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Nutrition: Key Concepts

Why it matters

Nutrition is an avenue to a better life. It gives us energy, mental focus, faster recovery and longevity, whether this involves weight loss or not. These are the fundamental physical aspects of quality of life, meaning that they represent the physical health components of happiness. As such, eating a healthy diet is your way of taking action on the idea that you matter. It is ***you*** taking ***you*** seriously.

Now that you are serious, what are you going to eat? There are simple and complex ways to answer this. The simple answer is to eat unprocessed foods and drink water. The complex answer is that you need a balance of satiating and nutrient dense foods in moderate amounts evenly spaced throughout your day while avoiding anything toxic. This answer is complex because it requires us to understand foods and food groups, portion sizes, nutrient timing, what drives hunger and what potential food risks exist, such as mercury in fish or trans fats.

Fueling muscle not fat

Fortunately, nutrition is simplified by the fact that a healthy diet achieves all of our quality of life goals at once. If you want to lose body fat to prevent disease, you want fewer nutrients to go to fat. If you want more physical and mental energy, you want more nutrients to go to your muscle and brain. If you want general health or injury recovery, you want nutrients to go to your organs or tissues, but not to body fat. Every major nutrition goal that we have comes down to sending calories to the organs that do work in our body instead of fat. This is an important concept because the foods we eat, not just the amounts, determine where the calories goes in our body.

The calories you eat have to go somewhere, and body fat is the overflow for whatever your active tissues cannot absorb quickly enough. Saturated fat and sugar ***close*** the doors through which nutrients enter active tissues (like your muscle), forcing more calories to overflow into fat. The same number of calories of vegetables (which are carbohydrates) and unsaturated fat ***open*** the nutrient doors to active tissues, leaving fewer calories for fat.

What we eat literally determines ***where*** it goes. I call this the "Fueling Muscle Not Fat Principle". Its impact is profound: Hundreds of calories can unnecessarily go to fat with just a single meal because the doors to muscle fueling get shut down by unhealthy food. In the medical community, this fat fueling at the expense of muscle is called "insulin resistance", a pre-diabetic state. And the fact that these tissues compete for fuel means that type II diabetes (i.e. inhibited muscle fueling) is directly linked to obesity and atherosclerosis (i.e. fat deposition). This fueling competition also means that eating for health is the centerpiece of sports nutrition because the athlete wants to fuel their muscle, not fat, for both performance and recovery.

Before describing how to fuel muscle not fat, it is important to define the macronutrients and food groups so that there is a framework for our discussion.

The 4 macronutrients

The body is made out of billions of cells. These cells are made out of proteins, fats and water. For energy, they depend on fats and carbohydrate. This is why we need to consume water, protein, fat and carbohydrate on a regular basis to stay alive. The fact that we need a whole cup or plate of them at a time makes them "macronutrients".

The macronutrients

Water	Protein	Fat	Carbohydrate

The cells of different types of organisms have different amounts of the macronutrients in them. For example, animals, which move around, are high in protein because of their muscles and organs. Proteins are molecules that do work, such as contraction, so muscle is loaded with protein.

Plants, on the other hand, do not move around. As a result, they don't contain as much protein, and the protein that they do contain is unrelated to muscle so it does not have a ratio of amino acids to match our needs as well as protein from animals (soy being an exception). Plants are mostly carbohydrate, meaning sugar. Specifically, they are made out of glucose and fructose. Some plants have energy storage organs, which, by design, are relatively higher in calories than the rest of the plant. These organs are known as tubers (e.g. potatoes and yams), cereal berries (e.g. rice, wheat and corn) and legume pulses (e.g. lentils and beans). These energy stores make up the "starch" foods in our diet and are mainly made out of glucose.

Note that most sugars in plants are connected into long chains called complex carbohydrates, which do not taste sweet. As a result, we might not always recognize them as sugars when we eat them. Even fiber is mostly made out of sugar chains, but is not digestible because of how the sugars are chemically bonded to each other. Fiber is found surrounding all plant cells and is therefore in all plant foods.

