 pmol/L, ranging from 125 to 299 pmol/L. A 2012 RCT in the United Kingdom found that supplementing with 500 mcg of B12 for eight weeks in elderly people with B12 deficiency did not normalize markers of B12 status in 8 to 25 percent of patients. (225, 226)
- We also now know that the dose of B12 in a supplement needs to be 100 times higher than the RDA of 2.4 µg/day to be effective (approximately 250 µg/day), and that in deficiency states, it should be 200 times higher (approximately 500 µg/day). (227)

- "Realistic vegetarian diets put children at risk for deficiencies that may have both short-term and permanent negative health consequences." (228)
- **The male/female sex ratio** of newborns is **typically 105/100**. Environmental stress association with reduced ratio due to spontaneous abortion of male fetuses, and malnutrition linked to lower sex ratio. In one study of 6,000 women at a British hospital, the **sex ratio among vegetarians was significantly lower than among omnivores (81.5:100 vs. 106:100)**—suggesting that vegetarians were 23 percent less likely to give birth to a boy. (229, 230, 231)
- **One case study included an infant who developed persistent neurological damage from B12 deficiency** caused by his mother's vegan diet (it's good to highlight a case study like this to make it real for people). (232)
- **There was severe vitamin B12 deficiency in a breastfed infant with a vegan mother**, and the infant was also deficient in iron despite the mother's multivitamin consumption during pregnancy. (233)
- Vegetarian preschool children and parents in Taiwan had low vitamin A, Ca, and iron intake, but greater vitamin C and fiber. (234)
- **"EPA and DHA status was lower in breast milk and in infants of vegetarian mothers** than those born to omnivore mothers, which suggests that in the absence of pre-formed dietary EPA and DHA, synthesis from α-linolenic acid is an important process in determining maternal EPA and DHA status in pregnancy." (235)

OTHER CLAIMS IN THE FILM

Rip Esselstyn's firefighter challenge

- In the film, Rip Esselstyn (former firefighter and son of plant-based diet author/advocate Caldwell Essylstyn) does a diet challenge with New York City firefighters.
- He switches them from a SAD to a plant-based diet, and some of their CVD markers improve and they feel better.
- Same issue here. Anyone will feel better after switching from an SAD to a WFD. But would they have done even better with a Paleo-type WFD? It's certainly possible.
- We've done programs with local fire departments that include sleep, stress management, and WFD with animal products. These firefighters have seen similar improvements.

Arnold Schwarzenegger

- "I ate a lot of meat. I ate my 10, 15 eggs a day. And, you know, had my 250 grams of protein a day because I weighed 250 pounds."
- Yes, and that's exactly how he built his strength and the diet he was eating when he became the youngest person ever to win the Mr. Olympia title (at the age of 23). He didn't do that while drinking soy protein shakes.

Is research on animal products tainted by conflicts of interest?

- Then we come to the section of the film that argues that recent research exonerating cholesterol, saturated fat, and red meat is tainted because it's funded by the meat, egg, and dairy industry.
- I've long argued that corporate funding of medical research is a problem. But it's not just by the meat/egg/dairy industry. In fact, **the Big Food lobby that supports processed and refined foods like sugar and industrial seed oils is far larger than the meat/egg/dairy lobby.**
- In fact, a **historical analysis of sugar industry documents published in *JAMA* in 2016** found that the **sugar lobby paid for research in the 1960s** with the goal of pointing the finger at fat, rather than sugar, as the primary driver of CVD. (236)
- Marion Nestle wrote an editorial in the *JAMA* issue with that study, and gave examples of how that is still happening today. Coca-Cola funded an anti-obesity group, which came to the conclusion that there is "virtually no compelling evidence" that sugar-sweetened drinks contribute to obesity. The group was later disbanded due to allegations of industry bias. (237)
- It's particularly rich that David Katz is accusing others of conflicts of interest. "The formula works beautifully for people selling food. It works beautifully for people selling drugs to treat the diseases that bad food causes. And it works beautifully for the media, which can give us a new story about diet every day."

