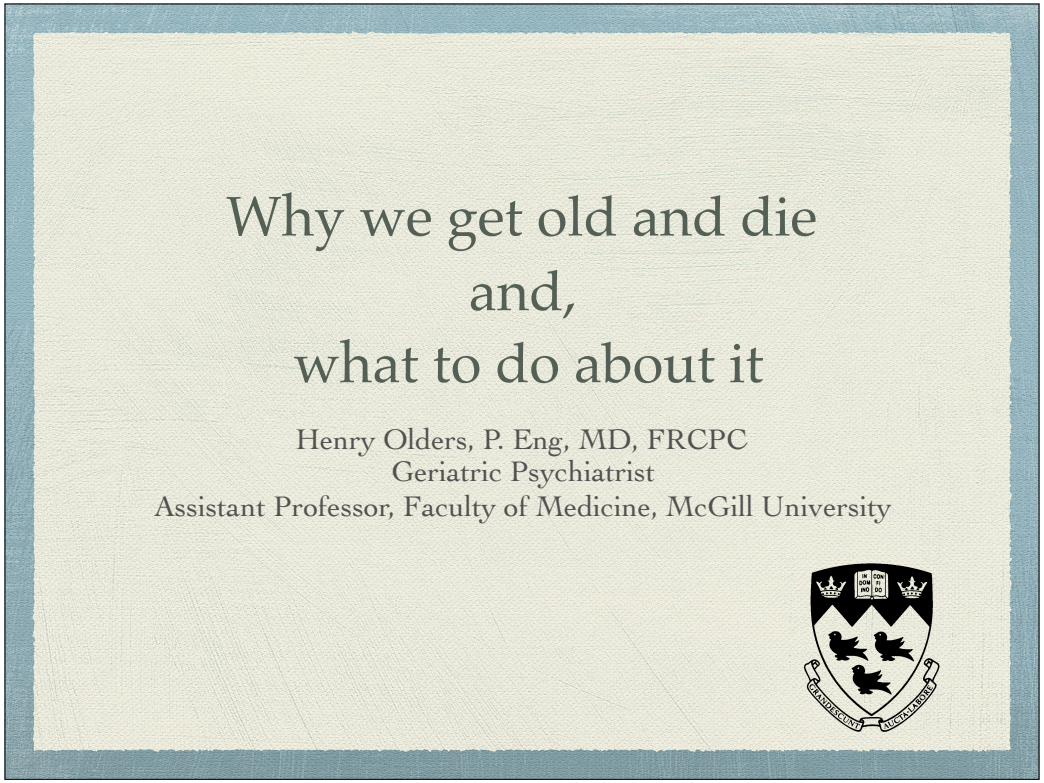


The diseases of aging include cancer, heart disease, dementia, arthritis, cataracts, osteoporosis, and stroke. Oh, and type 2 diabetes.
It is likely that all of us have relatives or friends with these afflictions. Possibly even ourselves!

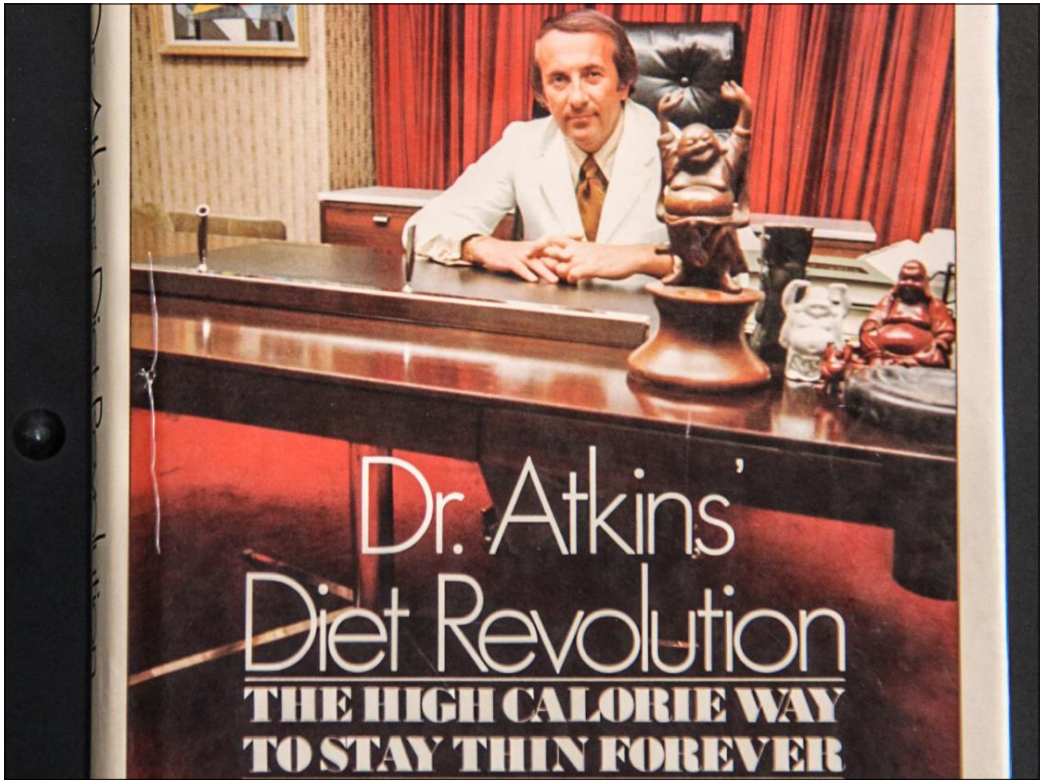
As a physician and engineer, I've been looking for answers: what causes these disorders? And what we can do to prevent or treat them? Recently, finding some answers has become urgent. My dear wife Helen was operated on for colon cancer last year, then had 17 cycles of chemotherapy, and is now in a research study using immunotherapy.

What I've learned so far has greatly surprised me! But it's also made me very hopeful, and I'm really excited to share my insights with you.

Now, I like to talk. When I get into too much detail, my daughter is, like, “Daddy! Oversharing!!” and rolls her eyes. So I’ve had to really pare this presentation down to the essentials.

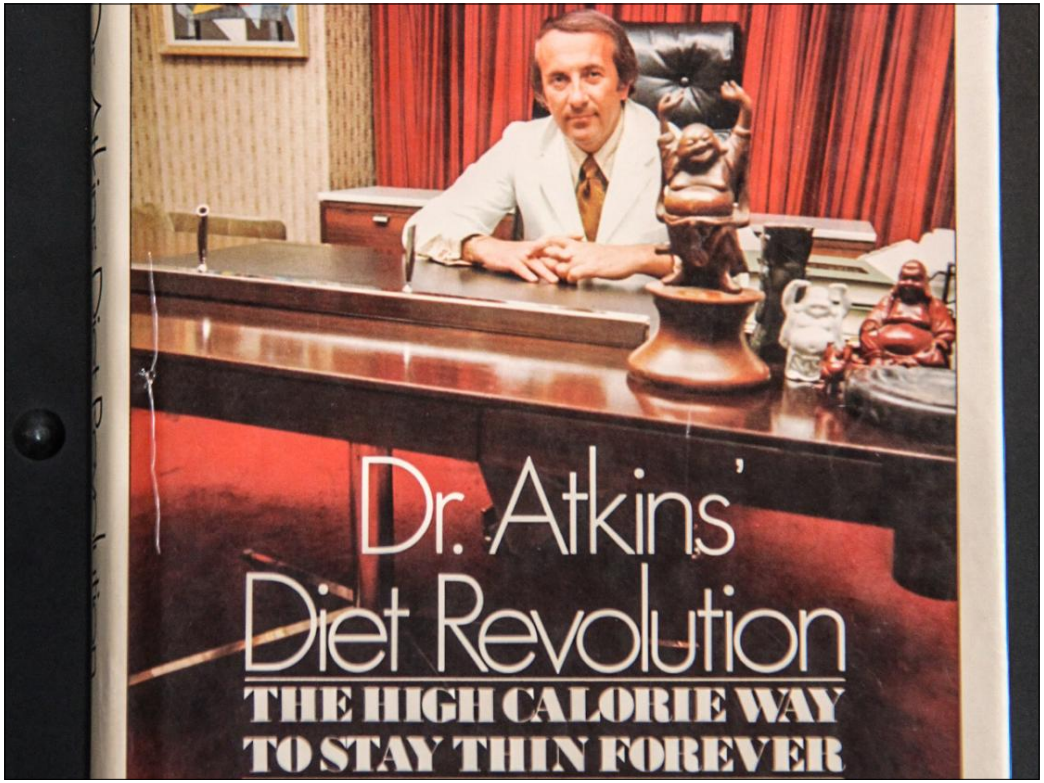
Here’s my story. Since grade school, I’ve been overweight. It affected my sports participation, hurt my self-esteem, and impaired my relationships. After my first child was born in 1970, I quit smoking, and I added ten pounds. I suspect some of you can relate.

Then, in 1972, I read this book by a New York city cardiologist, Dr. Robert Atkins.



“Dr. Atkins’ Diet Revolution: The High Calorie Way to Stay Thin Forever.”

At the time, there was a great deal of controversy about this diet. It was condemned by pretty well the entire medical establishment. But that just stimulated my contrarian nature! I looked up the references in his book. Journal articles reporting solid research. No (air quotes) “alternative facts”! No “fake news”!



I started on his diet, and guess what! It worked! Not only did I rapidly lose 20 pounds, I was able to keep them off, but only as long as I stayed on the diet.

Why did this diet work? As the book subtitle suggests, Dr. Atkins believed you could be thin even when eating lots of calories. But **what** you ate was critical.

As Dr. Atkins explained, eating carbohydrates, carbs for short, stimulates our bodies to make **insulin**. Insulin is a hormone which tells our cells to absorb sugar from our blood and store that sugar as energy. In the case of muscle cells, the sugar is stored as glycogen, but fat cells turn the sugar into fat.

If you eat very little carbohydrate, you produce very little insulin, and as a consequence cannot put on weight. What's more, your body fat will be used as fuel by the body. That's how I lost those 20 pounds!

But, the Dr. Atkins diet was **not** a revolution, as he claimed in his book title. In fact, low-carb dieting for weight loss had already been written about as far back as the 1800's. But back then, they hadn't yet discovered insulin.

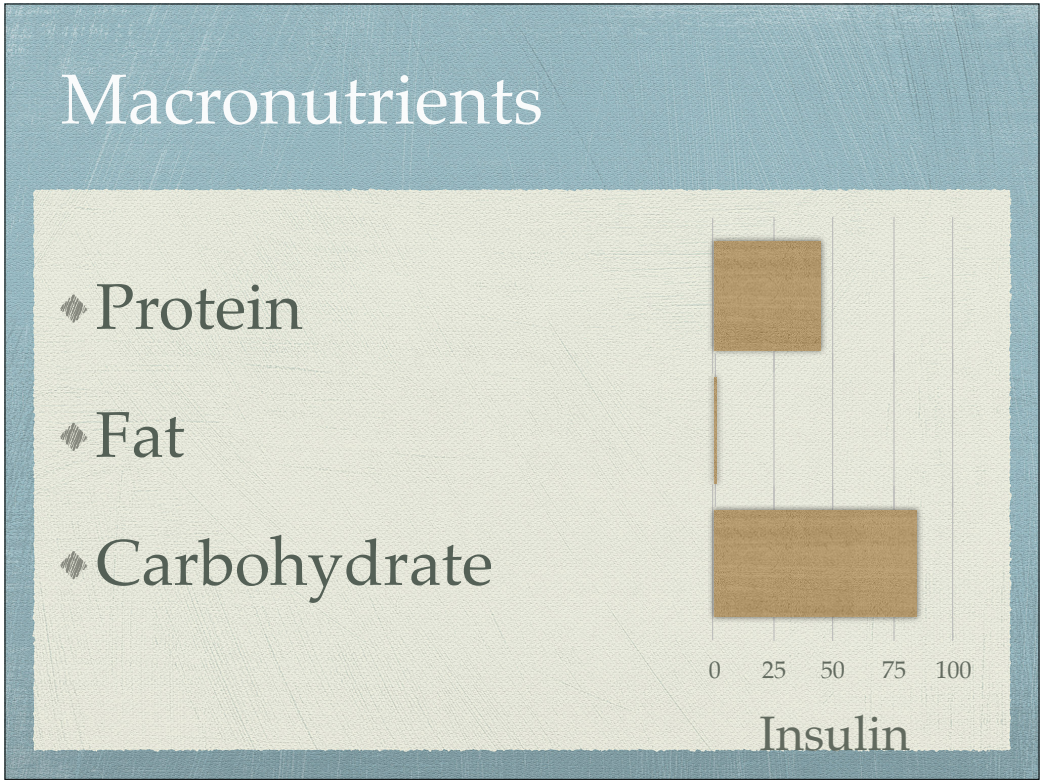
Insulin was successfully isolated only in 1922. A Canadian discovery, no less! Charles Banting and Frederick Best managed to extract insulin from a dog pancreas and used it to treat a young boy with diabetes. They saved his life! This was huge! Nobel prize huge!

Prior to this game-changing discovery, children with what we now call Type 1 Diabetes would invariably die at a young age from their disease, also called Juvenile Onset Diabetes, or sometimes insulin-dependent diabetes. (I gotta say, wouldn't it be nice if the doctors could at least agree on terminology?) No matter how much they ate, even 10,000 calories a day, these kids would lose weight, waste away, and literally starve to death. All because they were unable to make their own insulin. After 1922, insulin injections literally saved lives!

The take-away message? For weight gain or loss, it's not how **much** you eat, it's **what** you eat that counts. Because **what** you eat controls how much **insulin** your body produces.

Sorry! I couldn't resist!

OK, what do we eat? Here’s the nitty-gritty. Our diets are made up of just three macronutrients:



protein ➽, fat ➽, and carbohydrate ➽.

Eating carbs stimulates insulin secretion ➽. Protein does too, but less ➽. Fat by itself does not stimulate insulin secretion ➽. So if you eat a lot of carbs, you will produce a lot of insulin, which will stimulate a lot of fat storage and lead to overweight and obesity. But not in everybody! Genetics is important, too.

So, what are carbs? Sugars..., starches, and... No, that's it. Just sugars and starches!

There’s added sugars,

and natural sugars found in fruits and many vegetables,

and then there’s starches found in foods like breads, pastas, grains, beans, and root vegetables.

OK, I lied. Sorry! Besides sugars and starches, there's also a kind of carbohydrate called fibre. But because fibre is not absorbed in our gut, it's not considered a nutrient.