The non-starchy parts of plants are made of sucrose, which is equal parts glucose and fructose. Fruits are essentially plant ovaries that are high enough in simple sugars to taste sweet. They are not generally as high in calories as an equal amount of starch. We use the term 'vegetables' for everything in plants other than starches and fruit: Leaves, roots, stalks and fruits that are not sweet, the latter including tomatoes, cucumbers, zucchini, and squash.

Another sugar source in our diet is lactose from dairy, which is a combination of glucose and galactose.

The amount of fat in foods varies depending on the animal or plant in question. Generally, saturated fats are found in land animals (e.g. beef, pork and lamb), animal products (e.g. milk and egg yolks) and components of tropical plants (e.g. coconut, palm oil and Brazil nuts). Unsaturated fats are found in most plants and in seafood.

The amount of water in food varies dramatically and is ~ ½ L or Qt per 1000 Cal of food. Additional water needs beyond this are ~ 1 L for every 1000 Cal that we eat. For most of us, this corresponds to 2 Qt per day, which is ~ 8 cups. Sugars in soda and fruit juice, xanthines in coffee and tea, and alcohol do not hydrate us as well as water. Large amounts of low-calorie sweeteners may have long-term negative effects, so their intake should be kept in moderation. For these reasons, at least half of our

fluid consumption should be water. A reasonable way for achieving this is to consume at least an equal amount of water before consuming any other type of fluid.

What falls into the macronutrient categories

Water	Protein: Animals & soy	Fat: Animals & plants	Carbohydrate: Plants
Water • Should be the source of at least ½ of our hydration. **Other fluids** • Coffee, tea, etc always proceeded by water: Drink water first.	"If it has a mother it's protein". **Animals** • Beef, poultry, fish, etc. **Animal products** • Egg & dairy **Soy** (best plant source)	**Unsaturated fats** • Fish & the vast majority of plant foods, including olives, vegetable oil, soy, avocado, seeds & nuts. **Saturated fats** • Land animals, their products, tropical plants.	**Starches** • Bread, pasta, rice, potato & cereal. • Glucose energy stores. **Produce: Fruits, veggies** • Calories mostly sucrose **Fiber** • In all of the above.

The 4 basic food groups

Foods that fall into any one macronutrient category can be thought of as a "food group", except for water, which is in essence the only thing that falls into its category and is not food.

There are still 4 food groups, however, because carbohydrates are split up into 2 groups: Starches and produce. The reason for this is that they play very different roles in a culinary sense (e.g. pasta versus salad) and they impact the body differently.

Starches are generally lower in phytonutrients and higher in calories than produce so they mainly supply the body with energy. Their calories are primarily glucose, which can be directly burned as fuel by all tissues in the body. Since many starches digest relatively quickly, excess amounts easily overwhelm the capacity of our active tissues to absorb fuel, leading to increased body fat levels.

Produce (meaning fruits and vegetables), on the other hand, is generally lower in calories and higher in phytonutrients. This is particularly true of vegetables, making vegetables absolutely essential in a diet whose aim is to optimize health. Produce calories are mainly sucrose, which is equal parts glucose and fructose. Fructose must be converted into glucose in the liver before it can be used as fuel by the body, but large amounts of fructose (as can occur with fructose sweetener or large amounts of fruit)

stimulates the liver to produce triglycerides and LDL (or "bad") cholesterol. For this reason and the fact that vegetables are low in calories, it would be misguided for a highly active person to obtain all of their carbohydrate calories from produce.

On the other hand, if sedentary, starches are not required to be in the diet. Pulses (i.e. lentils and beans) are an exception; they digest so slowly that by themselves they do not put a sedentary person at risk of weight gain and they are by far the highest in phytonutrients of the starch group.

Carbohydrate comparison chart

	Starches (whole grain)	**Fruits**	**Vegetables**
Type of sugar	Glucose	Sucrose (glucose + fructose)	Sucrose
Calories per unit weight	High*	Moderate	Low
Phytonutrients	Low*	Moderate	High
Fiber level	Good (whole grain only)*	Good	High
Digestion rate	Moderate*	Moderate	Low
Health value	Good (whole grain only)*	Good (whole only; not juice)	High
Important for	Highly active individuals*	Everyone in moderation	Everyone
Drawbacks	Excess results in body fat*	Excess results in TGs & LDL	None: Veggies are the healthiest foods & are so filling that they are calorically self limiting

* Exception: Pulses (i.e. lentils and beans) are starches made of glucose but otherwise follow the above characteristics of vegetables. Everyone should be encouraged to eat them.

