Various Metabolism Factoids From Jason Fung, MD and Others

This is a collection of some rather random thoughts on fasting, along with some tips gleaned primarily from Jason Fung's books.

I haven't been so excited about nutrition books since maybe 15 years ago when I first read The Art and Science of Low Carbohydrate Living and The Art and Science of Low Carbohydrate Performance.

What Fung commonly recommends is a 30-36 hour fast - sometimes 42 hours. Longer if you have significant weight to lose or are very deep into type 2 diabetes and need to get right fast.

A typical recommendation is to have a normal evening meal, then don't eat the next day. Eat the following day at breakfast (36 hours) or lunch (42 hours). Have water, tea, coffee, water with a very tiny bit of lemon. Stay hydrated. Do it on a day that you are going to be busy. The distraction helps.

There are two major adaptations that I see being needed. If you are used to eating a higher carb diet, it might be more difficult to get your insulin level down so that you can access your own body fat for fuel. Fasting is boot camp for that issue. It works fairly quickly, but you might have some issues in the beginning as your body figures it out.

If you are already on a lower carb diet, your body is probably used to burning fat at least somewhat. For me, the AM bulletproof coffee provides 500 calories of fat. I use that for fuel, no problem. The issue for me initially was that when my stores of glycogen started to run out at about the 24 hour mark, when I am on a water and tea fast, my body had to access my own body stores of fat, rather than the relatively larger quantities of fat I had been eating on a lower carb diet. I believe that that system was a bit rusty. The second time I did the fast was much easier than the first.

What I am going to aim for myself is to do a 48-60 hour fast every 2-3 weeks rather than do frequent short fasts.

As Fung says, fit the fasting into your life rather than the other way around.

Low calorie diets slow metabolism.

Inadvertent calorie restriction happens when you start a low carb diet and you don't know how to do it. You must increase your fat intake to compensate for the decrease in calories. There is so much fat phobia that this is often a heavy lift. Plus, people just don't know how to increase fat.

If you restrict calories and don't periodically fast, metabolism will slow and stay slow. Calorie restriction while fasting seems to not present this problem. If you restrict calories but then periodically fast, metabolism stays in the fast lane.

Fasting may jump start metabolism that is stuck in the slow lane.

One of the effects of the fuel crisis is that you can't get adequate energy into the cells. The net result is that you think about food all the time.

Perhaps we crave food because the slowed metabolism makes us feel like our energy is draining out.

The Obesity Code

In Ancel Keys starvation experiment, the participants were started at 1570 calories per day, with this adjusted downward to keep a weight loss of 2.5 pounds per week on average. More and more severe calorie restriction was needed to keep the weight loss at 2.5 pounds per week on average.

Resting metabolic rate dropped 40%. Strength decreased 20%. Body temperature dropped to an average of 95.8.

Emotionally, there was apathy and inability to focus on anything but food.

Typically the body will adjust calories burned to match what is taken in.

The calorie expenditure will not increase back to normal as calorie intake increases back to normal - even after a year. The net result is weight gain. The hormones of satiety also stay low for a long period after long-term calorie restriction.

Leptin is produced in fat cells. This provides a signal that the cells are full. Leptin is actually quite high in obesity. In addition to insulin resistance, leptin resistance is also characteristic of obesity.

There are two hormones that reliably cause weight gain - insulin and cortisol.

Carbs and protein raise insulin levels, but protein does little to raise blood sugar. Fats don't raise insulin.

(A question that I have is that if people fast 16 hours, is it necessary to eat 2000 calories to keep the metabolic rate up? Is this enough time to prevent the hypocaloric decrease in metabolic rate?)

The metabolic set point is not the weight set point. In other words, you can be fat, very fat even, and have a very slow metabolism.

To hasten your body's transition to burning its own fat, exercise, especially during the first 24 hours of a fast. The body has about 24 hours worth of fuel stored as glycogen generally. When you exercise, you will more rapidly burn through this glycogen, stimulating your body to actively burn fat stores.

If you have symptoms of hypoglycemia, what this means, generally, is that you are having great trouble accessing fat to burn, that is, trouble making the transition to fat burning mode.