> I've long argued that corporate funding of medical research is a problem. But it's not just by the meat/egg/dairy industry. In fact, the Big Food lobby that supports processed and refined foods like sugar and industrial seed oils is far larger than the meat/egg/dairy lobby.

- Katz has a shockingly long list of ties to industry, which journalist Nina Teicholz has detailed. (238) They include:
    - **Being paid $3,500/hour to defend the super-high sugar content (36 percent more sugar than protein) of Chobani yogurt.** He downplayed the harm that sugar causes and claimed that added refined sugars affect the body in the same way as fruit.
    - Hershey: $731,000
    - Quaker Oats: $633,000 (and continued after PepsiCo's acquisition of that company). Katz wrote a column promoting Quaker Oats and mentioned the brand in his book.
    - Western Sugar Cooperative—Katz was an expert witness.
    - KIND Bars: Katz was paid $154,000 to be a scientific advisor. Katz wrote a HuffPost column on KIND bars and is quoted advising people to "add a low-sugar KIND bar" to their bag.
    - The walnut industry: $1,109,945. Katz wrote two HuffPost columns promoting walnuts without disclosing this fact.
- **It's also true that virtually all the medical experts in the film profit from selling books, supplements, or other products related to the vegan diet.**
- Upton Sinclair: "It is difficult to get a man to understand something, when his salary depends on his not understanding it."
- Conflicts of interest go both ways. The film doesn't make any mention of this.

Should we eat like gorillas, rhinos, and elephants?

- Damien Mander: "This whole fantasy that we need meat to get our protein, it's actually bullshit. I mean look at a gorilla. A gorilla will fuck you up in two seconds. What does a gorilla eat? I just do the same things as these big gray things out here that we're trying to protect, elephant and rhino."
- Like I mentioned, that's an absurd argument. **A human with a gun will "fuck you up" even faster!** A gun is a tool invented by humans. **How did we get smart enough to invent tools?** Most scientists believe that it was because **we started eating meat and fish and cooked tubers**, which are more energy-dense and easier to digest and absorb than plants.
- Comparing humans with herbivores like

> Comparing humans with herbivores like rhinos and elephants and even other primates doesn't make any sense.

rhinos and elephants and even other primates doesn't make any sense. **Humans have relatively large brains and small guts compared to our primate relatives**. We also use tools and cook our food (e.g., we eat cooked steak with a fork and knife, rather than tearing it from the bones of a dead animal).

- **Gorillas have big large intestines that help them break down fiber, seeds, and other hard-to-digest plant foods**. Humans don't. Instead, we have big small intestines, which suggest adaptation to energy-dense foods like meat and cooked starches.
- **A gorilla eats up to 40 to 60 lb. of plant matter a day, which consumes more than half of their waking hours**. Even if humans could eat that much plant matter, and spend that amount of time eating, they wouldn't be able to absorb the nutrients because we have a very different anatomy than a gorilla.

IS VEGANISM THE "NATURAL" HUMAN DIET?

Did early humans eat mostly plants?

- One of the most preposterous claims in the film is that Paleolithic humans ate mostly plants. Wilks: "Advanced technologies, like those used to analyze the gladiator bones, have allowed scientists to take a closer look at the tools, bones, and teeth of our ancestors, leading to the discovery that early humans ate mostly plants."
- **This is literally rewriting history, and it goes against what virtually all respectable anthropologists believe.**
- Isotope analysis from archaeological studies suggests that our **hominid ancestors have been eating meat for at least 2.5 million years**. (239)
- There is also wide agreement that **going even further back in time, our primate ancestors likely ate a diet similar to modern chimps, which we now know eat vertebrates**. The fact that chimpanzees and other primates evolved complex behavior like using tools and hunting in packs indicates the importance of animal foods in their diet—and ours. (240)

> One of the most preposterous claims in the film is that Paleolithic humans ate mostly plants. This is literally re-writing history, and it goes against what virtually all respectable anthropologists believe.