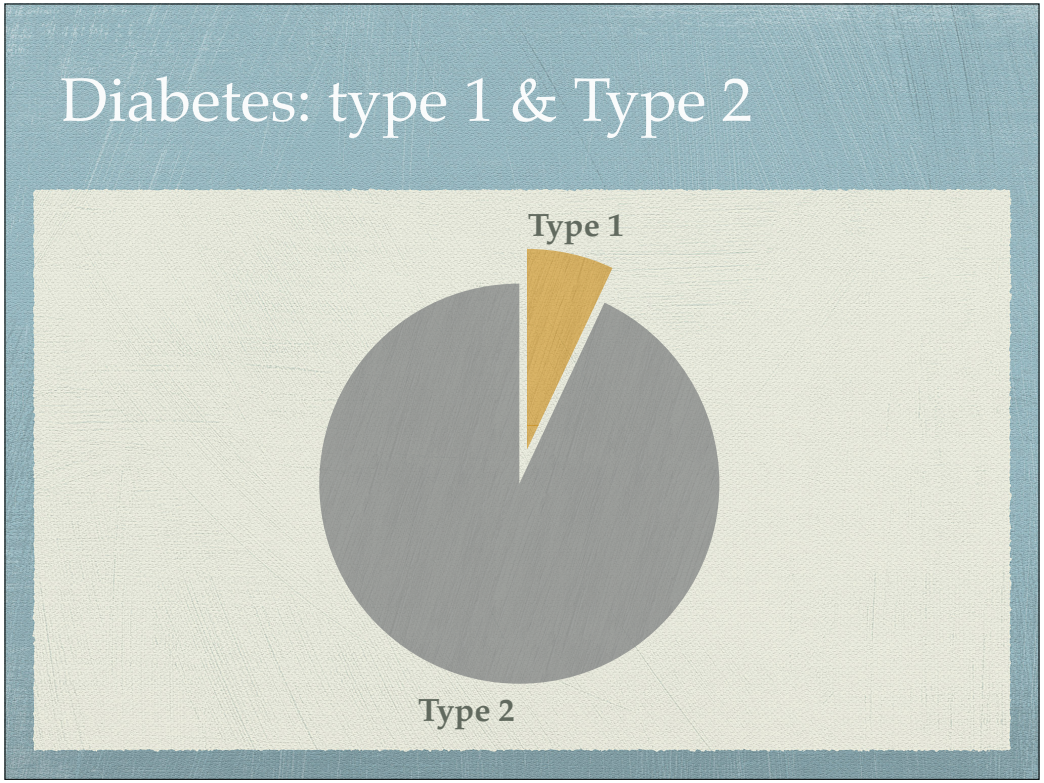
It’s important to note that Dr. Atkins said to replace carbs with fibre from fruits and vegetables, with dietary fats and oils, and with some protein. But starting about 1985, doctors began saying that fats in our food were bad and contributed to cancer and heart disease. These doctors caused the American people to have a terrible fear of dietary fat.

Fat phobia was king for at least 20 years! And not just in the United States! We Canadians were badly infected by the fat phobia meme.

And many dieticians and nutritionists continue to tell their clients to eat low-fat, even now!

So people trying the Atkins diet felt that they couldn't replace carbs with the dreaded fats and oils. But the alternative, replacing carbs with protein, was not very effective for losing weight. So the Atkins diet fell out of favour.

But well before fat phobia took hold, I'd graduated in 1981 from McGill medical school, where I had learned more about insulin and diabetes. First, those children who cannot make insulin, the so-called type 1 diabetics,



only make up less than 10% ➽ of people with diabetes.

The vast majority, more than 90% ➽ and still increasing, have what was then called adult onset diabetes, and now is known as type 2 diabetes. Most type 2 diabetics are obese when they first become diabetic.

How did they become obese? Eating too much sugar and starch! This stimulated excessive insulin which then caused sugar in the blood to be stored as fat. Excessive fat. Often fat around the waist, commonly called “central obesity”.

But many obese people never develop diabetes! Why is that? The short answer is: genes. But for those who do become diabetic, our medical school teachers in the late 1970’s told us that too high insulin levels

caused insulin resistance.

That is, fat and muscle cells became resistant to the effects of insulin, and thus less able to remove sugar from the blood stream

The result: high blood sugar levels, excess sugar being dumped into your urine, causing excessive urination and thirst. Symptoms of diabetes.

To me, the idea that high levels of insulin would cause fat and muscle cells to become less responsive to insulin made a lot of sense. It's the same kind of mechanism that causes tolerance to and dependence on opiates such as morphine or oxycodone, or to benzodiazepines like valium or ativan.

But during the 1980s, this explanation gradually morphed.

In retrospect, this change was brought about largely by the efforts of one very persuasive researcher, Dr. Gerald Reaven.

Dr. Reaven said that insulin resistance was the **cause of** high insulin levels.

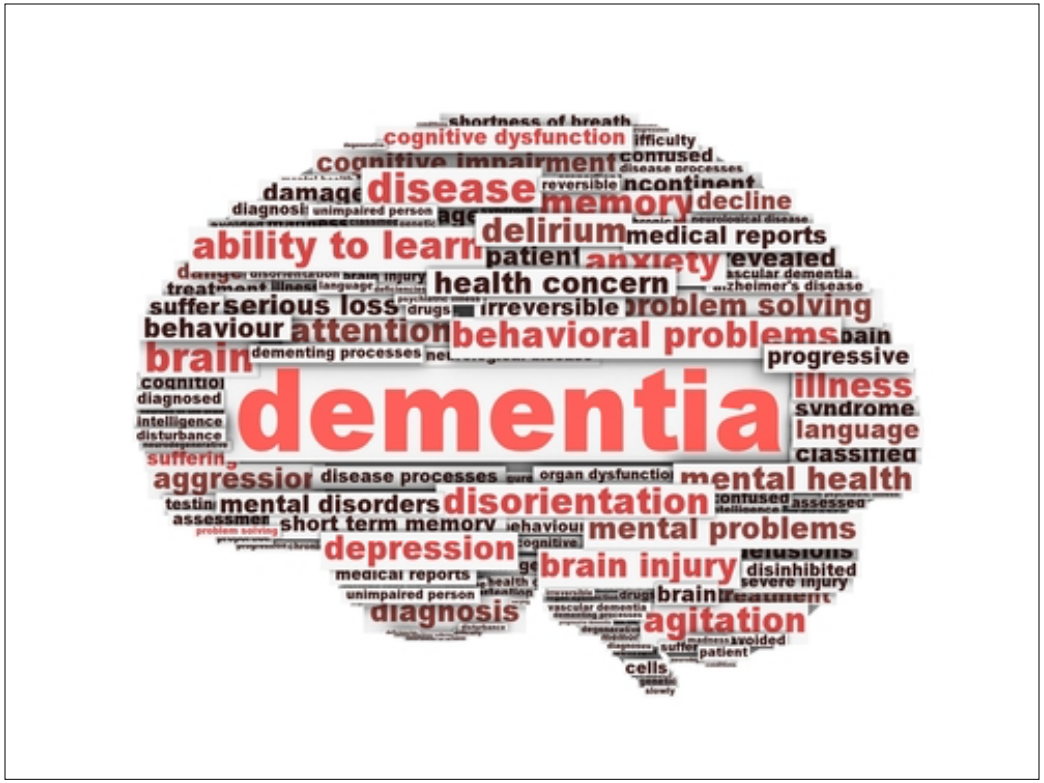
He called this ➽ "compensatory hyperinsulinemia".

This turned the idea that high insulin levels cause insulin resistance, completely upside down! I was, and remain, flabbergasted by this new explanation, and in rereading some of his articles, I believe Dr. Reaven was truly misguided. Once you have insulin resistance, it is true that higher levels of insulin are needed to overcome it. But this does not explain what caused the insulin resistance in the first place!

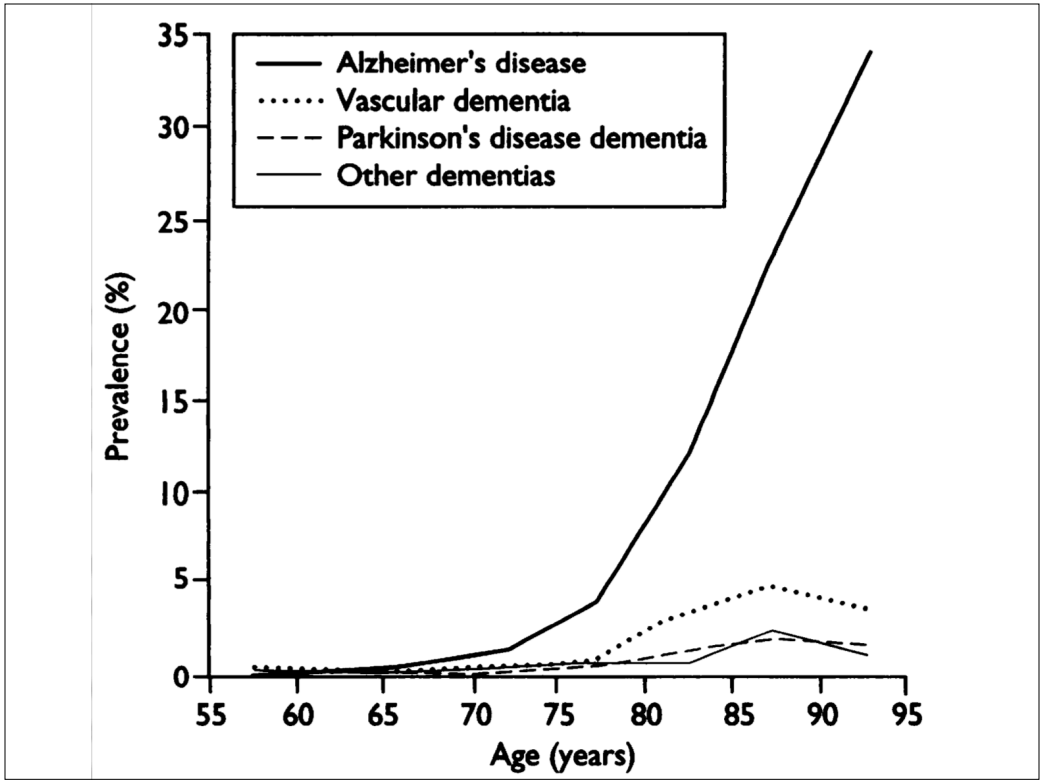
And the consequences of this new upside down theory are very negative. It offers little for type 2 diabetics except control of blood sugar levels. In contrast, the old theory means that many cases of diabetes can be cured with a low carb diet!

When I ask experts in the field about how the new theory works, they mumble about inflammation, obesity, insufficient exercise, high fat diets and other things as causing insulin resistance. When I ask, show me the research, I get the brush off: it's too complicated for a psychiatrist to understand, they say.

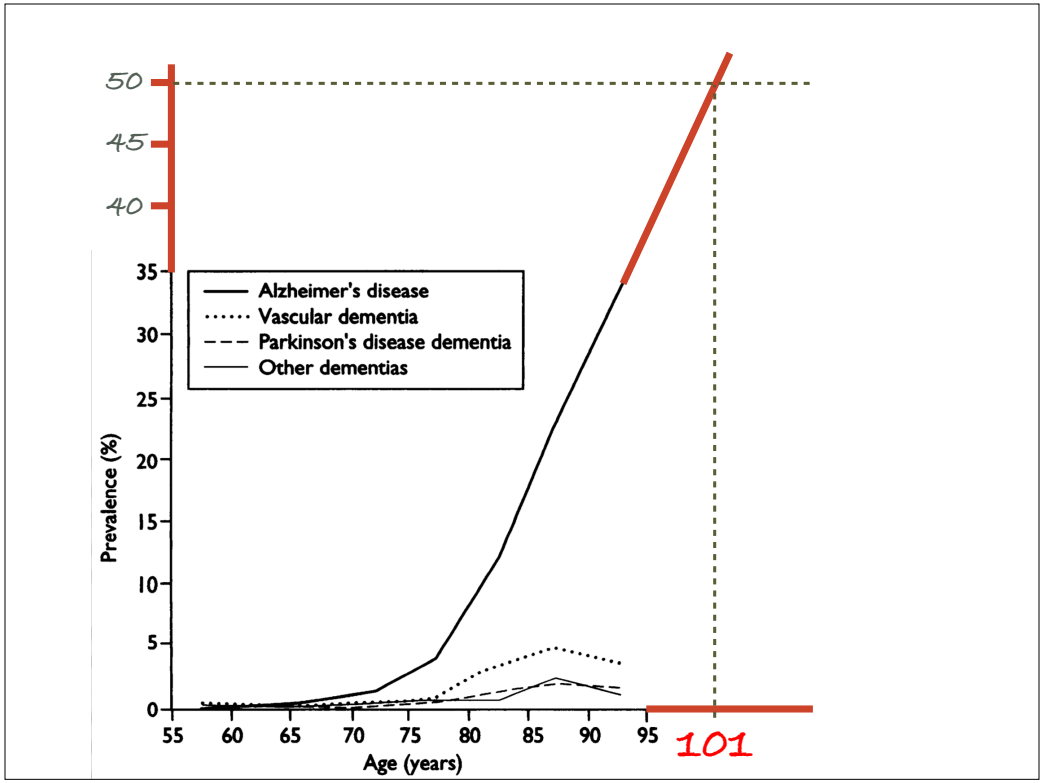
And why would I, a geriatric psychiatrist, even care? It turns out that there is a convergence between my personal interest in dealing with overweight, and my professional interest in dealing with a condition I see very commonly in my line of work. What condition is that? Dementia.



I see it a lot for two reasons: one, dementia frequently causes behaviour or emotional disturbances; and two, dementia is extremely common in old age. How common? Have a look at this slide.



This graph plots the percentage of people at any given age who have dementia. You can see that as people get older, the percentage increases very steeply for Alzheimer's disease.



I'm now going to extrapolate from this prevalence curve. First, let's lengthen the horizontal axis, then the vertical, the tick marks, some labels…

OK, now I want to see at what age the prevalence would be 50%. We'll draw a horizontal line, extend our Alzheimer's plot, drop a vertical from the point of intersection,

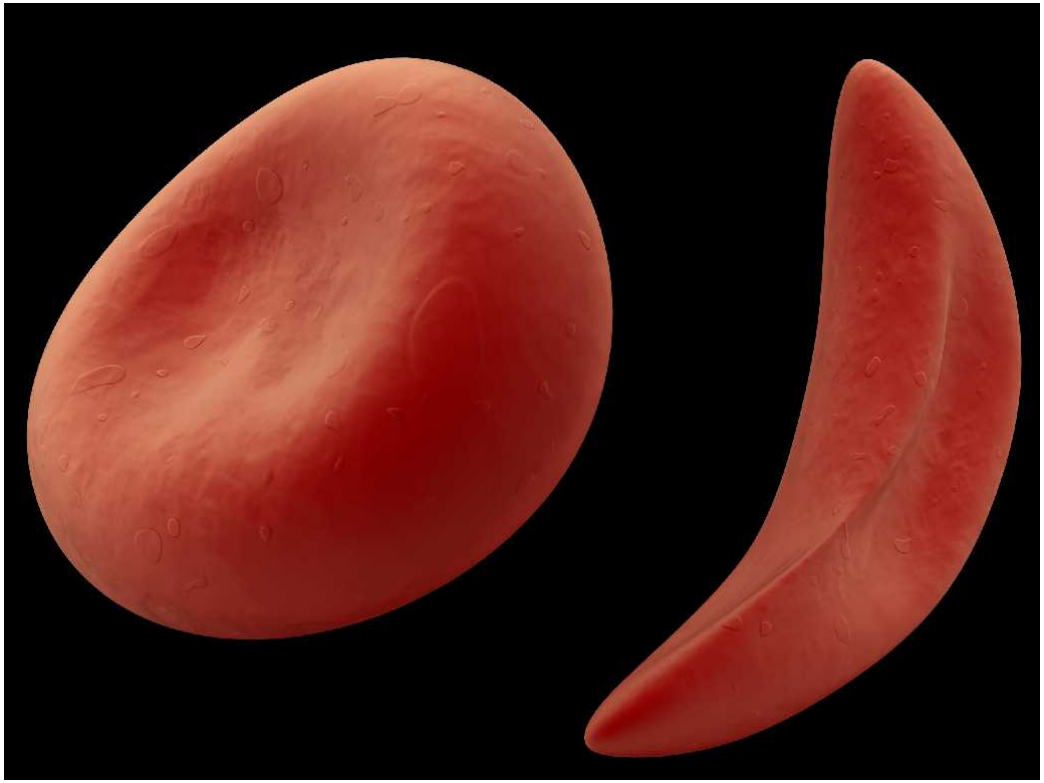
And measure to get the age,

By the way, my apologies for the animations. But I was having way too much fun!