(In people with strong insulin resistance, bulletproof coffee or tea with Brain Octane oil throughout the day the first day of fasting to provide a ready source of energy that bypasses the insulin blockade may be very helpful. In time, as the insulin levels come down and stay down, this will not be necessary.)

Skipping meals can just mean a low calorie diet. Doing this with no access to fat or no decrease in insulin can mean a slowed metabolism. Without a longer period without food, low food intake will probably decrease metabolism. This will especially be the case if your diet tends to raise insulin and keep it relatively high.

Constant snacking with a low calorie diet could mean the same thing.

High insulin levels increase the body fat set point. Obese people have a much higher fasting insulin than normal weight people. In lean people, insulin returns to baseline much quicker than in obese people.

Both fasting insulin and fasting leptin levels are high in obesity. In lean people, leptin levels rise with eating. In obese people, they actually fall.

Elevated cortisol levels raise blood glucose and subsequently raise insulin levels. With chronic stress, glucose levels remain high. Prednisone increases glucose levels by 6.5% and insulin levels by 20%.

A night of sleep deprivation increases cortisol by more than 100%. It is still elevated the next evening.

Low fat diets slow body metabolism the most.

It is the processing of carbohydrates that causes the problems with insulin excess and weight gain. A high carbohydrate diet in the absence of refined carbs, especially sugar, will not cause weight gain, at least in people raised on that type of diet. Some populations eat 85% carbohydrate diets and have virtually no obesity. They have virtually no refined carbohydrate intake either.

The development of insulin resistance depends on persistent high levels of insulin. Eating processed foods frequently throughout the day can result in persistently high levels of insulin.

Fructose does not raise blood sugar. It has a very low glycemic index actually. It raises insulin only slightly.

Fructose can only be processed in the liver. It is converted into fat. Fructose in excess will cause fat to accumulate in the liver. *Only six days of excess fructose will cause insulin resistance. By eight weeks, prediabetes develops.*

When the liver gets stuffed with fat and sugar, insulin can no longer get rid of excess blood sugar through the liver. It backs up into the bloodstream. We call this insulin resistance, but actually it is much more of a problem of a backup than actual resistance. Because the blood sugar increases, insulin increases.

Insulin secretion is stimulated strongly by carbohydrates and by certain proteins. Dairy protein and whey are especially effective at raising insulin, mostly by affecting some hormones produced in the stomach in response to eating.

Dietary fat stimulates insulin the least.

The same stomach hormones than cause insulin to go up also cause you to have a sense that you are full. So, these incretins cause your insulin to go up, but they also cause you to have a sense of being full.

Large amounts of lean meat, skim milk, and protein bars can inadvertently stimulate insulin, as can increased meal frequency.

The common theme in obesity is hyperinsulinism. Sugar increases insulin in both the short term and in the long term.

To break the insulin resistance cycle, we need to have periods of low insulin.

Fasting is one of the best ways to ensure that insulin levels drop. Fasts of 24-36 hours are a good place to start.

Phases of fasting:

- Feeding
- Post absorptive phase (6-24 hours after fasting starts)
- Gluconeogenesis (24-48 hours)
- Ketosis (one to three days after fasting starts)
- Protein conservation phase (after 5 days)

Longer fasts reduce insulin dramatically. Alternate day fasts are an acceptable way to reduce insulin levels.

In response to a four day fast, energy expenditure *increased* up to 14% in one study.

Alternate day fasts and complete fasts do not decrease metabolic rate. It is as if the body fat stores are opened up and there is an abundance of energy available, so the body senses no need to slow metabolism.

What to drink on fasting days:

- Water, still and sparkling 2 liters a day
- Start with 8 ounces of water in the AM
- Lemon or lime - a bit - can be added for flavor
- Dilute apple cider vinegar
- Tea of all kinds
- No sweeteners or sugars in the tea
- Coffee
- Broth with salt

It is good to exercise during a fast.

If you get headaches, you may need more salt.

Changing a fasting routine can help you to break through plateaus.

The Complete Guide To Fasting

Gluconeogenesis is most active beginning 24-48 hours into a fast. Glycogen has begun to run out, (though it is never lower than about ½ the usual stores if I remember right. I believe that Attia talks about this.)