- It is true that we can't know with certainty the exact proportion of animal products vs. plants that our Paleolithic ancestors ate. Since plant foods don't leave many traces, there's no way to determine from a two-million-year-old archaeological site how important meat was in the diet. And the proportion of animal vs. plant foods likely varied significantly among early human groups depending on where they lived.
- **That said, the archeological record provides strong evidence that animal products played a critical role in human evolution.** Right at the time that tool-marked bones (which indicate butchering meat) started to appear, humans went through huge physiological changes: our brain doubled in volume, our gut became smaller, the proportion of small intestine to large intestine increased, and our teeth and jaws became less robust. Most scientists believe that these changes coincided with a shift away from a typical energy-poor primate diet of leaves and low-calorie fruit to a higher-quality diet consisting of energy-dense animal foods and starches. (241)
- **Stable isotope (carbon and nitrogen) analysis of bone collagen also indicates significant consumption of animal products.** The earliest hominids that have been studied using these methods are the Neanderthals. Three studies have been performed on Neanderthal groups ranging from 130,000 to 28,000 years ago. In all three studies, the isotope levels were compared with known diets of contemporary species, **and the Neanderthals were most similar to top-level carnivores**. The five Neanderthal individuals studied were "all top-level carnivores who derived the vast majority of their protein from animal sources, likely to be large herbivores." (242, 243, 244, 245, 246)
- **There have only been two stable isotope bone collagen studies of modern humans (*Homo sapiens sapiens*).** The first group lived about 13,000 years ago in Southern England and the second group 30,000 to 40,000 years ago in La Gravette, a coastal region in France, and other Eurasian sites. Again, both studies revealed diets that were very high in animal proteins. The Southern England group consumed mostly large herbivores, but the French/Eurasian group consumed a more diverse mix of animal protein, including seafood. (247, 248, 249)
- So, the fossil record clearly indicates a strong history of animal product consumption in humans from 130,000 to 13,000 years ago.

What about anatomical evidence?

- One of the claims of the film is that human anatomy is not well-suited to consuming animal products, and is best adapted for plant consumption. Dr.

Christina Warinner: “Humans do not have any specialized genetic, anatomical or physiological adaptations to meat consumption. By contrast, we have many adaptations to plant consumption. We have longer digestive tracts than do carnivores. And this allows humans to digest plants and fibers that require longer processing time.”

- Some advocates of plant-based diets (like Dr. Warinner) have argued that humans are herbivores because of our blunt nails, small mouth opening, flat incisors and molars, and relatively dull canine teeth—all of which are characteristics of herbivorous animals.
- **But this argument ignores the fact that we evolved complex methods of procuring and processing food, from hunting to cooking to using sharp tools to rip and tear flesh**. These methods/tools take the place of anatomical features that serve the same function.
- As noted above, as we added animal products to our diet (thanks to tool use), our teeth and jaws became less robust. This increasing “gracilization” of the mandible is thought to be “due to an increasing consumption of meat, which is less fibrous than plant foods and therefore easier to masticate.” (**250**)
- Dr. Warinner is correct that the human gut is longer than a carnivore’s. What she neglects to point out is how our guts differ from those of herbivores and even other primates that consume primarily plant foods.
- **The greatest portion (45 percent) of the total gut volume of our primate relatives is the large intestine**, which is good for breaking down fiber, seeds, and other hard-to-digest plant foods. **In humans, the greatest portion of our gut volume (56 percent) is the small intestine**, which suggests we’re adapted to eating more bioavailable and energy-dense foods, like meat and cooked starches, which are easier to digest.
- The digestive tracts of herbivores, like the ox that Baboumian refers to in the film, differ even more significantly from those of humans. Carnivores have only one stomach and a much shorter digestive tract. **Herbivores can often have several (up to six) stomach chambers and a much longer digestive tract**. Ruminants also regurgitate food and rechew it to help with the digestive process.
- Human anatomy is nothing like the anatomy of animals that primarily eat plants.

What do studies of contemporary hunter–gatherers tell us about the "natural" human diet?