So, at age 101, half of the people have Alzheimer's!

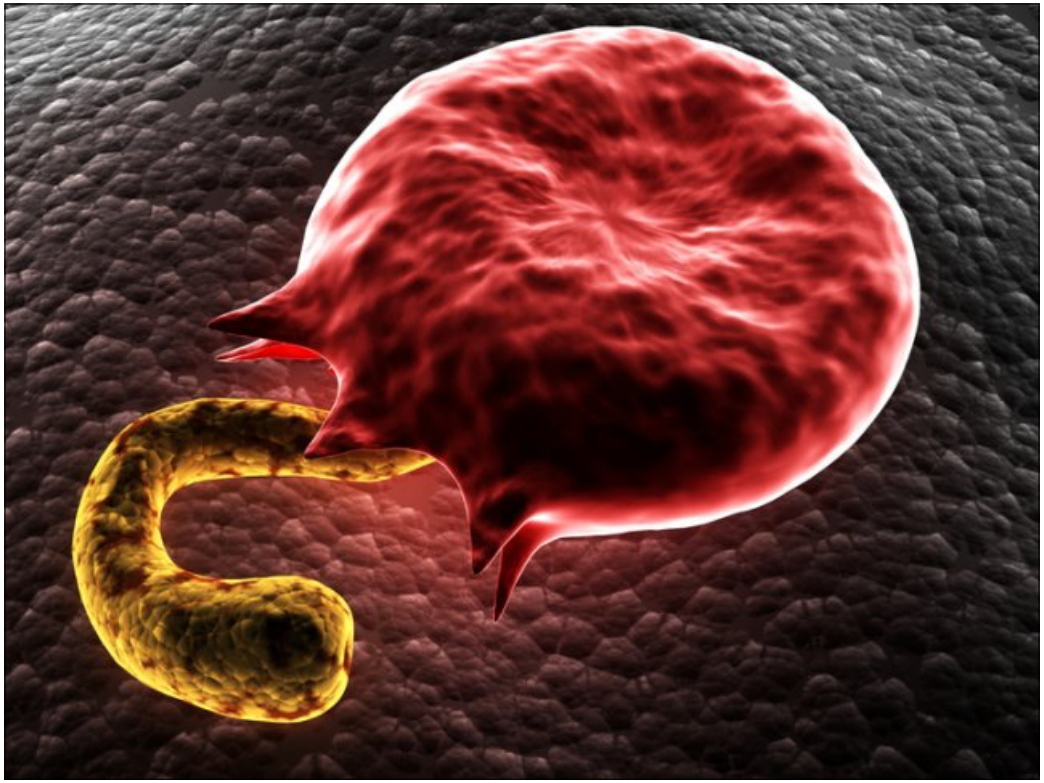
For people over 100 years of age, dementia is not abnormal. You cannot call something abnormal if more than half of the people have it! In fact, NOT having dementia is the abnormal condition for centenarians!

In medical school we were also taught that if a deleterious condition remains common in the population, that is, evolution has **not** selected against it, it is probably because having that deleterious condition confers some sort of advantage. The example used was sickle cell anemia, a genetic condition common in Africa.



On your left is a normal red blood cell; the other one is a sickle cell.

Sickle cell anemia is believed to remain common because it helps protect against malaria.



This malaria parasite is attacking a red blood cell. Ooooh, creepy! Reminds me of the movie “Alien”!

OK, back to dementia.

So if dementia is so common, even a normal condition if you're old enough, what possible advantage could having dementia confer? Well, very little to the individual with dementia!

But consider for a moment what would happen to an animal in the wild if it developed dementia. It would get picked off pretty quickly by a predator, a "Happy Meal" for that predator! Maybe not so happy for the prey!

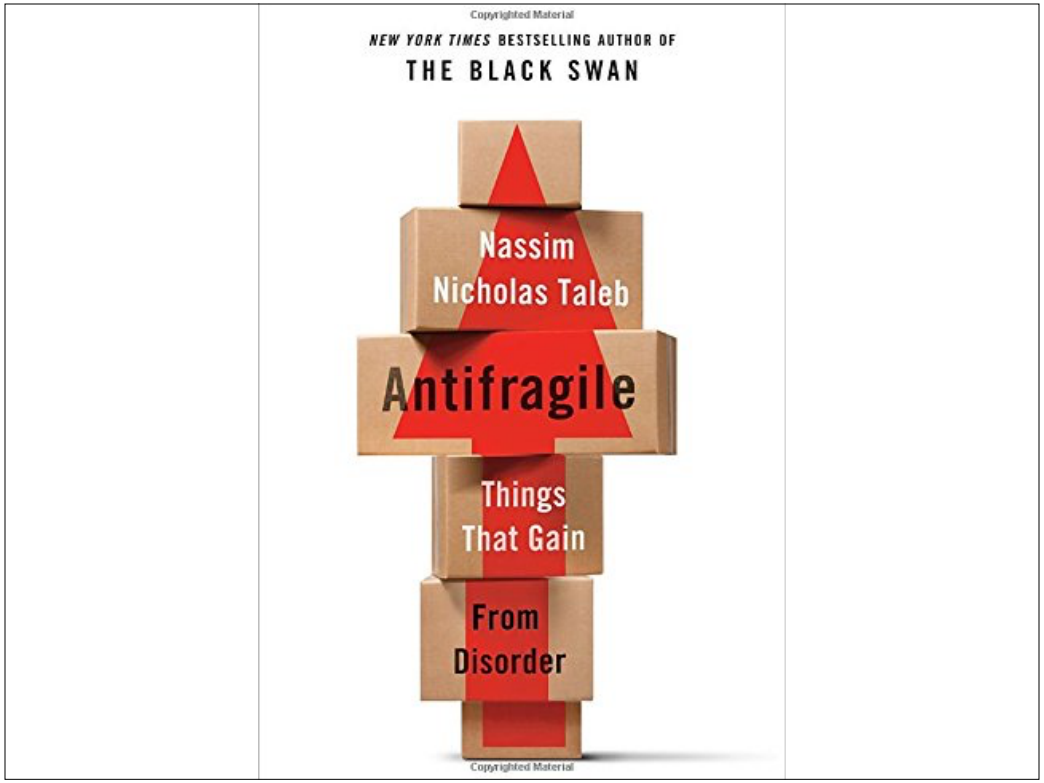
When you think about it, the same is true for all the conditions of aging. Cataracts, hearing loss, arthritis, heart disease, stroke, you name it…any of these conditions would quickly cause death in the wild.

Could evolution have built in these conditions of aging with the goal of knocking off individual animals? My God, how evil would that be! And what for? What would be the point?

Here's my take.

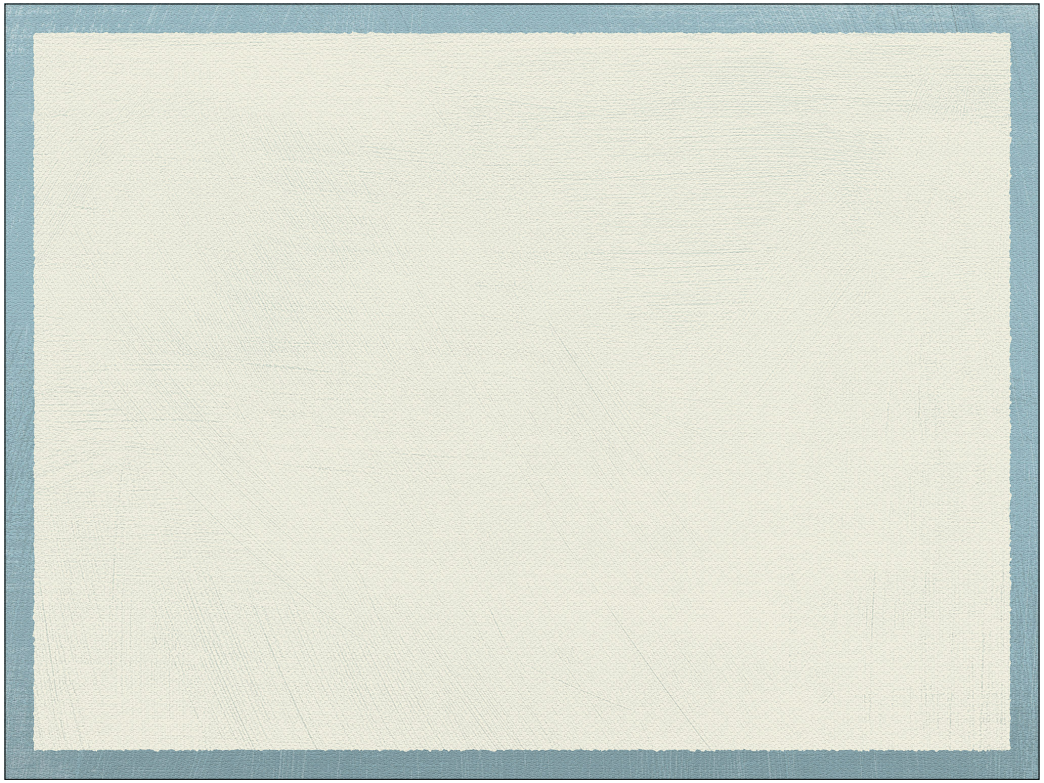
I believe that by knocking off the eldest members of a species, evolution improves the chances for the youngest generation to survive and have offspring.
I'll repeat that: knocking off the eldest members of a species helps the youngest generation to thrive and reproduce.
In an environment which is constantly changing, the youngest generation is the one most evolved and best adapted to its environment. So the diseases of aging benefit the species, not the individual.

This should not be surprising. In his book "Antifragile"



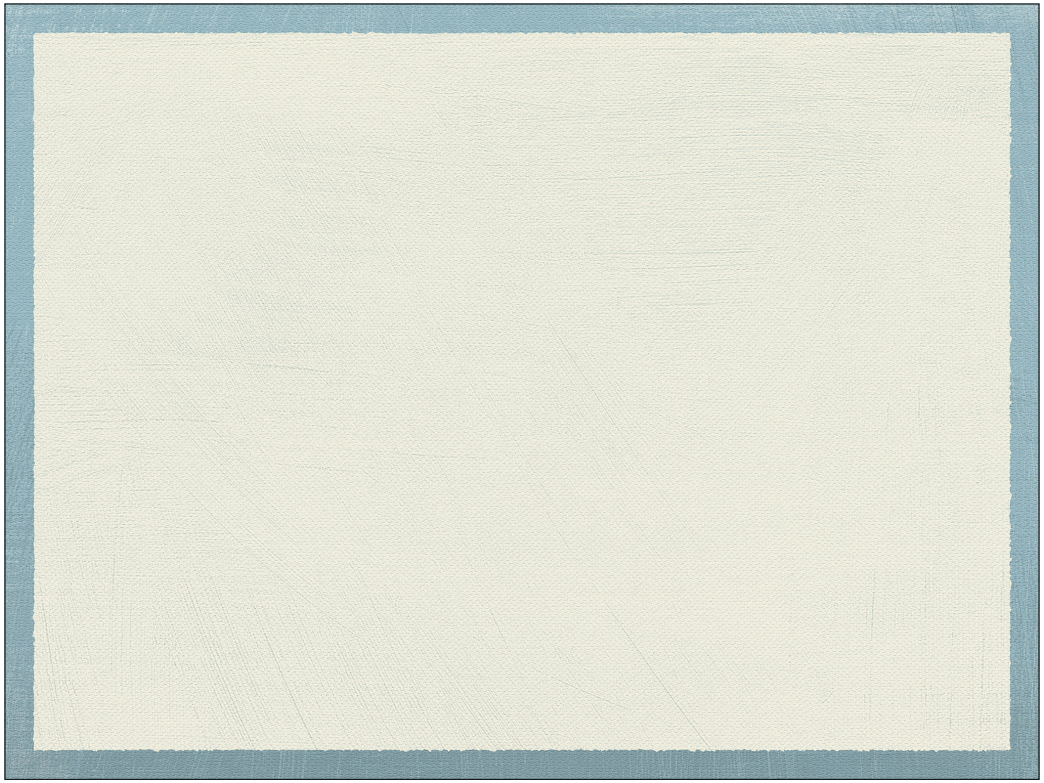
economist and philosopher Nassim Taleb spelled out how general this idea is.

For example: the Montreal restaurant scene is very healthy; there are lots of great places to eat, in every price range. What makes it great? Competition. And competition works because less successful restaurants go out of business. They have to die in order for the whole restaurant scene to be robust and healthy. Sounds like elderly individuals dying for the good of the species, doesn't it?



Now, here's an interesting factoid. It's been known at least since the time of Charles Darwin, that the average lifespan of members of an animal species is related to the reproductive rate of that species, that is, how many offspring per unit time that survive to reproductive age. We know that, in a given area, the number of members of a species remains relatively constant. That could only be true if average lifespan and reproductive rate are inversely proportional.

If, for some reason, the reproductive rate changes, for example due to climate change, the average lifespan will change in proportion. I believe that could only happen if lifespan were under genetic control.



A genetically controlled lifespan would also explain why there is so much variability in lifespan between species that is otherwise difficult to explain.

Finally, genetic experiments in animals, where specific genes are “knocked out” or made inactive, demonstrate that a number of genes have a huge influence over lifespan.

This means that the timing of our death is controlled by our genes. But we don’t just drop dead all of a sudden! Typically, we develop a condition of aging, such as dementia or cancer, which eventually does us in. The same is true for animals in the wild, although the onset of the aging condition and becoming prey is so fast that one could almost say that animals don’t age in the wild.

OK, can we agree on the conditions of aging being under evolutionary control? Show of hands: who disagrees? Would any of you who disagree care to explain why?

The main point typically hinges on whether you believe that evolution is all about survival of the fittest individual. But in reality, the genome only cares about itself. The individual is only its carrier or transporter.

I've brought all of that up, because it appears insulin has a large role in this genetic control of the conditions of aging.

But, you should still be asking, what does dementia have to do with insulin or diabetes? It turns out, quite a lot! Having diabetes doubles your risk of dementia! And there is research suggesting that insulin resistance in the brain is a cause of one form of dementia, which some people are now calling, type 3 diabetes.

Could it be that high insulin levels are causing both type 2 diabetes and dementia due to insulin resistance? If this is a possibility, what other things might insulin be doing? Because it does far more than its role in weight gain or loss, or the development of diabetes or dementia.

The insulin molecule has been found even in single-celled organisms which have been around for over a billion years! By the way, that's another Canadian discovery, Eh?

Turns out that insulin promotes cancer and inflammation. Even worse, at the level of individual cells, insulin suppresses the good functioning of a cell's repair and replacement mechanisms. When cell damage doesn't get fixed, the organism ages.

So, when we're young, insulin is necessary for growth, as we saw for the kids with juvenile onset diabetes. And later on in life, the exact same hormone, insulin, promotes aging as well as the conditions of aging! Who knew? Insulin kills!

That’s the bad news! The good news is, we can control our insulin levels by being careful about **what** we eat, and **how much** we eat!