At 2-3 days, ketosis becomes more prominent. Fat is accessed from fat cells and is broken down. Fatty acids are used by most of the body for fuel, but not the brain. The liver makes ketone bodies, which easily cross into the brain. The glycerol backbone of the triglyceride is used for gluconeogenesis.

By five days into a fast, the body has transitioned to a protein conservation phase. High levels of growth hormone maintain muscle mass and elevated NE levels prevent a slowdown of metabolism.

All foods raise insulin to some degree, carbs the most and fats the least. (I suspect that the rise after fats is because of the cephalic phase where insulin is released in anticipation of a carby meal, or perhaps just the anticipation of any food.)

Fasting is the best way to lower insulin levels.

Eating, even eating a low calorie diet will suppress growth hormone levels. Overeating suppresses growth hormone up to 80%.

There is pulsatile release of growth hormone in the AM which is augmented by non-pulsatile growth hormone release when fasting for longer periods.

Training in a fasted state may promote faster recovery.

BMR will decrease in chronic low calorie diets. Reductions can be upwards of 25-30% in someone going from 2500 calories to 1500 calories per day.

By contrast, overeating can increase BMR.

In a fasting state, metabolism increases as your body comes to access fat stores which can be quite large. (The body senses that times are good. Plenty of energy is available.)

In one study, four days of continuous fasting increased BMR by 12%. Norepinepherine is increased by 117%. Fatty acids in the bloodstream increased by 370%.

It is the increase in growth hormone that helps the body retain muscle while fasting.

The body retains amino acids and essential fatty acids while fasting.

The issue with high insulin is that with it, any excess calories go into fat storage, and with high insulin, fat cannot be mobilized for use as fuel.

(My extrapolation from a point Fung makes is that because the body cannot easily access fat for fuel, the body experiences periods of relative “starvation” every day. Metabolism will slow even in the face of a higher calorie diet. Either the insulin has to come down so that we can access fat, or we have to eat, 24/7, just exactly what the body needs moment to moment. Any bit of excess calories in a given moment will send the calories into the fat storage bin, never to be retrieved.)

Protein, especially animal protein raises insulin.

A low carb diet can lower insulin by 50%. Fasting reduces it even more.

Diabetic ketoacidosis happens when insulin levels are low (as in type 1 diabetes) and blood sugar is very high. The brain will burn the glucose, and the ketones will build up. This is a very dangerous situation that only happens when insulin is too low - a situation only found when the pancreas is non-functional in making insulin. Occasionally, at the end stages of type 2 diabetes, the pancreas is burned out and insulin is no longer produced.

Cortisol is largely unchanged even in a 72 hour fast.

Fat loss during fasting is about ½ pound per day.

Fasting preferentially removes visceral fat, the fat around the organs.

In type 2 diabetes, the cells are already packed with glucose, so even with high levels of insulin, glucose builds up in the blood.

BDNF is elevated by fasting.

Increased levels of glucose, protein, and insulin all shut off autophagy. All of these activate mTOR. mTOR is only affected by short term energy, not stored energy such as glycogen and body fat. Fasting is the single strongest stimulus to autophagy. Fasting also activates growth hormone so that new cell structures are more easily formed.

Hunger diminishes over time as you fast recurrently.

Part of the problem with hunger is that we are so conditioned to eat, to snack, that we lose connection with a more natural rhythm of hunger. Instead of snacking, have some tea. The hunger will pass. Hunger comes in waves. Just ride out the wave.

After one or two days, hunger tends to diminish.

A 12-hour daily fast may be enough to keep a thin person thin, but not enough to help with needed weight loss.

A daily 16-hour fast combined with a low carb diet has much more power than a 12 hour fast.

Dinner raises insulin 25-50% more than breakfast despite similar food intake.

Ghrelin, the hunger hormone, peaks during the first two days of fasting, then steadily falls.

An optimal strategy might be to eat your largest meal between noon and 3PM, and only a small amount in the evening hours.

You could do 24-hour fasts several times a week.

You could do 36-hour fasts 3x a week, continuing until you have the results you want. Here you have dinner, finishing by 7PM, skip all food the next day, then have breakfast at 7AM the day after. Have lunch and dinner, then fast again until 7AM 1½ days later.