- Studies of contemporary hunter–gatherer populations like the Maasai, Inuit, Kitavans, Tukisenta, !Kung, Aché, Tsimané, and Hadza have shown that, without exception, they consume both animal and plant foods, and they go to great lengths to obtain plant or animal foods when they're in short supply.
- For example, in one analysis of field studies of 229 hunter–gatherer groups, researchers found that **animal food provided the dominant source of calories (68 percent) compared to gathered plant foods (32 percent)**. Only 14 percent of these societies got more than 50 percent of their calories from plant foods. (**251**)
- Another report on 13 field studies of the last remaining hunter–gatherer tribes carried out in the early and mid-20th century found similar results: animal food comprised 65 percent of total calories on average, compared with 35 percent from plant foods. (**252**)
- **There is not a single known example of a hunter–gatherer or traditional human population that followed a completely vegetarian or vegan diet.** We have limited evidence that vegetarians who eat dairy and eggs can live long lives, but no evidence of long-lived vegan populations that consume no animal foods.

> Studies of contemporary hunter–gatherer populations have shown that, without exception, they consume both animal and plant foods, and they go to great lengths to obtain plant or animal foods when they're in short supply.

We can also look at the optimal human diet from a biochemical perspective.

- When we consider nutrient density and bioavailability, we reach the same conclusion. Humans are designed to consume both animal and plant foods. See this article for more info on the biochemical perspective.

WILL A PLANT-BASED DIET SAVE THE WORLD?

Several common, yet inaccurate, claims about the environmental impacts of animal foods are made in the film:

- That producing meat takes up too much farmland and cropland, and that livestock consume valuable food/calories that could be used to feed humans
- That livestock consume too much freshwater
- That livestock are responsible for a large percentage of greenhouse gas (GHG) emissions
- That shifting to a plant-based diet would have a significant impact on GHG emissions and would free up a huge amount of land that could be used to grow crops

I'll examine these claims more closely below.

But before I do that, I want to be clear that I agree 100 percent with plant-based diet advocates that our current concentrated animal feeding operation (CAFO) system for producing beef and other animal foods is problematic. Where we disagree is on the solution. They propose eliminating animal foods from the diet; I propose regenerative agriculture. Read on to find out why.

> I agree 100% with plant-based diet advocates that our current CAFO system for producing beef and other animal foods is problematic. Where we disagree is on the solution.

Does raising livestock displace farmland that could be used to grow crops?

- **Most of the land that is used to cultivate livestock is suitable only for grazing.** It could not be used for crop production.
- A report by the Food and Agriculture Organization of the United Nations (UN FAO) called "Livestock & the Environment - Meeting the Challenge" found that 60 percent of agricultural land is too rocky, hilly, dry, or the soil is too poor for cropping. (**253**)
- See the "**Not All Land Can Be Cropped**" infographic on Diana Rodgers' **Sacred Cow website** for a visual illustration of this.

Do livestock consume protein and other food that could be used to feed human beings?

- **Most livestock feed is not grown specifically for livestock**—it is a byproduct of food overproduction processes. So, eliminating livestock wouldn't increase the food supply for humans.
- For example, soy is mostly grown to make soybean oil, which is used in all kinds of processed and refined foods. The consumption of soybean oil has risen a thousand-fold since 1900, and soybean oil now comprises 60 percent of the edible vegetable oil consumption in the United States. The soy cakes that are a byproduct of the soybean oil production process are less valuable, and are fed to livestock. (**254**, **255**)
- **Eighty-six percent of what cattle eat is inedible by humans.** This includes grasses and leaves (ever try eating them?), hay, corn stalks (byproduct of ethanol), grains leftover from distilleries (alcohol production), fodder crops, oil and seed cakes, and other non-edible byproducts. (**256**)
- If we didn't feed these products to cattle, they would decompose (and produce GHGs). This means that stopping cattle production will not provide more food for humans.
- **Livestock on pastures do not displace wildlife and natural vegetation.** To the contrary, when properly managed, they **stimulate vegetation regrowth and create habitat**. It is croplands that displace habitat, and again claims against meat often include croplands used for livestock feed.
- See the "**Livestock Turn Food We Can't Eat Into Protein**" infographic on Diana Rodgers' **Sacred Cow website** for a visual illustration of this.