And here is another insight. In the same way that insulin is good when we’re young, but bad when we’re old: the foods that stimulate insulin are **also** good for us when we’re young, but **bad** later on. And vice versa! Foods and drinks that are **bad** when we’re **young**, become **good** for us as individuals when we’re **older**.

But, here's a very important caveat: no matter your age, too much insulin is bad for you! So a diet high in starches and added sugars is a no-no! But, there are other environmental influences that affect insulin levels.

You are all aware that the diseases of aging are not limited to old people. We are currently experiencing an epidemic of type 2 diabetes in children!

This business about different effects for young vs older individuals may help explain why scientists tell you something is good one day, and then bad the next. Take coffee.

It turns out that coffee actually **does** stunt your growth when you're young. What your mother told you was on the money!

But when you're older, coffee helps protect you against cancer, dementia, cardiovascular disease, and diabetes. And, yes, it appears to exert these effects through insulin.

Now, if you’re NOT sceptical about this idea, there's probably something wrong with you! After all, why should insulin be so implicated in growth and then later on, in aging and in promoting death?

It all comes down to having offspring. Just consider, reproduction is what drives evolution.
Little story: you’ve heard of the “Great Depression” in the 1930s, starting in the United States but spreading worldwide.

Many people felt that not getting enough food because of poverty was very bad for one's health. In an effort to convince the government of the day to increase food aid to poor people, a number of studies were done on rats and mice, in which the animals were given only 70% of their usual energy intake. Unfortunately for the researchers, and to their great surprise, the animals on the reduced rations lived up to 50% longer than the control animals. And in good health!

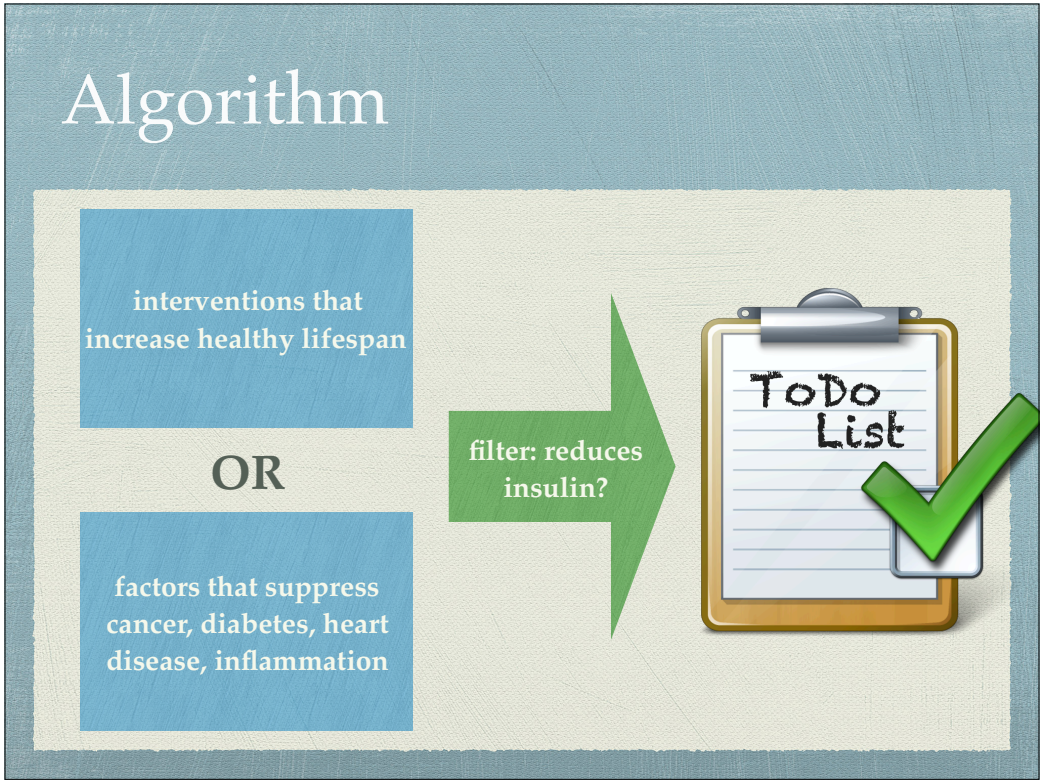
This protocol, called caloric restriction, has been studied in a variety of animal species since then. And the results have been pretty consistent: caloric restriction extends healthy longevity, but at the same time often impairs reproduction.

The best explanation I’ve found is this: if a female animal tries to have offspring when there is not enough food, the offspring will not survive. And, that mother will probably die in the attempt to have children.

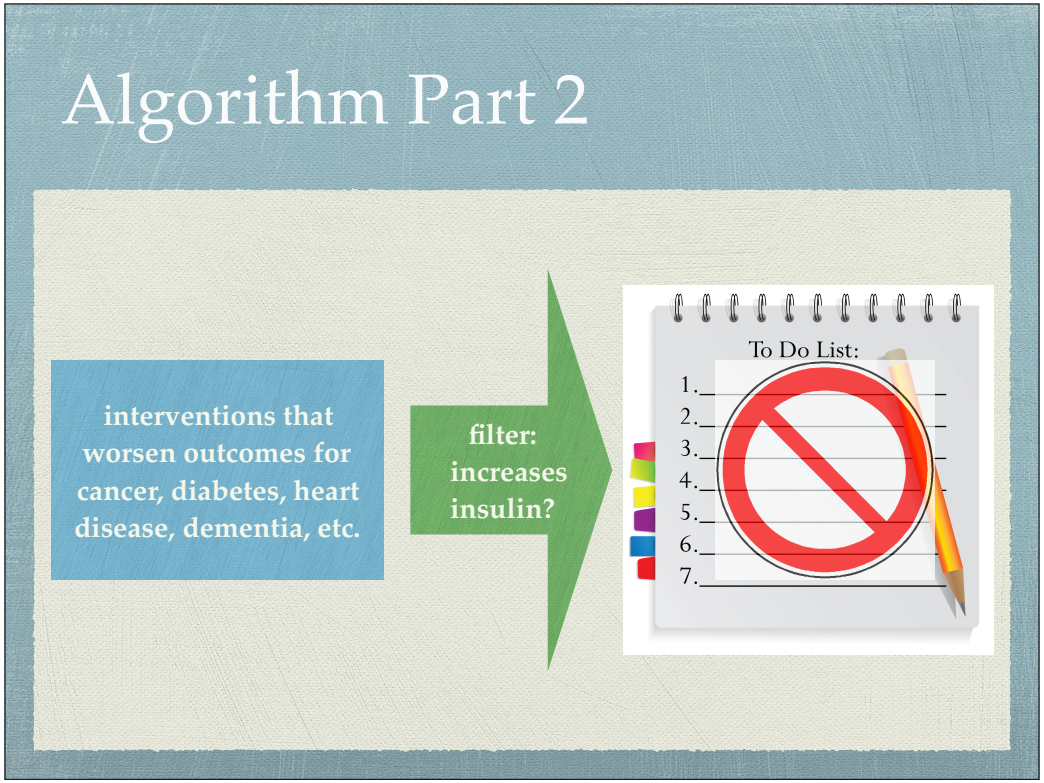
So the best strategy would be: when food is scarce, stay healthy, live longer, and wait until the good times return. When there is enough food again, go back to having babies, or laying eggs.

And how does an organism know when there’s enough food? Insulin is the signal. Insulin levels are controlled by what we eat and how much we eat. And insulin in turn controls growth and development, but also aging.

So I've been trolling the scientific literature, using this algorithm.



What interventions ➽ increase healthy lifespan? OR ➽, what factors ➽ suppress cancer, diabetes, heart disease, inflammation? Filter ➽ by whether they reduce insulin. The result is a list ➽ of good things to do when you're older. Next,



look for factors ➽ which worsen outcomes for cancer, diabetes, heart disease, and so on. Now, filter ➽ by whether these factors increase insulin. The result ➽ is a list of things to avoid when you're older ➽.

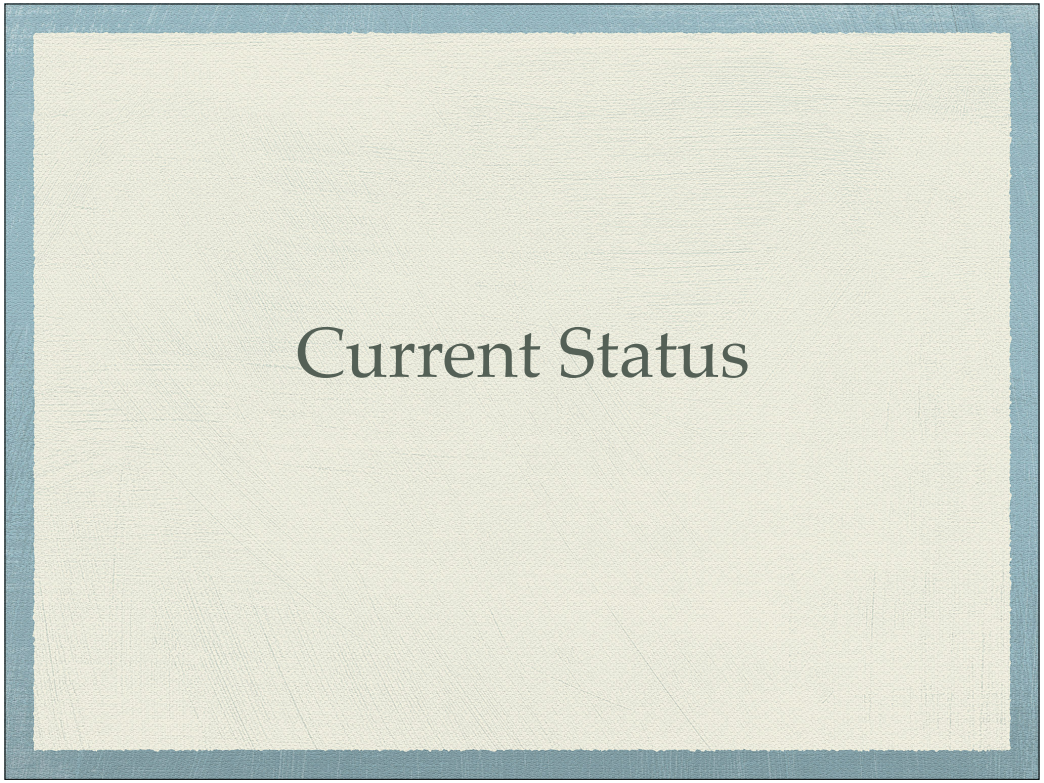
Of course, it's not quite so simple. It's not only insulin: there is another hormone, called Insulin-Like Growth Factor one, IGF-1 for short.

IGF-1
Insulin-like Growth Factor 1

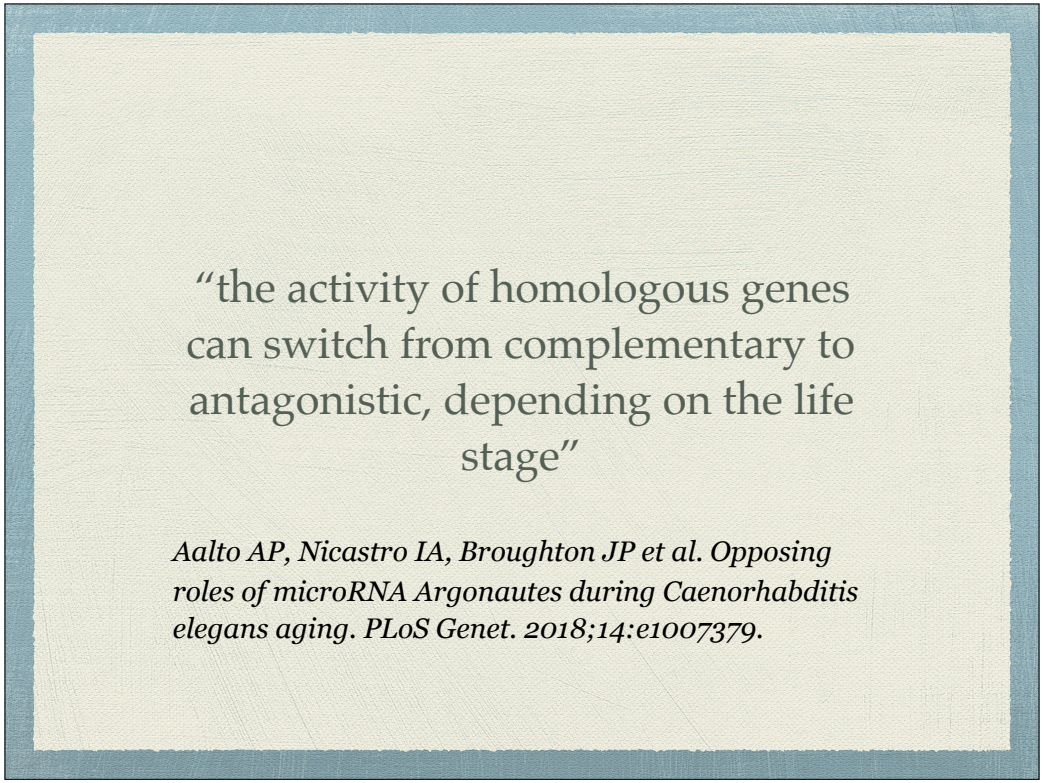
IIS
Insulin and IGF Signalling

As the name suggests, it's like insulin because it acts on insulin receptors, and conversely, insulin acts on IGF-1 receptors. Together, the two are often referred to using the acronym IIS, as in IIS Pathway, which stands for the Insulin and IGF Signalling Pathway.

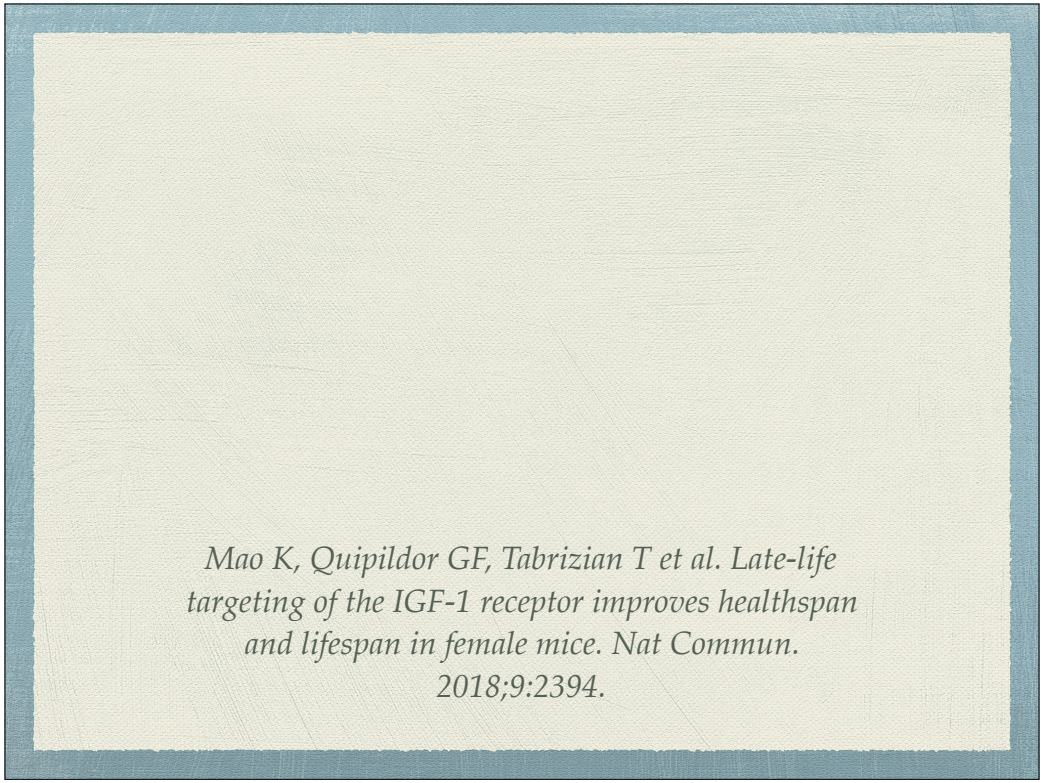
And, like insulin, IGF-1 is important when we're young for us to grow and reproduce, but it appears to contribute to the conditions of aging, such as cancer, when we get older. And, like insulin, IGF-1 secretion is to some extent controlled by what we eat and how much we eat. More specifically, protein consumption increases IGF-1 levels.