A 42-hour fast would have you eat dinner by about 6PM, skip all food the next day, breaking your fast at noon the day after.

Diabetics often have a low blood magnesium.

Fit fasting into your life rather than fitting your life into your fasting.

Dizziness during a fast is often due to dehydration. You need water and salt, sometimes lots of salt. The salt to use is sea salt. You can take ¼ teaspoon of salt in some water and drink it. Drink more water.

Fasting will improve your muscle's ability to burn fat. This takes time, but once your body figures this out, you can use fat for muscle fuel quite readily.

The Dawn Phenomenon is the occurrence of high blood sugar in the morning, even while fasting. This is related to the AM increase in growth hormone, glucagon, adrenaline, and cortisol. Eventually the stored sugar will diminish.

The Diabetes Code

Insulin triggers the liver to convert excess sugar into fat in the form of triglycerides. Insulin is the signal that says to stop burning sugar and fat and store it instead.

When the liver is full of glycogen, the triglycerides are packaged with a protein and released into the bloodstream as VLDL. Insulin inactivates lipoprotein lipase which tells the cells away from the liver to remove the fat from the bloodstream and to put it into long term storage.

There is good evidence that hyperinsulinemia directly causes weight gain.

Steady elevated levels of insulin create insulin resistance.

Hormones are pulsatile. Hormones generally stay low and are released in bursts. High steady levels are problematic.

Thus hyperinsulinism causes insulin resistance, obesity, and diabetes.

Receptors are not defective in insulin resistance. Insulin is not defective either.

What happens is that lipogenesis continues at an accelerated rate because of the presence of high levels of insulin. So much new fat gets generated that there is nowhere to put it. Liver fat increases. The liver cells are overflowing with sugar, so much so that the glucose spills out into the blood. The cells are not internally starved. They are overloaded with glucose. Insulin continues to rise.

Too much sugar and fructose causes fatty liver, the key cause for insulin resistance.

Fatty liver and insulin resistance precedes the diagnosis of type 2 diabetes by a decade or more. The hyperinsulinemia keeps blood sugars normal early in the course of fatty liver and insulin resistance.

The main culprit for fatty liver is high levels of dietary fructose.

Besides fatty liver, hyperinsulinemic patients can develop fatty muscle and fatty pancreas.

In the year 1900, average consumption of fructose was about 15-20 grams per day.

By 1977 it was up to 37 grams per day.

Per capita consumption of added sugars has reached almost 55 pounds per year.

Fructose overfeeding can increase liver fat 38% in only 8 days when fructose is substituted for all sugar. Fructose does not raise blood sugar directly. Pound for pound fructose is about 34x as likely to cause fatty liver as glucose. Recall that white sugar or sucrose is half fructose.

Where people eat a diet high in unrefined carbohydrates but low in sugar, obesity and diabetes are relatively rare.

Fructose can only be metabolized in the liver. If the energy needs are met, the fructose is turned into fat.

Further Thoughts

Iodine will decrease weight initially by stimulating metabolism.

From WIKI: In humans, defects in the tight control of glucose uptake and utilization are also associated with diabetes and hyperglycemia. Patients with type 2 diabetes

normally exhibit low glycogen storage levels because of impairments in insulin-stimulated glycogen synthesis and suppression of glycogenolysis.

With chronic undereating, I suspect that if you do this with relatively constant stimulation of insulin levels - through snacking, through stress and lack of sleep, then you will have metabolic slowing. If you do this without snacking, without stress or lack of sleep, perhaps the metabolism will stay normal, or even elevate because you have access to your body fat.

Insulin tells fat cells to store fat. When insulin is down, fat cells mobilize fat into the bloodstream to fuel metabolism.

Fung's Podcasts:

You need good quality, full meals that leave you satisfied. If you are hungry in 2 hours, you didn't eat enough. No half meals when you eat.

High levels of insulin do not cause insulin resistance. Persistent high levels do.

A smaller window for eating is a key to helping insulin resistance.

(I wonder again - if your insulin resistance is improved by meal timing and fasting, will eating an inadequate amount of food lead to metabolic slowing, or does the access you have to your own body fat keep this from happening? I suspect that the latter is the case.)