Are cattle "inefficient middlemen"?

> 86 percent of what cattle eat is inedible by humans.

- One of the claims made throughout the film is that "cattle are just the middlemen," and that we'd be better off just eating the nutrients that cattle eat rather than trying to get them from meat.
- This is false, and indicates a lack of understanding of nutrient density and bioavailability. As noted above, 86 percent of what cattle eat is inedible by humans. **Yet cattle convert these non-food products into highly nutrient-dense, bioavailable food for humans.**

- Cattle are even efficient at converting the 10 to 14 percent of grain they eat (which could be fed to humans). **Their "feed conversion ratio" is about 2.6:1 in the U.S.**—2.6 kg of corn, which is nutrient-poor and high in calories, gets converted into one kg of beef, which is nutrient-dense and relatively low in calories.
- According to the UN FAO Report on Feed, **for every 0.6 kg of edible-to-human protein feed ruminants they consume, they produce a 1 kg of edible-to-human protein food**. So ruminants increase—not decrease—food security. (**256**)
- This makes cattle very efficient "protein upcyclers"—they convert food that is either not edible for humans, or is poor in nutrient quality, into one of the highest quality foods we can eat.
- See the "**Livestock Turn Food We Can't Eat Into Protein**" infographic on Diana Rodgers' **Sacred Cow website** for a visual illustration of this.

Do cattle consume too much freshwater?

- One of the most common myths about the environmental impact of meat production, both in the film and on the internet and in the media, is that it takes an enormous amount of freshwater to produce meat.
- You've probably heard the claim that it takes 2,400 gallons of water to produce a pound of beef. But is that really true?
- Even with conventional beef, the vast majority (94 percent) of the water used to produce it is "green water"—water that comes from natural rainfall. The remaining 6 percent is "gray water" or "blue water"—water that is sourced from surface or groundwater sources.
- With grass-fed beef, an even higher percentage—**97 percent—of water comes from rain, and only 3 percent comes from irrigation** (gray + blue). Also, **water is recycled back into the land as urine**.
- **Beef requires only 280 gallons of "blue water" per pound, which is less than the amount required to produce a pound of avocados, almonds, walnuts, rice, or sugar!**
- Claims of high water usage usually refer to irrigation needed to grow crops that livestock need, so they are irrelevant to grass-fed conversations.
- See the "**Beef Isn't a Water Hog**" infographic on Diana Rodgers' **Sacred Cow website** for a visual illustration of this.

Is livestock responsible for a significant amount of GHG emissions?

- This is another common myth. In the film, Rob Bailey says: "The livestock sector is responsible for 15 percent of global man-made emissions. So, to put that in perspective, that's about the same as all the emissions from all the forms of transport in the world, all the planes, trains, cars, vans and ships all added up."
- The numbers Rob Bailey shared in the film come from commonly cited FAO statistics, which found that GHG emissions from cattle are 14.5 percent compared to 14 percent for the entire transportation sector.
- However, **the FAO data used a full life cycle analysis for cattle**, including carbon needed for feed, transport, and processing of cattle (not just emissions)—**whereas they only looked at direct emissions from transportation**. They did not consider a full life cycle analysis, which includes the carbon needed to manufacture the vehicles (cars, buses, airplanes, etc.) and the inputs required for making the fuel (feedstock production and distribution, fuel production and distribution, and final use of the fuel).

This is not an apples-to-apples comparison. It is comparing only the final stage (emissions) of transportation with the full life cycle of cattle production.