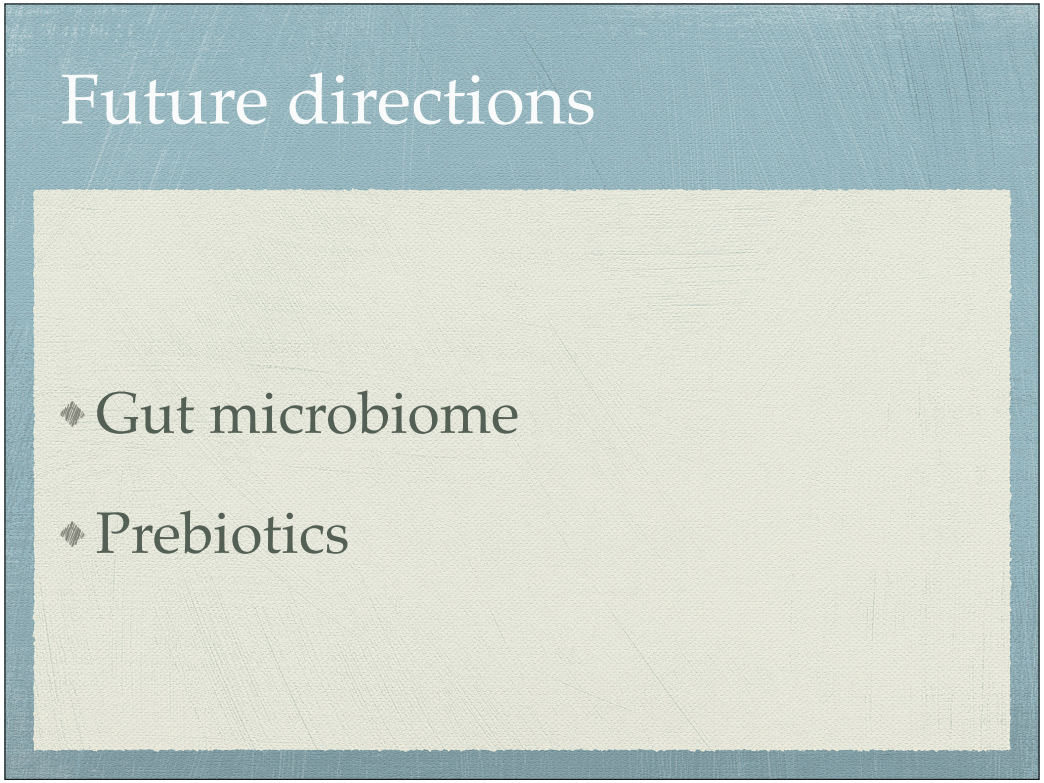
I've been giving variants of this talk for years, and trying to get the point across that things which are good for us when we're young, may become bad when we're older, and vice versa. In other words, the effect of some intervention may depend on the age of the animal. I'm happy to report that, finally, this idea is being taken seriously!



For example, this article looked at how certain proteins work together with microRNAs to modify the transcription of certain genes which control longevity, and found that this works in opposite directions depending on whether the C. Elegans worm is in the larval stage or is an adult.



And this study looked at blocking IGF-1 receptors with monoclonal antibodies. In young male mice, this reduction in IGF signalling reduced life expectancy, while for aged mice, described in the title as “late-life”, both healthspan and lifespan were increased, although this was true only for female mice.

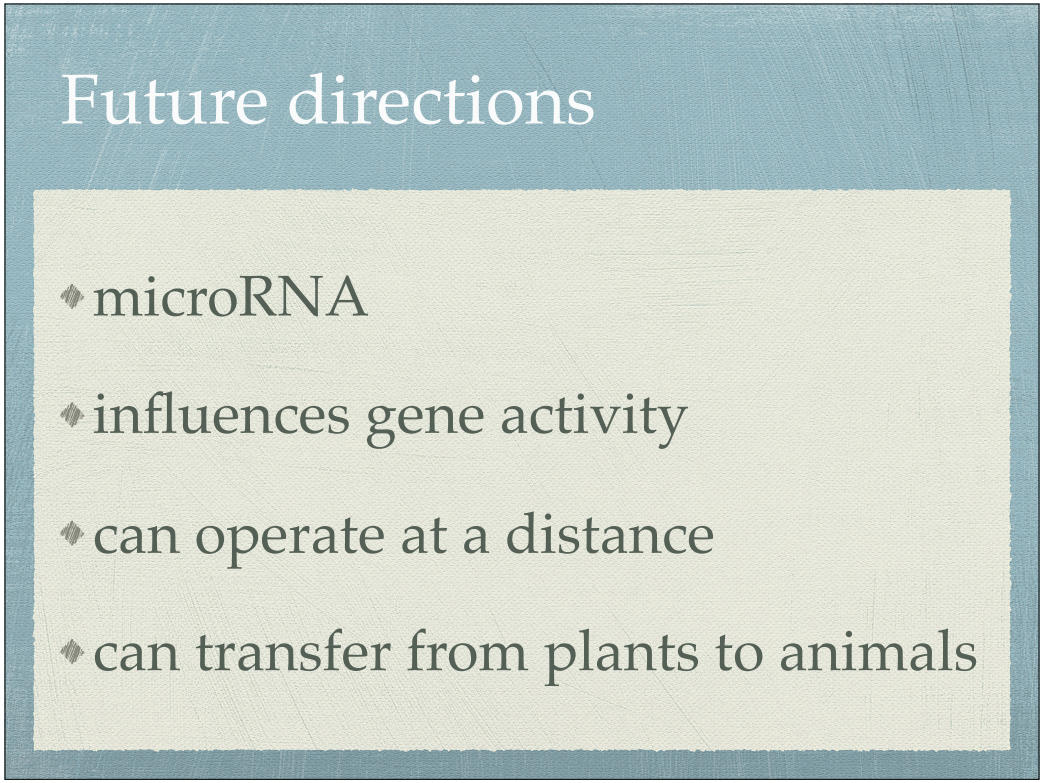


Then there are two areas of research that promise to bear much fruit: one is the gut microbiome, the bacteria and other microbes that inhabit our gastrointestinal tract.

Recent evidence suggests that the gut microbiome can regulate weight gain, obesity, insulin sensitivity, and inflammation.

And what influences the gut microbiome? Certainly, what we eat, including compounds in foods and spices, as well as nondigestible food fibre. The term for this class of substances is “Prebiotics”.

Certain medications such as metformin and acarbose also influence the composition of the microbiome.



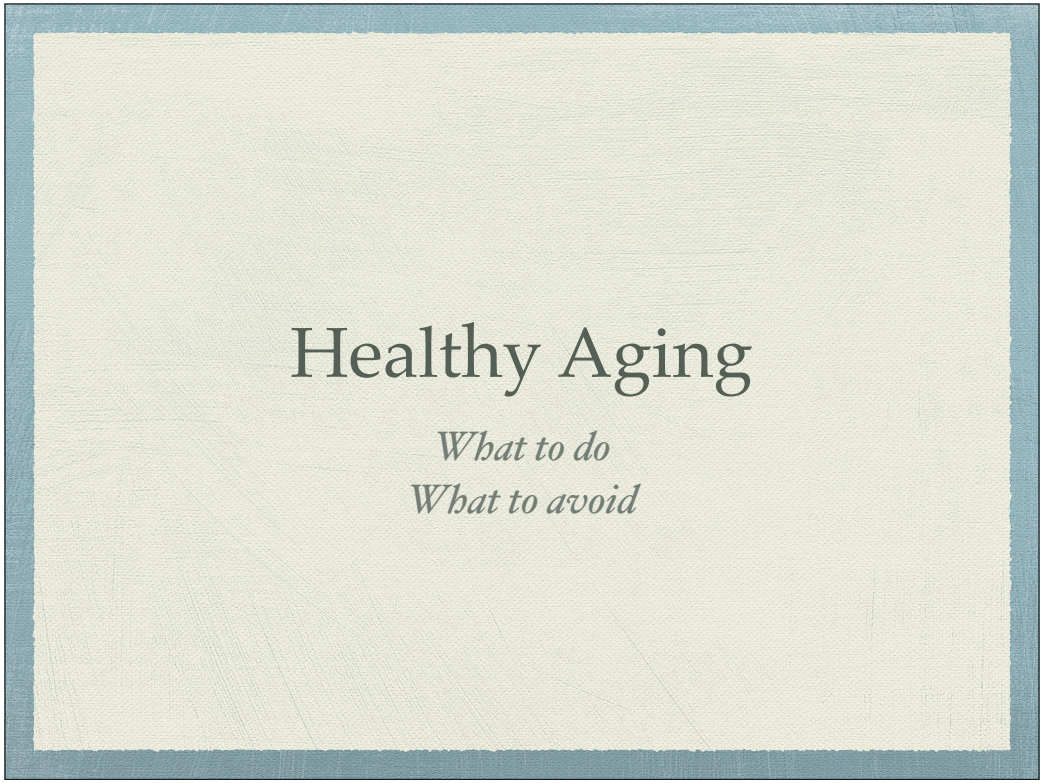
The second hot research area is microRNA. Here is the Wikipedia description of a microRNA: “a small non-coding RNA molecule (containing about 22 nucleotides) found in plants, animals and some viruses, that functions in RNA silencing and post-transcriptional regulation of gene expression”. Whew! That’s heavy!

Basically, we’re talking about little strings of genetic material which can modify whether our genes are actively producing proteins or not. These microRNAs can be packaged into little vesicles, and in this form, can be incorporated into distant cells and influence those cell’s behaviours. And what’s truly exciting is that plant microRNAs can enter an animal’s cells when that animal eats the plant, and very possibly affect the animal cell’s behaviour.

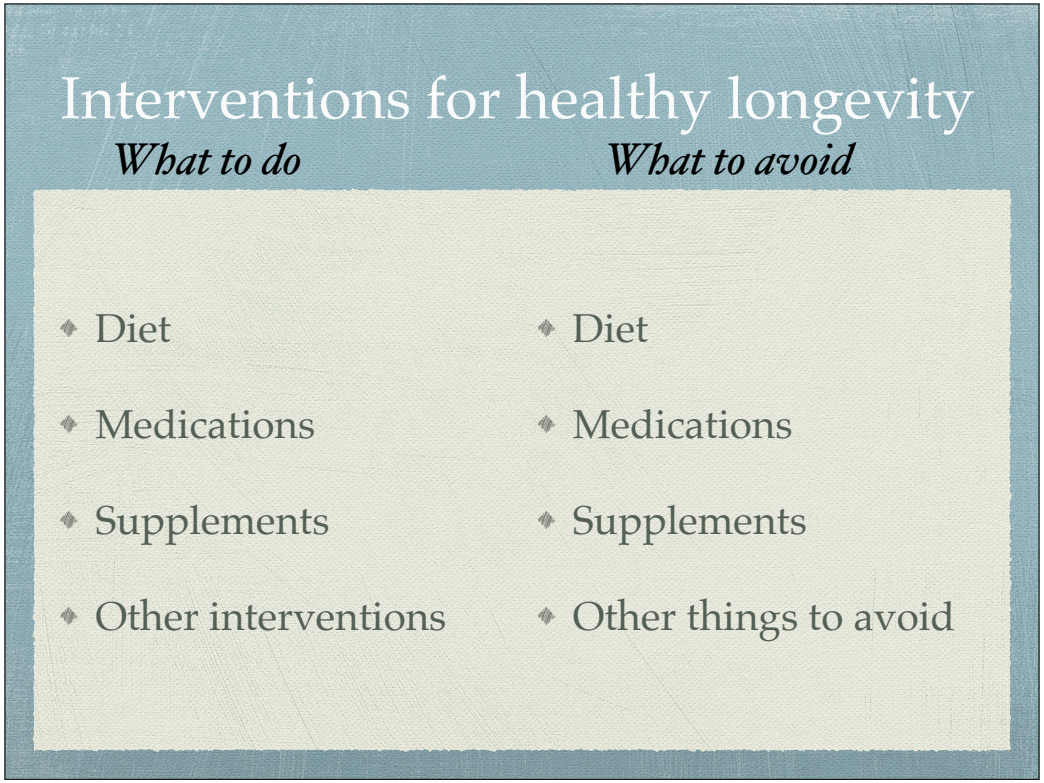
So now we have another mechanism that needs to be studied, when we look at how what we eat affects our health and our longevity.

Now, back to the lists of things to do and things to avoid when one gets older. So not just insulin is at play, but also IGF-1. As the state of the art advances, I keep on revising these lists, and thus I keep on changing some aspects of what I do or avoid doing. After all, if I believe in something, I have to try it on myself!

Following these lists has been very helpful for my health, and I hope and pray that it will also help in my wife Helen's battle with her colon cancer.



What can you or I do, or avoid doing, to support living healthily for longer?

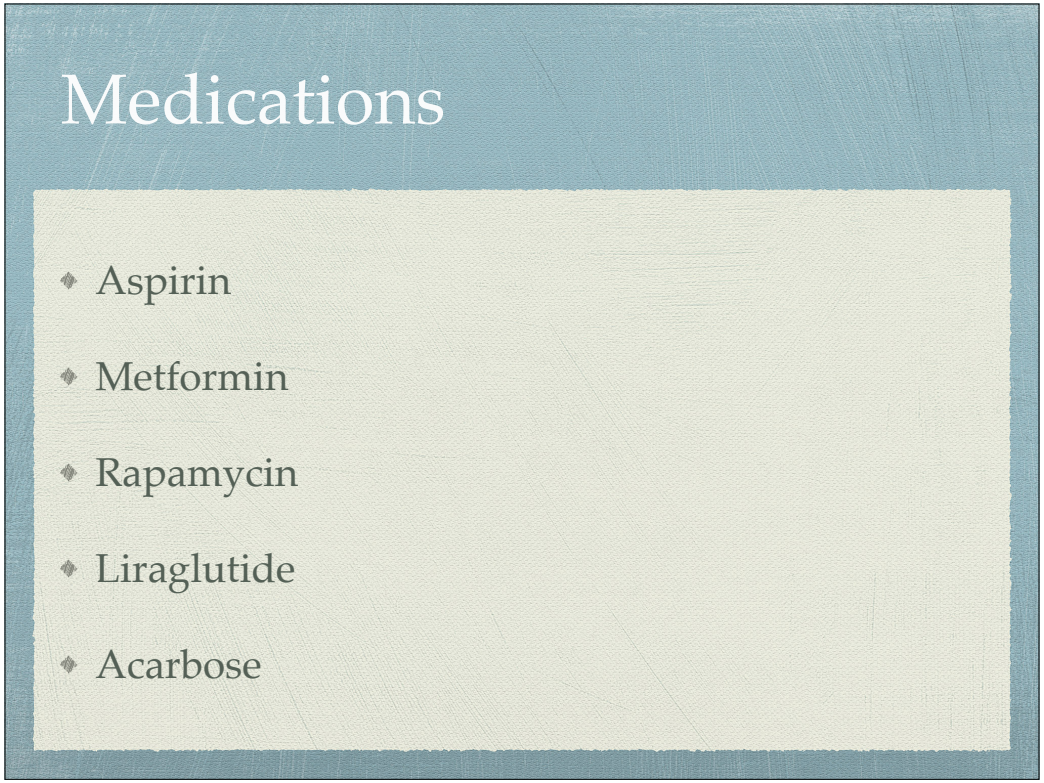


Here's an overall outline of what I'll talk about. For both the things to do ➽, and the things to avoid ➽, topics include diet, medications, dietary supplements, and other stuff.