To help remember the food groups, it is easiest to put protein and produce first since they start with the same letter and to put starches last since they are the only group that is not essential for health (but important for very active people). When putting meals together, simply remember the jingle: "Produce, Produce, Fat, and Starch."

The basic food groups

Protein	Produce	Fat	Starch

How to fuel muscle not fat

Sometimes when we are sick we lose our appetite. This can happen to cells too, and it is caused by excess saturated fat or refined carbohydrates, meaning >10% of your daily calories of either. Refined carbohydrate includes white bread, white pasta, white rice, desserts, and sugar.

The reason saturated fat and refined carbs shut down cell appetite involves insulin, a hormone that tells cells when it is time to eat by binding to them. Once insulin binds, a signal is sent within the cell to its nutrient transporters telling them to open. This is like insulin acting as a dinner bell telling cells to open their mouths to let food in.

Saturated fat in our diet goes into the outer membrane, or skin, of cells, shutting down insulin's ability to send a signal through the outer membrane and the nutrient transporters' ability to open in the outer membrane. Refined carbs digest quickly, resulting in sugars entering cells quickly and shutting down subsequent signaling inside the cell between insulin and the nutrient transporters, keeping the mouths from even knowing that insulin is present. Either way, the cell is not binding or not responding to insulin and is therefore "resisting" the action of insulin; a condition called insulin resistance ("IR").

IR mainly affects skeletal muscle, the liver and some other regulatory organs, such as the hypothalamus in the brain. But in the simplest sense, IR can be thought of in terms of saturated fat and refined carbs directly shutting off muscle fueling, causing an overflow into fat cells.

Unsaturated fat and slow-digesting carbohydrates (e.g. vegetables and coarse whole grains), as well as moderate amounts of protein (which slows digestion) ***increase*** muscle fueling. This, in turn, increases metabolism, energy, and tissue health while reducing body fat. Such an approach to eating is a dramatic improvement over simply cutting calories, which cuts not only body fat but also healthy tissue and energy while driving up hunger.

The Fantastic 4: The "fueling muscle not fat" food groups

Protein: Low in sat. fat	Produce: Fruits & Veggies	Unsaturated fat	Starch: Pulses, whole grain

The Bucket Brigade

The Bucket Brigade is the central concept of this book. Imagine your circulatory system as a bucket holding 5 Liters of blood with 200 Calories of blood sugar. Now imagine that there is a hole in the bottom of the bucket through which blood sugar leaks out to fuel the active tissues in your body, meaning everything other than fat cells. We will call this hole the 'Energy Entryway' because when calories go through it, they give you energy, mental focus and health. The Energy Entryway represents the nutrient transporters in cells that fuel muscle not fat.

When you eat or drink, food and fluids go into your digestive system and then your bloodstream, which we will represent as a pitcher pouring nutrients into your bloodstream (the bucket). The more you eat, the more the pitcher has in it to pour into the bucket. The faster your food digests (e.g. sweets and refined carbohydrates digest quickly), the faster the pitcher pours its contents into the bucket. Whenever the pitcher pours calories into the bucket faster than they can get through the Energy Entryway, the bucket overflows to fuel fat cells. Over-eating, no matter how healthy the food, overflows the bucket because there are simply too many calories in the pitcher pouring in. Eating refined carbs, even in relatively small amounts, overflows the bucket because of rapid digestion.

If we graze too much, meaning that we don't eat much at any one time but eat too many calories over the course of the day, our active tissues will fill up with fuel and will not be able to absorb any more. This is like trying to fill your car's gas tank after it is already full; it just overflows. Your gas tank is, effectively, closed to being filled. In the same say, the Energy Entryway is effectively closed when your tissues are fully fueled. Calories then build up in your bloodstream (the bucket) and overflow into fat.