- **This is not an apples-to-apples comparison**. It compares only the final stage (emissions) of transportation with the full life cycle of cattle production.
- If we compare *only* the emissions of cattle vs. the emissions of transportation, **globally cattle accounts for 5 percent and transportation for 14 percent**. In the United States, cattle account for only about 3.9 percent of our GHG emissions—far lower than the 18 to 51 percent number that many plant-based diet advocates report. (**257**)
- See the "**Methane Claims Against Cattle Are Overblown**" infographic on Diana Rodgers' **Sacred Cow website** for a visual illustration of this.

Does grass-fed beef have the same GHG impact as CAFO beef?

- The numbers above reflect industrial beef production. If we switched toward a more regenerative system of raising cattle, it would be a completely different story.
- In fact, recent studies that look at the full life cycle of grass-fed cattle managed holistically show that **they can actually sequester carbon from the atmosphere**. This means that **holistically managed cattle can be either net-carbon neutral or even a carbon sink**.
- A 2017 paper by Richard Teague differentiates between CAFO and regenerative methods, and shows how "previous reviews of grazing studies were limited in scope and applicability to larger, more complex landscapes." (**258**)
- Dr. Teague went on to publish a review paper in 2018 that documented various carbon sequestration rates from multiple sites being managed holistically, with most rates around 3 to 4 tons of carbon/hectare/year, and one up to 7 tons. (**259**)
- See the "**It's Not the Cow, It's the How**" infographic on Diana Rodgers' **Sacred Cow website** for a visual illustration of this.

What would the real environmental and nutritional impact be of everyone in the United States going vegan?

- Advocates of plant-based diets often claim that removing animal products from our diet would have a huge impact on reducing GHG emissions.
- But a study published in *PNAS* in 2017 called "Nutritional and greenhouse gas impacts of removing animals from US agriculture" contradicted this claim. (**260**)
- The researchers found that if everyone in the United States went vegan and gave up all animal products, **we would reduce GHG emissions by only 2.6 percent. Yet our intake of carbohydrates, total calories, and the incidence of nutrient deficiencies would increase significantly**.
- In fact, without animal products, domestic supplies of Ca, EPA and DHA, retinol, and B12 would be "insufficient to meet the requirements of the US population."
- It's important to note that the *PNAS* study **didn't account for bioavailability of nutrients**. As I've discussed earlier in this document, the bioavailability of certain nutrients like iron, Zn, Ca, vitamin K2, vitamin A, and protein is significantly lower in plant foods than in animal foods. (**261**)

- From the study: "If bioavailability of minerals and vitamins were considered, it is possible that additional deficiencies of plant-based diets would be identified."
- **Plant-based diet advocates haven't considered the full impact of eliminating animal products from the food system**. Again, from the *PNAS* study: "The challenge with plant-based diets comes when one considers the need to feed the entire growing population. Even though it is possible to balance plant-based diets for individual humans, it may be a challenge for these diets to scale well within the US food production system because of the types of crops that can be grown in the available climates and soils. When animals are allowed to convert some energy-dense, micronutrient-poor crops (e.g., grains) into more micronutrient dense foods (meat, milk, and eggs), the food production system has enhanced capacity to meet the micronutrient requirements of the population."

> Plant-based diet advocates haven't considered the full impact of eliminating animal products from the food system.

- The current SAD with animal products provides a surplus of calories (145 percent). **If we removed animal products entirely, this surplus would increase to 230 percent**! Given that 70 percent of the U.S. population is overweight, and 40 percent is obese, this is not a desirable change, especially when this increase in calories comes with a decrease in essential nutrients. (262)
- **Finally, we have to consider practical matters like the sheer quantity of food that people would need to consume on each diet**. According to the *PNAS* analysis, "plants-only diets required 444–522 g more food solids than those with animal products to meet nutrient requirements. This lower solids intake is evidence of the higher essential nutrient density of animal-based food products, which has also been identified by research focusing on improving nutrient density of diets in developing nations and indigenous populations."
- This is consistent with the "protein leverage hypothesis" (PLH), which suggests that if protein intake is insufficient, we'll keep eating carbohydrates and fat (calories) until we meet our protein needs. The PLH has gained a lot of support in the scientific literature. (263)
- Another study by Payne et. al in 2016 found that "**plant-based diets with reduced GHGs were also often high in sugar and low in essential micronutrients and concluded that plant-based diets with low GHGs may not result in improved nutritional quality or health outcomes**." (264)

- It's also worth considering the GHG emissions of diseases like diabetes, which is contributed to by a diet high in processed and refined foods, and is improved by a low-carb, high-protein diet. Think about all the plastic needed for amputations, dialysis, all the needles, lancets, etc.