CCK levels increase with fat intake. CCK is a satiety hormone, amongst other things.

Protein increases peptide YY and incretins.

Insulin prevents you from accessing your own body fat.

(If you eat low calorie and what you eat raises insulin excessively, you will not be able to access fat and your metabolism will slow. If you eat low calorie, but your diet is high fat with your insulingenic foods in 1-2 meals, you may be able to access fat and your metabolism will not slow as readily.)

(For high insulin people who struggle with fasting, in the first few days until the insulin comes down, perhaps you could have them do BP coffee or tea 3-4 times in the day-about 2000 calories worth. When insulin comes down, you can switch to water or tea. Just remember that in all likelihood, the machinery that helps you access fat is probably suffering from disuse atrophy and will need to be upregulated.)

Sugar, refined carbs, and fructose will eventually cause a fatty liver, which in turn cause insulin resistance in the liver.

If you are having a big problem with fasting, have half an avocado every 24 hours. (Or do the BP coffee as noted above.)

Pickle juice is available on Amazon. Pickle juice can help those that feel washed out from lack of salt.

If women have a strong increase in appetite after exercise, have them eat before. It will blunt this strong response.

The main nutrient signals are:

- Insulin
- mTOR
- AMPK

mTOR signals that there is a supply of amino acids available.

AMPK rises when cellular energy decreases. When ADP goes up or the ratio between ATP and ADP changes in a certain way, AMPK is increased.

Insulin acts over minutes to hours. mTOR acts over days. AMPK acts over weeks.

A low carb, higher protein diet may help with blood sugar and weight loss, but protein is still a strong insulin signal and mTOR signal. AMPK will not change.

A ketogenic diet with low carb and moderate protein will decrease signalling of insulin and mTOR.

Keto with intermittent fasting will decrease insulin and mTOR, and will raise AMPK.

Metformin increases AMPK, which will increase fat burning and decrease gluconeogenesis by the liver. This can decrease the growth pathways in cancer.

You maximize autophagy with 24-36 hours or more of fasting.

Training in a fasted state takes advantage of the increase in norepinepherine and growth hormone.

When keto-adapted, the body clears lactate much faster. The transporters for lactate are upregulated when the transporters for ketones are upregulated.

Peptide YY expression is sensitive to protein intake.

CCK is sensitive to fat intake.

Incretins slow the movement of food through your gut. You feel fuller for longer.

If you are eating less than 2000 calories and are not losing weight, chances are that your metabolism has slowed.

Exercise uses up glycogen, pushing you into keto mode more quickly.

(If you are having trouble burning the fat that you eat, or are having trouble adapting your fuel source to being fat instead of carbohydrates, you may be having trouble getting the fat out of your blood and into the cells, or from the cells into the mitochondria within the cells. These two processes require pantothenic acid and carnitine. You may see greasy skin or hair, or bad odors around your body.)

(If you are having trouble with feeling somewhat nauseated on a higher fat diet, you may be having trouble absorbing fat because of a poorly functioning gall bladder. Here you may see greasy stools or a sheen on the water in the toilet after a bowel movement.)

(Difficulty with sleep with fasting may be an indication of being unable to mobilize fat for fuel efficiently. This will probably clear in time. It may be helped by pantothenic acid and carnitine.)

Longer fasts may be necessary for people who have long eaten low calories diets and whose metabolic rate is low. It is as if they get really good at being in a low calorie/ low metabolic state.

A fat fast will help blood sugar but not as much as a water fast. In more serious cases, there will be a plateau in these situations.

A fat fast is especially helpful after a carb binge where there is a lot of water weight gain. The fat fast will be easier to tolerate than a water fast in this situation because there is less disruption in electrolytes. Another option is to do the water fast a few days later.

In someone with mild insulin resistance, 20-30 pounds overweight, a fat fast will help bring back balance to the system.

In someone with strong insulin resistance, even the small amount of fat and protein in broth might be enough to stop the healing. These people need water fasting.