The Bucket Brigade goals

1. Not overeating throughout the day. Even if we don't eat much at any one time, active tissues will be completely filled up and won't absorb any more, forcing our bucket to over-flow.

2. Not overeating at any one meal. Even when eating healthy foods, too much at once puts calories into our bloodstream too quickly, overwhelming the rate at which active tissues can absorb fuel. This is the pitcher pouring calories into the bucket faster than the Energy Entryway can clear them, so the bucket overflows.

3. Slowing down digestion so that normal-sized or even small meals don't digest too quickly. Even a small meal or snack (like a candy bar) can digest so quickly that the bucket will overflow.

4. We want to open the Energy Entryway, which is the same as saying we want to use the Fueling Muscle Not Fat Principle to open the nutrient transporters to our active tissues.

The bottom line of the goals

We want calories to enter the bloodstream slowly and enter active tissues quickly so that there is little left remaining at any given time for fat cells.

Achieving the goals of the Bucket Brigade

Goals 1 and 2: Reducing the number of calories you eat in a meal and throughout the day

Hunger is based on our blood sugar levels, hormones that respond to our diet, and the emptiness of our stomach. All 3 of these stimulate hunger if we don't eat enough. Ironically, blood sugar and hormone levels also make us hungrier if we eat too much. This is particularly true if we eat too many calories that digest quickly, such as processed carbohydrates. If blood sugar levels rise quickly, the large insulin response in the body drives blood sugar down to very low levels, making us tired and hungry.

High-fiber foods such as whole grains, whole fruits, and particularly vegetables slow down digestion so that sugars enter the bloodstream slower. This stabilizes blood sugar and therefore reduces hunger. These foods also put more bulk into the stomach, reducing hunger due to stomach filling with fewer calories than when eating processed carbohydrates. Protein and fats in a meal generate a hormonal response from the stomach and intestine that reduce hunger for hours after a meal.

Conclusion for goals 1 and 2

Hunger is reduced most effectively in the short term by vegetables, for several hours by protein, fats and vegetables, and to a lesser extent by whole grains and whole fruits.

Goal 3: Slowing down digestion

The hormones that reduce hunger in response to protein and fats in a meal also slow down digestion. Naturally high-fiber foods, particularly vegetables, slow down digestion mechanically because they increase the workload on the stomach as it breaks down the meal.

Conclusion for goal 3

Digestion is slowed most effectively by vegetables, then protein and fats, and to a lesser extent by whole grains and whole fruits.

Goal 4: Opening the Energy Entryway

This refers to the Fueling Muscle Not Fat Principle, meaning insulin sensitivity.

Conclusion for goal 4

Avoid insulin resistance by eating unsaturated fat, protein low in saturated fat, high-fiber starches, and whole fruits and vegetables.

The 'Bucket Brigade' food groups

The Bucket Brigade food groups work together in each meal to reduce hunger, digestion rate and body fat while increasing active tissue fueling. The simplest way of balancing meals would be to eat roughly equal numbers of calories from each group.

The "Bucket Brigade" food groups: The same Fantastic 4

Protein: Low in sat. fat	Produce: Fruits & Veggies	Unsaturated fat	Starch: Pulses, whole grain

The emphasis of the Bucket Brigade is two fold: Increase body function and reduce disease. Active-tissue fueling achieves the first goal. Reducing metabolic, inflammatory and body-fat related mechanisms of disease that stem from excess or empty calories in the diet is a large step towards achieving the second goal. Metabolic and inflammatory responses to poor diet typically occur simultaneous to increases in body fat, including fat in the arteries. For this reason, most of the top diseases that kill Americans are correlated to body fat even if body fat is not the direct cause.

The American mortality profile is correlated to body fat

Below are the top causes of mortality in the US, the % of deaths due to each mortality, the number of people who died in 2004 due to that mortality, the average range of years that each disease takes away from its victims (assuming that otherwise there would have been a 75-85 year life span), and how many life-years total are taken from the entire US population each year by each disease (CDC data). Note that over half of deaths in the US are due to either heart disease or cancer, taking about 10 years of life on average from each victim. The current life expectancy in the US is 77.9 years, which includes infant mortality, meaning that adult life expectancy is higher.