Are meat substitutes like Impossible Burger and Beyond Meat more environmentally friendly than holistically managed beef?

- Companies like Impossible Foods and Beyond Meat have claimed that meat substitutes are the future of protein, and are less environmentally destructive than beef. Impossible Burger's main ingredients are GMO soy protein concentrate, coconut oil, sunflower oil, and natural flavors. Beyond Meat's main ingredients are pea protein isolate, canola oil, and refined coconut oil.
- Impossible Foods has also publicly criticized holistic land management practices and claimed that they don't make a significant impact on GHG emissions and environmental impact of beef.
- Yet a third-party full life cycle analysis conducted at White Oak Pastures, a Savory Institute hub in Georgia that uses holistic land management practices, found that **their beef operation was a net carbon sink**. (265)
- It's notable that this analysis was **performed by the same company (Quantis International) that conducted an LCA on the Impossible Burger**. So, any claims that Impossible Foods makes about their LCA are no more or less reputable than the findings for holistically managed beef in this LCA.
- However, although Quantis found that Impossible Burger is less environmentally destructive than conventional beef, **their GMO soy-based product is still a net carbon emitter** in comparison to White Oak's properly managed livestock that create a net carbon sink.
- In addition to the higher carbon impact than holistically managed beef, **these "fake burgers" are highly processed and refined foods**. For example, the primary ingredient of the Impossible Burger is soy leghemoglobin" (SLH). SLH, or "heme," is a bioengineered protein additive that adds meat-like taste and color. It does not meet the basic FDA "generally recognized as safe" (GRAS) status—because it's not a food or even a food ingredient.
- In discussion with the FDA, Impossible Foods also admitted that up to a quarter of its "heme" ingredient was **composed of 46 "unexpected" additional proteins, some of which are unidentified and none of which were assessed for safety in the dossier**. (266)

- Impossible Burger has put this product on the market despite admitting to the FDA privately that they **haven't done adequate safety testing**.
- According to the FDA documents, which were obtained through the Freedom of Information Act, the "FDA believes that the arguments presented, individually and collectively, do not establish the safety of SLH for consumption, nor do they point to a general recognition of safety." (267, p. 26)
- In an article criticizing fake meat by Dana Perls, the senior food and agriculture campaigner with the environmental organization Friends of the Earth, "**Instead of investing in risky new food technologies that are potential problems masquerading as solutions, shouldn't we be investing in proven, beneficial, regenerative agriculture and transparent, organic food that consumers are actually demanding?**" (268)
- We should also question whether it's truly more humane to destroy soil with industrial monocrops like soy (which require chemical agriculture with many negative downstream effects) than it is to raise cows for meat. **This type of farming kills a much greater quantity of animals**—including insects, snakes, field mice, rabbits, birds, fish, and other native wildlife—than eating cows does.

> We should question whether it's truly more humane to destroy soil with industrial monocrops like soy than it is to raise cows for meat. This type of farming kills a much greater quantity of animals—including insects, snakes, field mice, rabbits, birds, fish, and other native wildlife—than eating cows does.

- A 2018 paper examining the impact of plant agriculture on animal deaths **found 35 to 250 mouse deaths per acre and up to 7.3 billion animals killed every year** from plant agriculture if you count birds killed by pesticides, fish deaths from fertilizer runoff, plus reptile and amphibian poisonings from eating toxic insects. (269)
- This presents a moral challenge for vegans who avoid animal products because they don't want the food they eat to involve killing animals. Are fish, insects, and birds less significant life forms than mammals? Are small mammals like rodents less "valuable" than larger ones like cows? Is it better to

kill many small animals for foods like grains and soybeans that have fewer and less bioavailable nutrients than it is to kill a larger animal with greater levels of and more bioavailable nutrients? These are important questions to ask—but they are rarely acknowledged by vegans.