Keto rash is a skin issue that comes up sometimes in people on a strict ketogenic diet. Megan, Dr. Fung's nurse, thinks that it is related to yeast. She has the patient add back about ½ cup of blackberries, raspberries, or strawberries daily for a while, which will increase sugars just a bit. She has them drink 6 tablespoons of raw apple cider vinegar diluted in water through the day, and make a 50:50 mix of vinegar in water and use as a wash over the affected areas 1-2 times a day. Keep up the fruit for about a week. Vinegar kills off Candida in the gut.

Breaking an extended fast: Can use chia seeds soaked in water for ½ hour or psyllium.

Nuts are high in phosphorus.

Nuts are not good to use for breaking a fast. They are hard to digest.

Fat loss can stall due to:

- Eating after satiation. Perhaps eating too quickly to allow your physiology to catch up to the feeling of satiation.
- Too many carbohydrates or too much protein
- High insulin with insulin resistance
- Low metabolic rate from yo-yo dieting.

Some people like to eat one meal a day. It is important to do what feels good to you. It is not a competition to eat the least. Some obese people have a very high metabolic rate (because of having to fuel a very large body) and eating only one meal a day will result in a kind of metabolic burnout.

People who do best on one meal a day are those with a normal metabolic rate, who are obese or overweight.

(I suspect that it is not even important to eat a keto diet so long as your insulin drops after you eat.)

You can eat keto and still run a high insulin. This was noted in one woman during the podcast. She ate a ketogenic diet perfectly, but still couldn't lose weight. She was still insulin resistant even on this diet. She needed to fast.

Do not discount the effect of chronic stress. This will sabotage all efforts at weight loss.

With high levels of insulin, the kidneys retain more sodium. When you start to decrease insulin, at least initially, your body will clear out sodium - perhaps too much sodium.

(How long does it take to rebuild a normal, non-fasting metabolic rate? I wonder if this is what happened with the Dutch hunger winter babies - the mom's were starving and their metabolic rate slowed. Epigenetically, the babies had the same condition.)

An obese pregnant mother will have very high insulin and very high glucose. The insulin doesn't cross the placenta while glucose does, flooding the baby, causing macrosomia, etc.

(It is very important in those who are fasting that they get a good amount of fiber when they are eating. This will keep the gut bacteria healthy. Healthy gut bacteria will keep your gut wall healthy. If you are avoiding grains and beans, eat plenty of vegetables, and perhaps add in some psyllium, inulin and acacia powders.)

My thoughts on what to do when one has no appetite

These people are probably not eating enough to keep metabolism going. This can be related to an age related loss of appetite. Part of what is happening is that ordinarily we require at least 1800-2000 calories per day just to keep the lights on in the body. When you chronically eat less than that, your body will adapt by slowing metabolism and limiting tissue maintenance and repair to critical items. So, everything slows. Hair doesn't grow or it falls out. We feel sluggish, perhaps cold.

The difficulty here is that it is hard to eat if you are not hungry.

One thing to do to help your appetite is to start your day with warmish water with some lemon. You can buy lemon juice in bottles at the co-op. Take 10 drops of Sweetish Bitters in a small amount of water. Swish it around in your mouth, then swallow it. Do this about ½ hour before meals.

Don't eat until you get hungry.

When you do eat, favor very high calorie foods- foods with plenty of fat- butter, avocado, meat fat, etc. Put plenty of olive oil- 2-3 tablespoons or more on your salads. Make sure to eat the oil at the bottom of your bowl. Eat cheese. Consider buying the pre-made guacamole. You can have some whole grain rice or potatos with plenty of added butter.

Exercise helps to activate hunger and digestion.

My thoughts on supplements that could help - Pantothenic acid and carnitine

- Coenzyme A is used at the cellular level for fatty acid oxidation. Acetyl CoA combines with the fat, making it ready to be transported into the cell, where it is then taken into the mitochondria via the carnitine shuttle.
- Vitamin B5 or pantothenic acid increases the production of coenzyme A.
- The more Co-Enzyme A, the more fatty acids can be metabolized, which means they are oxidized or burned up as energy production.
- Co-enzyme A is a combination of B5 and adenosine diphosphate or ADP.

- L-carnitine helps transport fatty acids across the mitochondrial membrane.
- Transport is the rate-limiting step in fatty acid beta oxidation in the mitochondria.