The diseases in **bold and underlined** are those **associated with being overweight**.

2004 top killers	# of deaths	Years lost	Total life years lost in US from 75 years, 85 years	
1. **Heart disease** (27.2%)	652,486	5-10	3,101,322	6,276,869
2. **Cancer** (23.1%)	553,888	8-15	4,282,583	8,296,043
3. **Stroke** (6.3%)	150,074	4-8	535,287	1,176,122
4. Respiratory disease (5.1%)	121,987	4-10	460,318	1,170,838
5. Accidents (4.7%)	112,012	27-35	3,031,173	3,949,971
6. **Diabetes** (3.1%)	73,138	7-13	492,524	969,218
7. **Alzheimer's** (2.8%)	65,965	0-2.5	n/a	164,202
8. Influenza & pneumonia (2.5%)	59,664	4-7	213,455	432,458
9. **Kidney disease** (1.8%)	42,480	5-10	205,019	422,572
10. Septicemia (infection, 1.4%)	33,373	7-13	224,769	417,106
11. **Suicide** (1.4%)	32,439	30-40	972,264	1,279,856
12. **Liver disease** (1.1%)	27,013	16-25	431,821	677,960
13. **Hypertension / renal** (1.0%)	23,076	4-8	89,589	189,398
14. Parkinson's (0.8%)	17,989	0-1*	n/a	n/a
15. Assault (homicide, 0.7%)	17,357	42-52	733,442	904,427

*Parkinson's is thought by many health care providers to reduce lifespan, but estimates vary from 0-2 years of lifespan reduction. The value has not been determined with any accuracy, so a conservative range half that of the general opinions in the literature is listed here. Because of the ambiguity in this value, the CDC does not provide an estimate.

It matters where your body fat is located

Nine of the top fifteen mortalities in the US are correlated to being overweight, as shown mainly by Body Mass Index (BMI). BMI is the ratio of a person's weight to the square of their height in units of kg/m^2. BMI levels for the US population indicate that 2/3 of us are now overweight, and that half of those 2/3 are obese. However, BMI does not take into account how a person's fat is distributed in their body. For example:

- A thin person who has fat in their arteries has a "good" BMI.
- A newborn infant with a lot of healthy subcutaneous body fat is classified as obese.
- BMI doesn't account for larger than normal amounts of lean tissue, so weight lifters can have a high BMI even if they have very little body fat.

Therefore, an individual's BMI is not by itself necessarily an indicator of health status. But newborns and lean weightlifters are minorities in the population and lean individuals with poor blood lipid profiles would only add to the numbers of unhealthy people beyond those who are overweight, so America's overall BMI is an indicator of overall health status in the country. Each of us should, with the help of our physician, determine what risks, if any, come with our body fat distribution.

The health impact of where our fat is

- **The worst:** In your organs, including your arteries, kidneys and liver. This occurs from excess saturated fats, carbohydrate and/or total calories.
- **Also bad:** In your torso, between and around your organs or 'viscera'. Also known as "visceral fat", abdominal fat, or the omentum. Caused by the same things as organ fat.
- **Body fat that is not unhealthy:** Subcutaneous fat under your skin over your entire body. 'Sub-Q' fat accumulates while we are in the womb and in those who overeat very healthy food and are highly active.

Clearly, unhealthy food can result in fat accumulating in the worst places whether the person looks overweight, thin, or even cadaverously thin. Disease risk does not come simply from being "overweight". However, if a person has a large amount of body fat, it is a near certainty that some of that fat will be unhealthy. Only in the womb can we gain sub-Q fat without accumulating organ and visceral fat because in the womb, while receiving nutrients via our umbilical cord, our intestines are not dumping calories onto our liver and visceral fat. Our portal system is bypassed.

Diseases caused by specific types of body fat

Organ fat: Fat accumulation in the walls of arteries, called atherosclerosis, contributes to circulatory diseases, including primary hypertension, stroke and heart disease.