- For more information, see Registered Dietitian Diana Rodgers' great article "**Why Fake Burgers Make No Sense**."

What about "lab meat"?

- There are also a number of startups focused on growing cell-based meat in a lab using clustered regularly interspaced short palindromic repeats (CRISPR) on stem cells from muscle tissue.
- While this may sound promising on the surface, once again we have to consider the full life cycle analysis.
- You can't create something from nothing. The inputs from these cell-based meats are monocrops. Most of these companies are secretive about their processes, but the bioreactors used to create cell-based meat are extremely energy intensive. And at least for now, a lot of that energy requires fossil fuels to be produced.

> You can't create something from nothing.

- Also, the environment that the cells are grown in has to be tightly regulated and maintained at a certain temperature. This isn't happening in a kitchen. This environment/temperature is the same that is conducive to the growth of bacteria, so they'll need some way of inhibiting bacterial growth. Antibiotics?
- This is not a regenerative process, like holistically managed cattle, that can restore grasslands and serve as a carbon sink. It requires soy/wheat/corn as inputs, and those are produced with industrial agriculture, herbicides, pesticides, etc.

But can we feed the world with grass-fed meat?

- A common criticism even from those that acknowledge the regenerative potential of grass-fed meat is that we can't scale production enough to feed the world.
- As regenerative farmer Joel Salatin has said, **it may be the only way we can feed the world**. (**270**)

- The UN FAO said in 2015 that **we have 60 harvests left at our current rates of soil loss. This is a sobering number**. (271)
- Our soils are rapidly deteriorating due to erosion, nutrient depletion, and loss of organic carbon. According to the report, the majority of the world's soil resources are in only "fair, poor or very poor condition" and things are getting worse in far more places than they are getting better.
- "In particular, **33 percent of land is moderately to highly degraded** due to erosion, salinization, compaction, acidification, and chemical pollution of soils."
- We desperately need new methods of restoring healthy soil, and regenerative, holistically managed livestock is a time-tested and proven method. Groups like the Savory Institute have demonstrated this over and over. (272)
- What would be required? First, we'd need to return all the croplands used for livestock to grassland. Second, we'd need to put unused land—we have 5 billion hectares of grasslands globally—into production. Third, all farmers/ranchers would need to adopt regenerative practices that can increase the carrying capacity of that land. (At Savory Institute, they guarantee two times more, but have seen folks get 17 times.)

> We likely could feed the world, and we'd be doing so in a way that supports a thriving ecosystem, full of nutrient-dense food, and with little-to-no reliance on fossil fuels for machinery or inputs.

- **If we do this, we likely could feed the world, and we'd be doing so in a way that supports a thriving ecosystem, full of nutrient-dense food, and with little-to-no reliance on fossil fuels for machinery or inputs.**
- There's no doubt that this would be an enormous undertaking. But that's true of anything that could make an impact on the problem we're facing. **Most of the other proposed solutions (fake meat, lab meat, etc.) will only make the problem worse, since they still rely on the industrial processes that have led to the erosion, depletion, and pollution of soil.**

ADDITIONAL RESOURCES:

- Why Eating Meat Is Good for You
- What Is Nutrient Density and Why Is It Important?
- Do Vegetarians and Vegans Live Longer Than Meat Eaters?
- Why You Should Be Skeptical of the Latest Nutrition Headlines: Part 1 and Part 2
- What Is the Optimal Human Diet?
- Why You Should Think Twice About Vegetarian and Vegan Diets
- B12 Deficiency: What Everyone (Especially Vegetarians) Should Know
- Do Your Kids Need to Eat Meat to Thrive?
- The Truth about Red Meat eBook
- RHR: Why the Optimal Human Diet Includes Animal Protein
- What Is an Ancestral Diet and How Does It Help You?