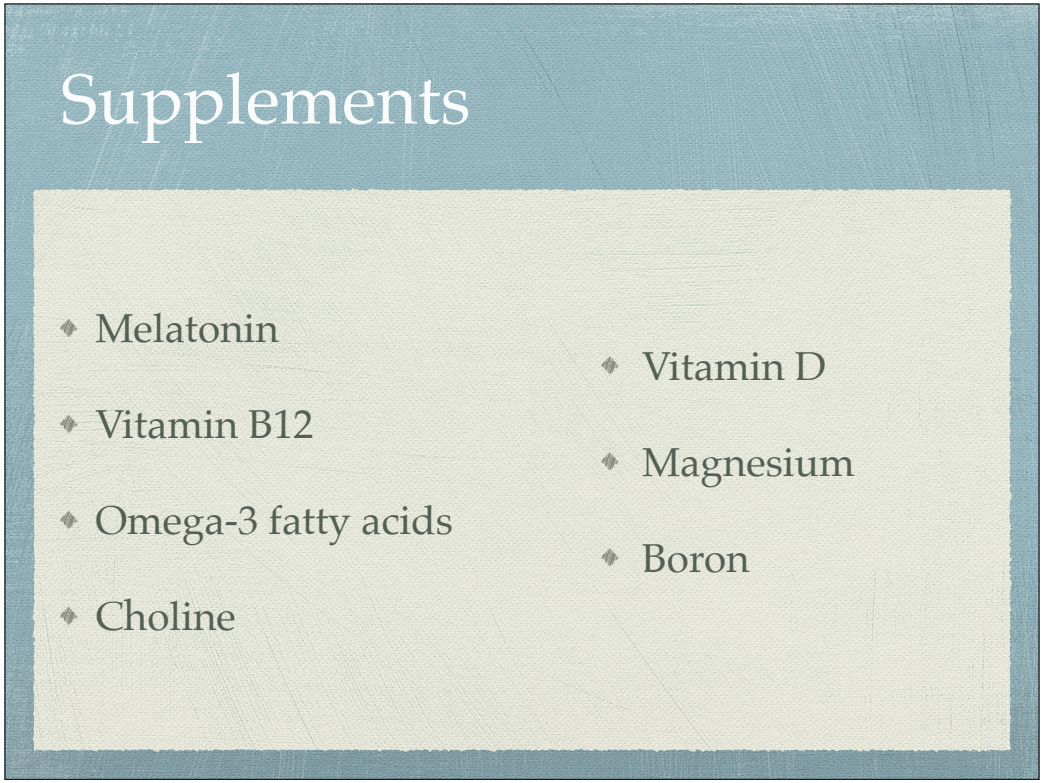
Diet for healthy longevity

- Caloric restriction
- Methionine restriction
- Protein restriction
- Spices
- Chocolate
- High fibre foods
- Other foods
- Beverages

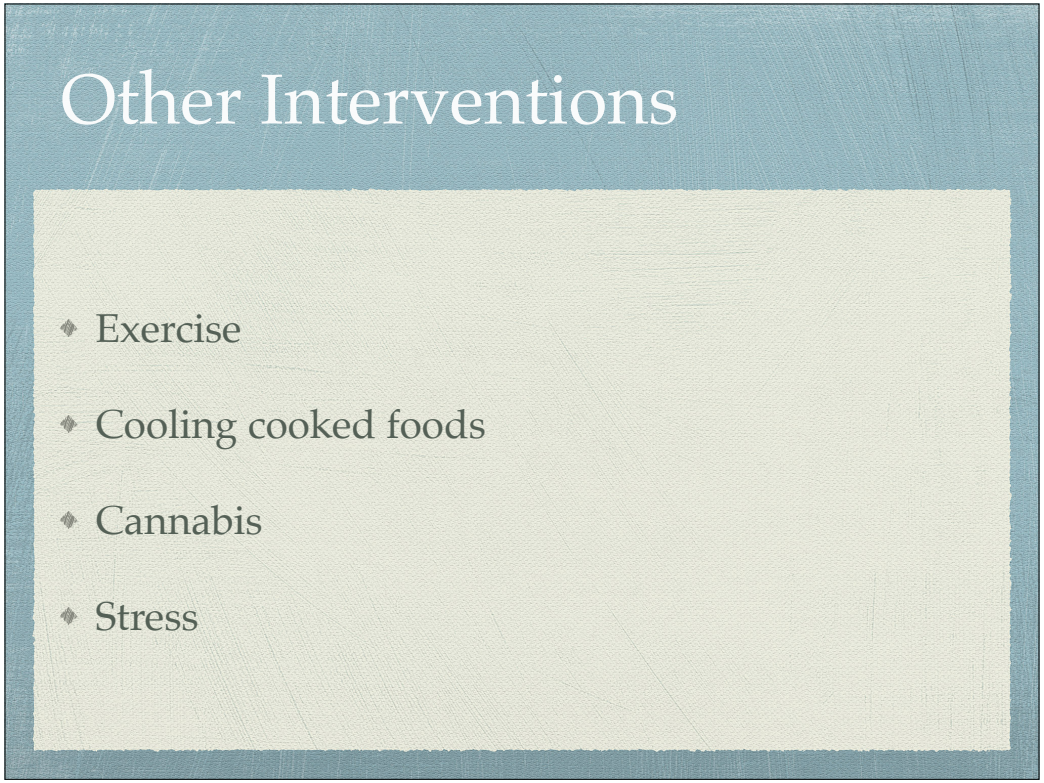
When we talk about dietary interventions in support of healthy longevity, we will be covering these 8 subtopics.



When it comes to medications, these are some that have been shown to increase healthy longevity in experimental animals. Can anyone see anything in common between any of these drugs? Here's a hint: three of them are used to treat type 2 diabetes. As for myself, I'm taking metformin.



These are the supplements that I take. We'll talk about a couple of them.



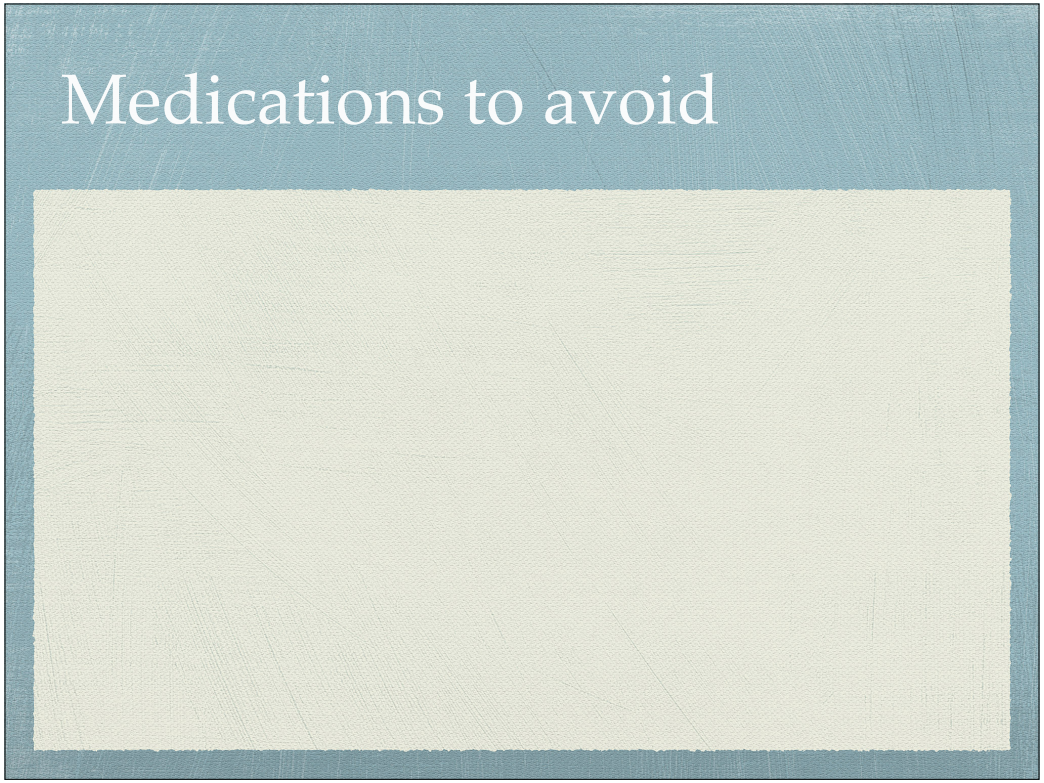
And here are some other interventions that we'll take note of.

Moving on to the topics under the heading: things to avoid for healthy longevity, also known as, things to do to age rapidly.

Dietary practices to avoid

- Sugars and starches
- Artificial sweeteners
- High glycemic index foods
- Artificial trans fats

Here are some things to keep out of our diets.

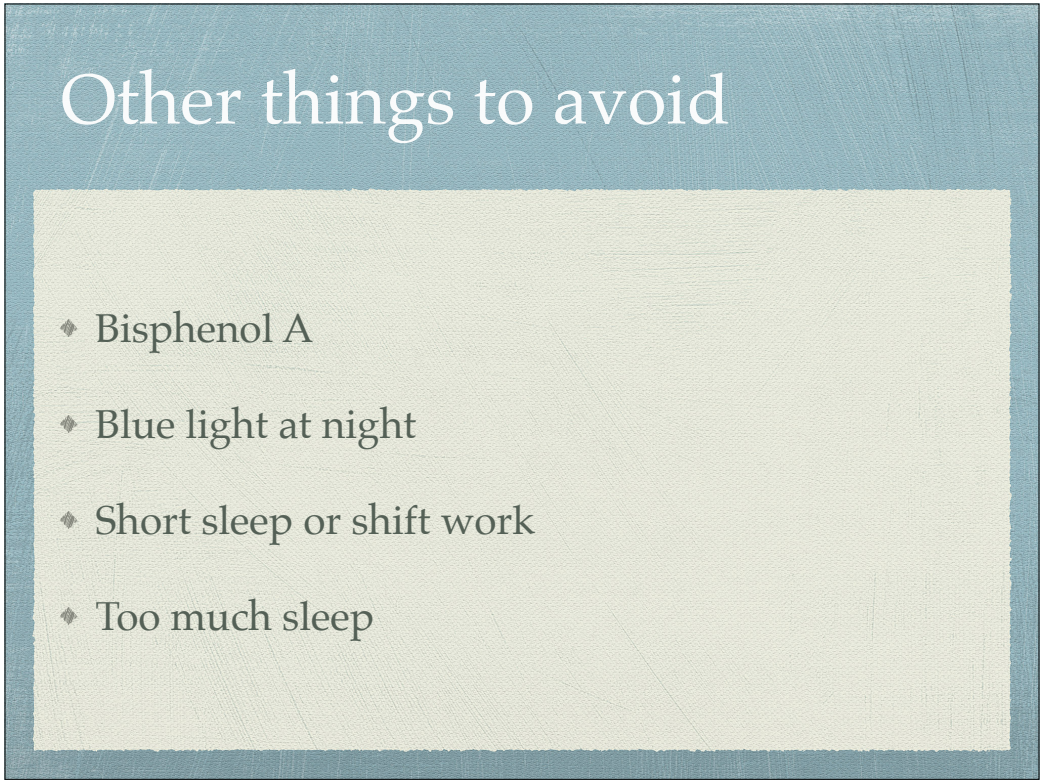


I’m not going to give you a list of medications to avoid, but perhaps some guidelines.

And here’s a disclaimer: please keep in mind that I am not dispensing medical advice here. I am not your physician, and if you have any questions or concerns about your medications or other treatments, please consult your health care provider. So I will talk only in generalities.

When it comes to dietary supplements, there are really no hard-and-fast rules in deciding which ones you want to consider doing without. And, I can't emphasize this enough, there are some supplements which are good when you're younger, but maybe not so good when you get older.

And it's time for another disclaimer: since many people in the anti-aging field seek to profit, for example by developing and selling anti-aging supplements, I want to state that I am not trying to sell anything, I have never earned any income from my work in this field, and I have no conflicts of interest to declare.



This is the last outline slide. Here are some practices which may contribute to the diseases of aging, and are therefore best avoided.

My wife will agree that I'm somewhat obsessive, so what I'm going to do will be difficult for me: instead of going through that outline in sequence, I will start with this slide, and maybe jump around a bit! So, here we have Bisphenol A, which I'll refer to as BPA.

Bisphenol A (BPA)

- BPA stimulates insulin
- Thermal printer paper is coated with pure BPA
- Because of recycling, BPA is found in many other paper products
- BPA probably contributes to obesity and type 2 diabetes

Canada has outlawed BPA in baby bottles because it is known to disrupt hormones, especially estrogen. BPA also stimulates insulin secretion. It is ubiquitous in our environment, because pure BPA is used to coat thermal printer paper, whether for grocery receipts, at the gas pump, or anywhere one uses a credit or debit card. There's also bus and train tickets, parking tickets, boarding passes, and lottery slips. Because all these bits of paper may get recycled, BPA has even been detected in paper currency, food cartons, napkins, paper towels, and toilet paper.

Handling any of these products can cause BPA to be absorbed through the skin. Greasy skin, including use of hand lotions, increases skin absorption. The alcohol found in many hand sanitizer products also increases absorption. Hand washing only removes some of the BPA from the skin. Studies suggest that all this exposure to BPA may be contributing to the current worldwide epidemic of obesity and type 2 diabetes.

Blue light at night

- Blue light suppresses melatonin
- Lower melatonin means higher insulin levels
- Computer screens, TVs, smartphones and tablets emit lots of blue light
- Likely contributes to obesity

Many studies have shown that exposure to light at night, eg for shift workers, increases risk for cancer, heart disease, obesity and diabetes. The effect is most pronounced for blue light of around 480 nm wavelength, as this suppresses melatonin most strongly. Because melatonin reduces insulin secretion, exposure to blue light at night results in higher insulin levels. The LED backlighting of flatscreen TVs, computer monitors, smartphones and tablets, is typically rich in blue light, and very likely contributes to the obesity epidemic afflicting young people.

Shift work or short sleep

- Light exposure at night suppresses melatonin
- Thus, higher insulin levels
- Female shift workers have 40% increased risk of breast cancer

You are likely aware that shift work and insufficient sleep have been linked to things like obesity. Both of these conditions result in increased light exposure, thus less melatonin, ➽ and consequently higher insulin levels. ➽ Shift work has been extensively studied in female workers, in whom the risk of breast cancer is increased by 40% ➽ compared to women who do not do shift work. There is also evidence for increased risk for type 2 diabetes.