Organ fat: Kidney and liver disease are correlated to fat accumulation within those specific organs, which generally but not necessarily occurs coincident to fat accumulation elsewhere in the body.

Visceral fat: Type II diabetes and insulin resistance (a pre-diabetic state) almost always occur with visceral fat accumulation because they are mechanistically linked. The fact that visceral and organ fat accumulation occur simultaneously leads to many disease risks increasing at the same time, including those falling under the umbrella of "metabolic syndrome" (obesity, diabetes, cardiovascular disease and high blood pressure) as well as stroke, liver disease, kidney disease and cancer.

In the case of cancer risk, inflammatory signaling processes that occur from excess body fat and separately from a poor diet are detrimental. Poor diet in this case means an excess of carbohydrate and/or saturated fats and a low intake of phytonutrients from natural foods as opposed to supplementation. Therefore, not only is a poor diet problematic, but so is weight gain from a poor diet.

How do you know what type of body fat you have?

The best way to determine your sub-Q versus visceral body fat distribution is by CT scan (computed tomography), DEXA (dual-energy X-ray absorptiometry) or MRI (magnetic resonance imaging). Imaging techniques also provide detailed information on blood flow and arterial fat accumulation. But there are some simple ways to tell where your fat is:

- Look at your waist size, not just your weight. Visceral fat is in the abdomen.
- If you have visceral fat, you are likely to have organ fat accumulation.
- A high triglyceride, LDL/HDL ratio, and/or blood pressure are indicators of organ fat accumulation regardless of how thin a person is ("fat on the inside, thin on the outside").
- Sub-Q fat will dominate when a newborn and when not obese and body fat is evenly distributed.

What can you do about it?

Use the Bucket Brigade (moderate amounts of healthy food) to channel fuel away from unhealthy fat and to active tissues. For added energy, mental focus and metabolism, eat several times per day and stay hydrated. Together, these are the cornerstones of "What, When and Water".

What, When and Water

The Bucket Brigade Principle tells us ***what*** to eat (the Fantastic Four) and not to overeat so that we don't overload our bloodstream and active tissues. There are 2 additional aspects of nutrition required for optimum energy, mental focus and tissue health: We must eat and hydrate at least a few times per day to keep our active tissues from going into starvation and dehydration. Our tissues cannot store sufficient amounts of protein, carbohydrate or water to eat or drink only once or twice per day.

Overeating at any one meal just increases body fat and does not result in extraordinary levels of protein or carbohydrate storage, so we run low on these macronutrients within roughly 6 hours. Similarly, over-hydrating results in going to the bathroom shortly thereafter, not in extra water storage. As a result, we should eat and hydrate evenly throughout the day. Key meal times to consider are breakfast to "break the fast", mid-day to fuel your body without a blood-sugar swing that makes you tired in the afternoon, and dinner long enough before going to sleep to avoid body fat gains as your day winds down. What we eat is important, but when we eat and hydration are important as well. These 3 cornerstones of healthy eating can be summarized by the phrase "What, When and Water".

Why eating has become so complicated

In the modern food environment, we are surrounded by processed and fast food. As we are all very busy, the convenience of these foods is a necessity. They also taste good to us since they are loaded with sugars, fats, salt and are low in vegetables. Unfortunately, trying to optimize convenience, taste and health is not possible. A salad doesn't taste like cake, it takes longer to eat, and it doesn't keep as well. However, the problem is not insurmountable because the body can handle plenty of less healthy food as long as healthy food is included in the diet.

With this in mind, we just need to know our limits and what specific food ingredients to avoid. In other words, in a simple world we would just eat balanced meals, but in the modern world we must also know what additives are toxic. Surprising examples of toxicity are margarines, many of which contain trans fats, fish, some of which contain mercury, and peanut butter, some of which contain a liver carcinogen from a fungus that grows on pulses. Larger amounts of sugar and saturated fat are, in the long term, also toxic. And even the healthiest things we can put into our bodies, such as water and omega-3 fats, can be dangerous when consumed in very large amounts. Ultimately, nutrition is about moderation in all things, with some things being better than others.