Too much sleep

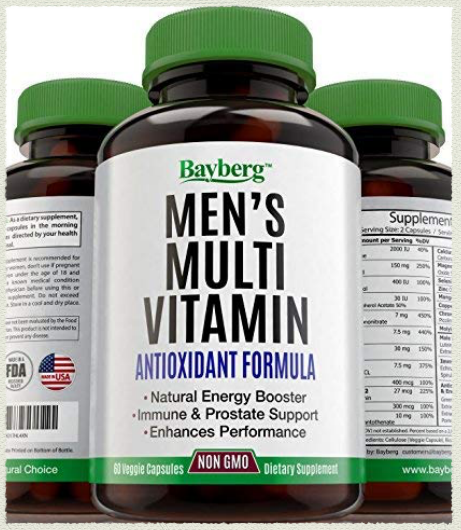
- Too much REM sleep can cause depressive symptoms (http://henry.olders.ca/)
- Appetite, energy, and motivation disturbances are common in depression
- can lead to obesity
- cognitive impairment

Strangely enough, while insufficient sleep surely worsens our health, who knew that too much sleep is also bad? How would this work? Can you think of anything that we need, where too much is not bad for you? Too much sun causes sunburns and skin cancer. Too much oxygen causes blindness in premature infants. Well, too much sleep, in particular too much REM sleep, causes symptoms of depression! I won't go into detail here, but I've given many talks on this subject, which you can find and read on my website.

So, big deal, depression isn't a condition of aging! True, but depressed people typically have problems with appetite, energy, and motivation, which can contribute to obesity. And the cognitive impairment experienced by some depressed people can become permanent if it goes on too long!

Be wary of supplements

- Substances occurring naturally in foods may have different effects when given in high doses or in concentrated form
- Associated with cancer: folic acid, vitamin E, vitamin A, calcium, beta-carotene in smokers



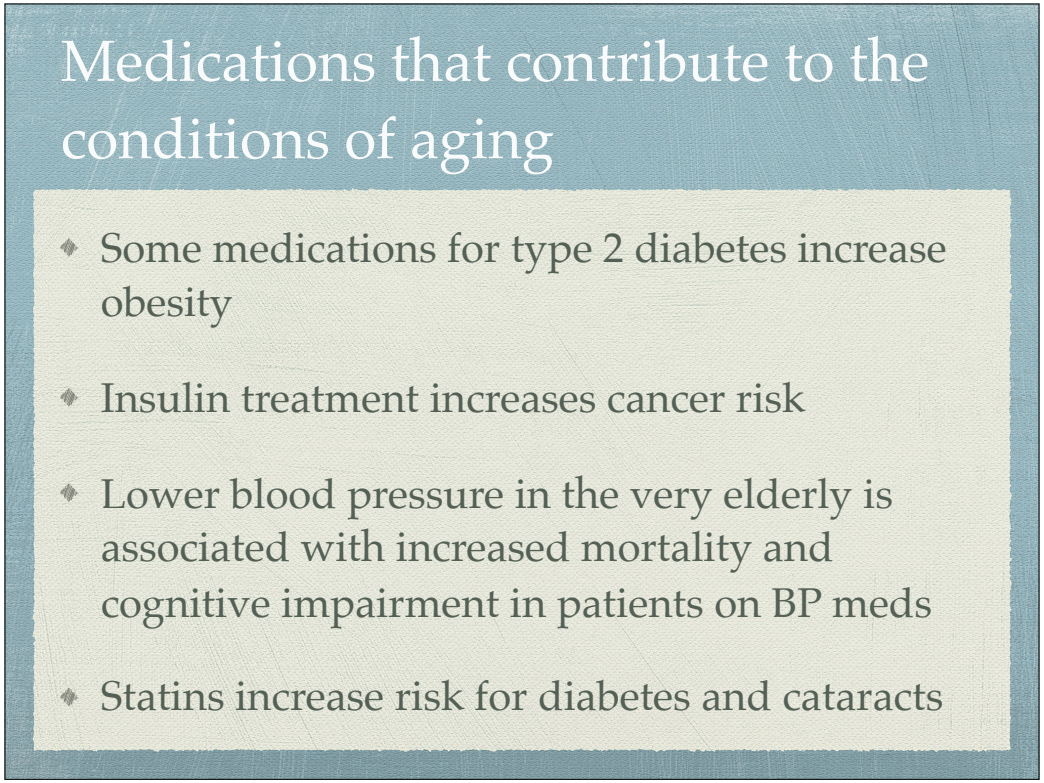
In general, I believe that taking supplements, even concentrated forms of substances that are found naturally in foods, may not be such a good idea when we're older. This is not to say that the particular molecule is bad for you, just that when a molecule is obtained as a component of the foods we're eating, it may work differently than when taken in concentrated form as a supplement. It occurs to me that supplements likely do not contain the microRNAs that we might be getting if we just ate the plant! Additionally, high-potency supplements have a higher risk of interacting with medications.

There is some evidence that anti-oxidant supplements can be bad for our health when we're older. For example, folic acid supplements were found to increase the risk of prostate cancer by 2.63 times compared to placebo, whereas folic acid obtained from foods decreased cancer risk. A 2010 review of vitamin and mineral supplementation suggests that higher than standard doses of some vitamins or minerals could worsen survival in cancer patients.

Be wary of medications

- do benefits outweigh side effects and risks?
- is the condition being treated really a disease?
- are there cheaper alternatives?
- are there nonprescription approaches?

When your doctor wants to give you a prescription for medications, here are some questions you may want to ask.
I have some pretty strong opinions about how the pharmaceutical industry manipulates doctors into prescribing or overprescribing medications which are not very effective, or are given for conditions which are not even diseases such as hypertension or high cholesterol. Another profitable play is to get doctors to prescribe the latest, most expensive treatment when there are equally effective and much cheaper alternatives. And I'm beginning to suspect that big pharma may also influence researchers and biomedical journals into publishing articles which say, in effect, that the cheap treatments, or interventions under the control of the patient, are useless.
You can find a couple of my opinion pieces on this subject on my website and on my LinkedIn page.
And I'll give just a couple of examples of how medications can contribute to the conditions of aging:

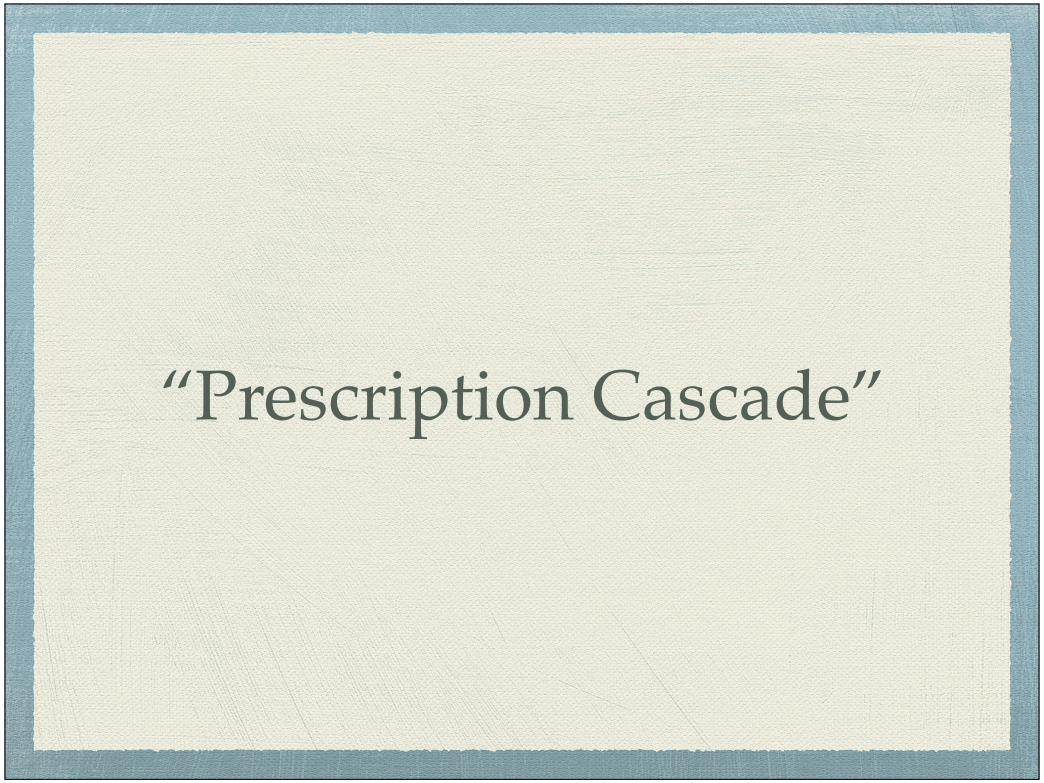


In people with type 2 diabetes, taking insulin, or other medications which increase insulin levels, may lead to worsening obesity ➽ and diabetes.

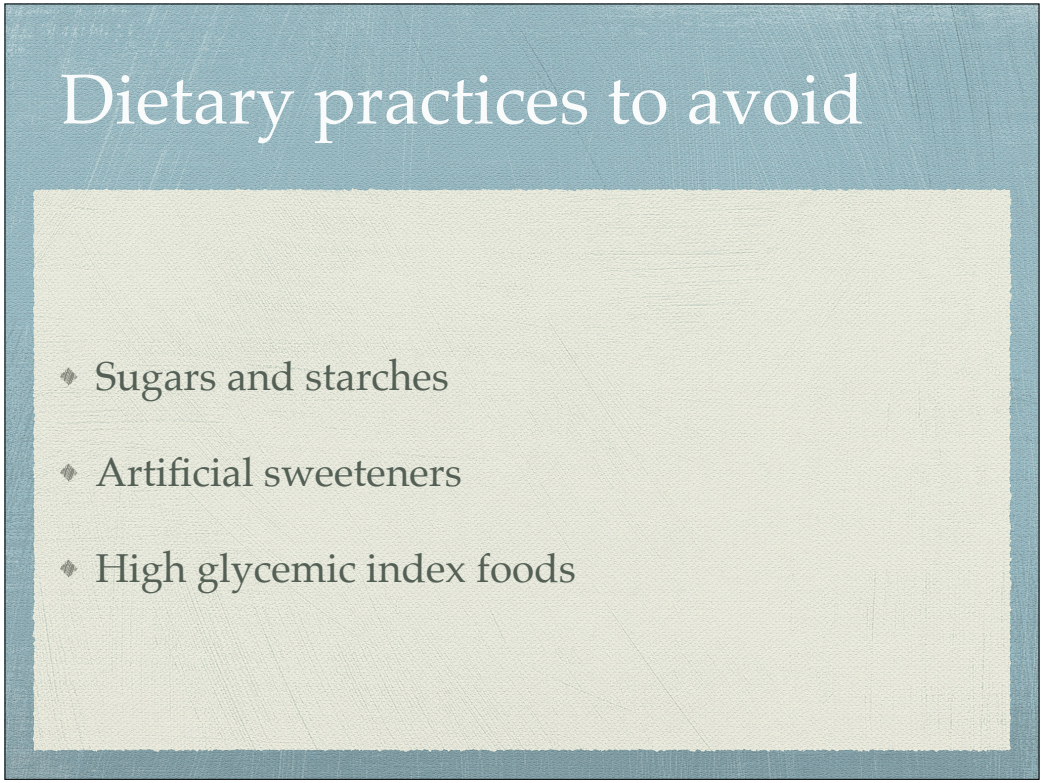
Similarly, insulin and some other medications increase cancer risk ➽ in diabetics.

In the over-85 age group, many of whom are on medication for high blood pressure, a very recent study showed that for every 10 mm of mercury decrease in systolic blood pressure, mortality ➽ and cognitive impairment increased.

And then, statins given for high cholesterol. Besides the muscle aches affecting about 10% of patients on statins, which may interfere with getting adequate exercise, statins may increase the risk of type 2 diabetes ➽ by 18% and for cataracts by 27%.



And seniors especially are highly vulnerable to what is called a “prescription cascade”. From Wikipedia: “Prescription cascade refers to the process whereby the side effects of drugs are misdiagnosed as symptoms of another problem resulting in further prescriptions and further side effects and unanticipated drug interactions. This may lead to further misdiagnoses and further symptoms.“



Let's turn to aspects of diet which may undermine healthy longevity.

As we covered before, carbohydrates, that is, sugars and starches, stimulate the secretion of insulin and also IGF-1, so we want to minimize them in our diets.

I'll bet you didn't know that just the taste of sugary or starchy foods on the tongue stimulates insulin secretion, even if we don't actually eat the food. This helps to explain why artificial sweeteners are associated with obesity, even if they contain no calories.

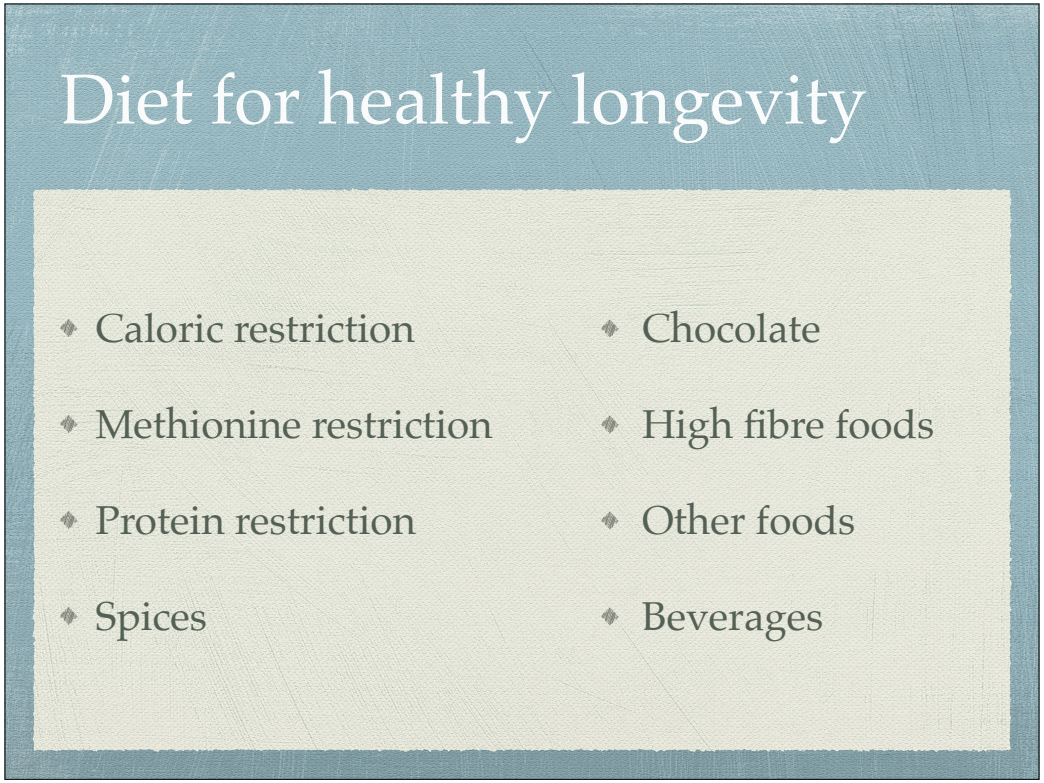
In fact, we have an insulin spike just from thinking about eating these foods!

Then there's the concept of glycemic index, yet another Canadian invention! The glycemic index is a number representing a food's effect on blood sugar, and therefore on insulin levels. There are other ways of measuring the insulin effect of foods such as glycemic load or insulin index. These measures may be more useful than glycemic index.

Artificial trans fats

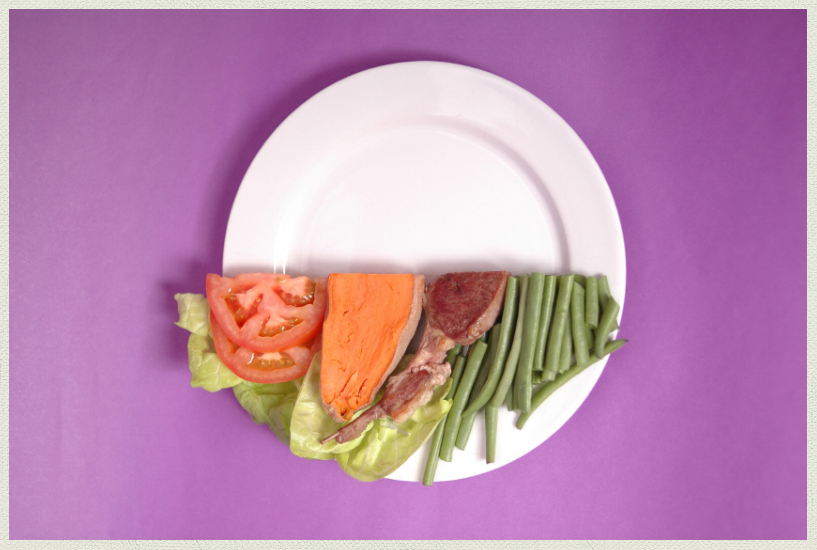
- Industrially produced trans fats came into common use in the 1950s
- Risk of cardiovascular disease increases with dose

Industrially produced trans fats have been widely used for frying foods, in baked goods, and in margarine. Although the problems they cause for cardiovascular health have been known since the 1950s, doing something about it has taken decades. In fact, in Canada the ban on trans fats came into effect only in September 2018, last month. And we have to wonder whether this is a total ban. For example, in the U.S., if a product contains less than 0.5g of trans fat per serving, it is considered to have zero trans fat for labeling purposes. That's actually quite a lot of trans fat, depending on the serving size.



OK, it's time to change our focus. Let's now look at the things we want to be doing to improve our health and longevity. Here is the slide you saw earlier on dietary interventions. First, caloric restriction.

Caloric restriction

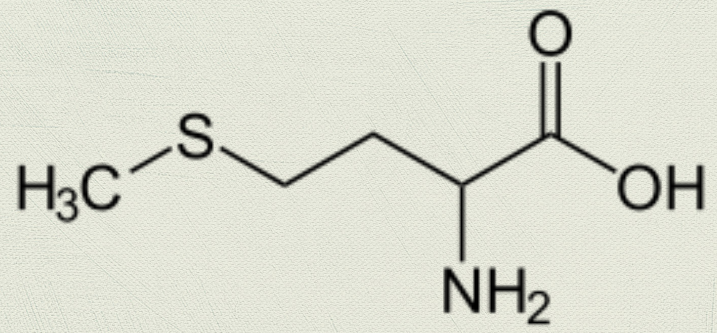


According to the Wikipedia article on caloric restriction, its benefits had been recorded even in the 16th century!

As I reported earlier, the experiments in the 1930s on rodents demonstrated that a reduction of caloric intake to 70% of the usual, led to increases in healthy lifespan of up to 50%. Since then, these kinds of experiments have been repeated in a variety of experimental animals.

But, going hungry voluntarily is very difficult for most people. So the search is on for ways to mimic the effects of caloric restriction without cutting food intake.

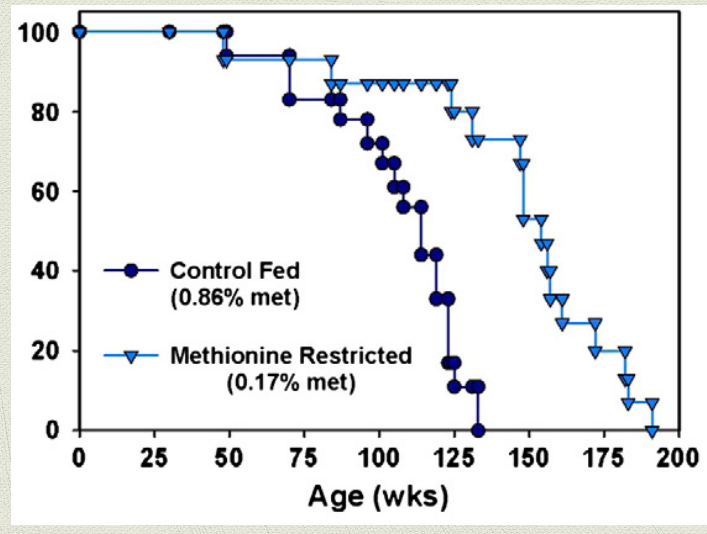
Methionine



Who knows what methionine is? Show of hands? Methionine is an amino acid. Amino acids are the building blocks from which proteins are constructed.
In the case of methionine, it was discovered way back in 1966 that certain cancers will die if deprived of methionine. Later, it was learned that many other cancers seemed to stop growing or grew much more slowly if methionine in the diet was restricted. This led to looking for the effect of methionine restriction on longevity.

While caloric restriction has been the most studied and is probably the most robust way of increasing lifespan, it appears that methionine restriction may be just as effective, and is much easier!

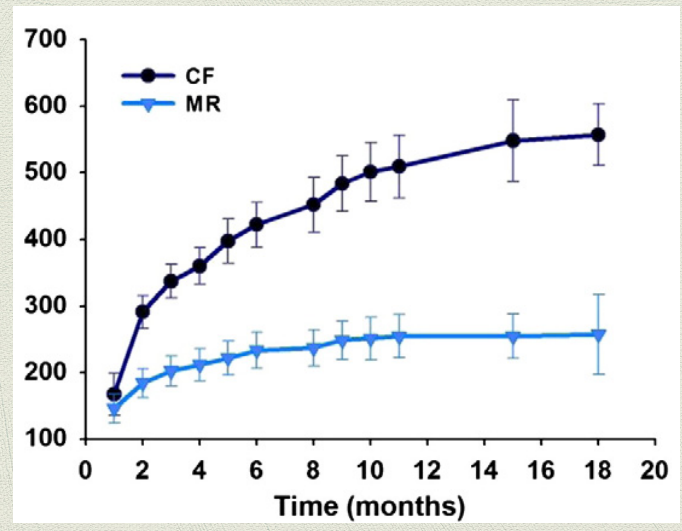
Methionine restriction



Perrone CE, Malloy VL, Orentreich DS, Orentreich N. Metabolic adaptations to methionine restriction that benefit health and lifespan in rodents. Exp Gerontol. 2012

Methionine restriction to 20% of the usual intake does confer health and longevity benefits to rats and mice, as these survival curves show.

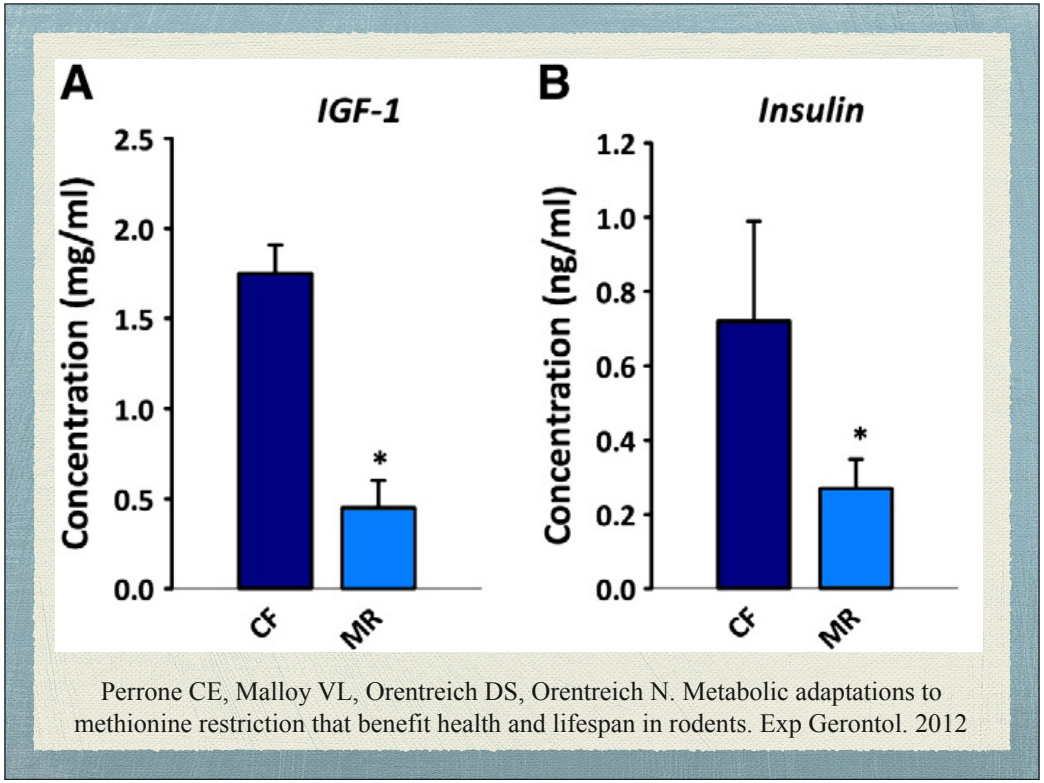
Methionine restriction



Perrone CE, Malloy VL, Orentreich DS, Orentreich N. Metabolic adaptations to methionine restriction that benefit health and lifespan in rodents. Exp Gerontol. 2012

But, just like caloric restriction, this kind of diet in young animals means severely reduced weight gain, so not good for you when you're young.

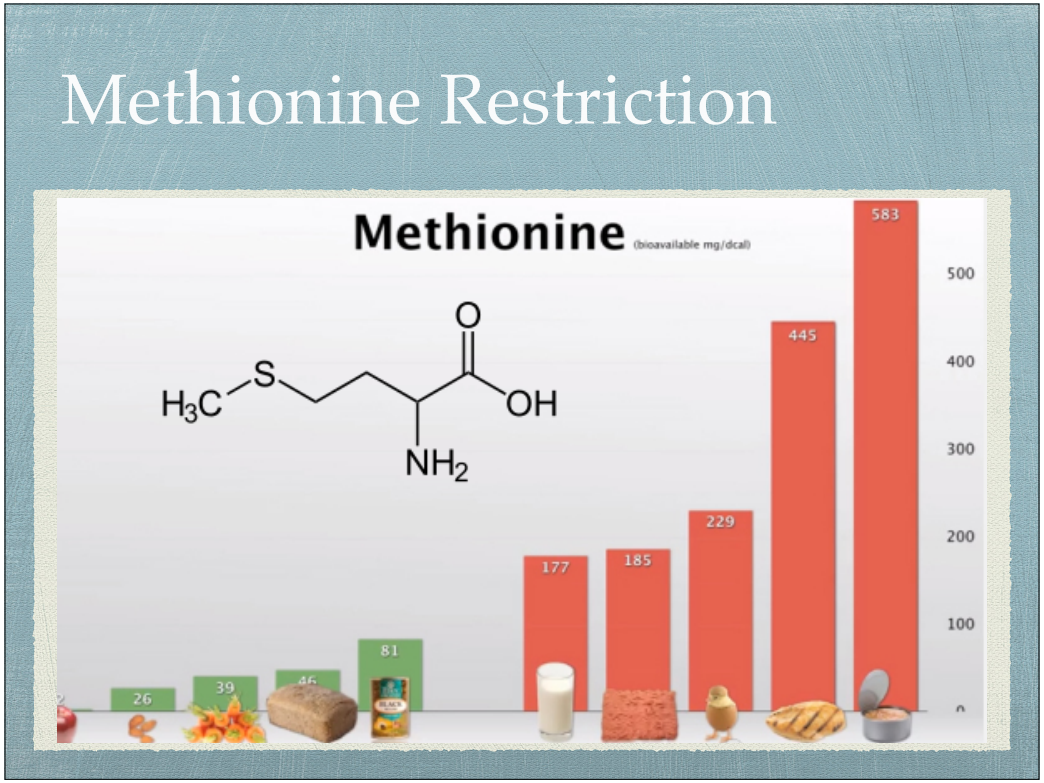
The graph shows weight in grams plotted against time in months. The lower blue line is for the animals on methionine restriction, while the higher black line is for the animals on the control diets, who received the identical amount of calories.



Perrone CE, Malloy VL, Orentreich DS, Orentreich N. Metabolic adaptations to methionine restriction that benefit health and lifespan in rodents. Exp Gerontol. 2012

How does methionine restriction work? Well, in rats, it causes marked reductions in the levels of both insulin, shown on the right, and insulin-like growth factor, on the left.

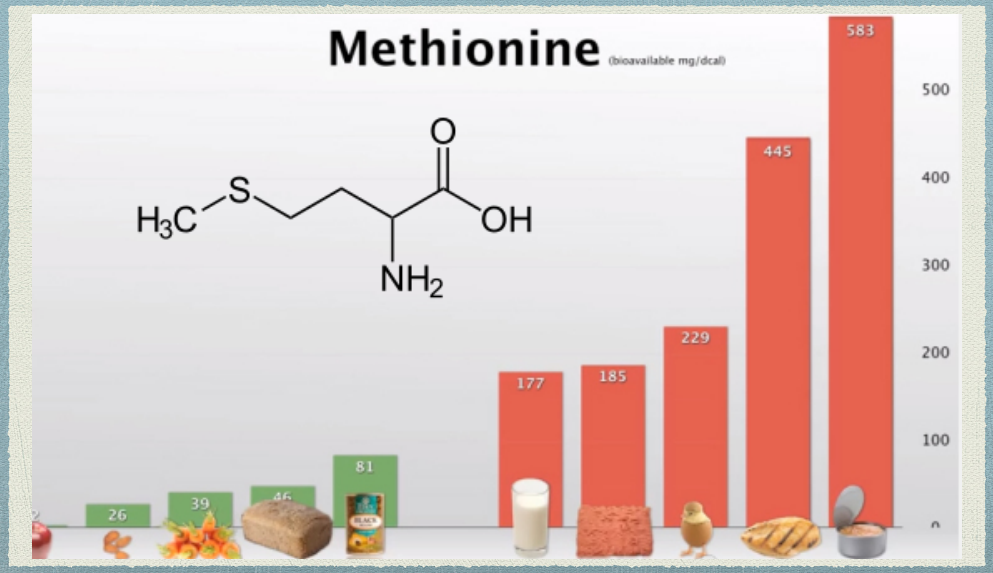
So when I read about these findings 6 years ago, Helen and I switched from a low-carb diet to a diet low in methionine.



This graph gives you a bit of an idea of methionine content. It ranges from a low of 1 mg per 100g of raw apple, to over 500mg per 100g of canned tuna!

In general, fruits have the lowest, followed by vegetables, then legumes and nuts, with animal products having the highest amounts of methionine. So, doing methionine restriction involves becoming mostly vegan, but at the same time avoiding the protein sources that vegans rely on, such as nuts or soy products like tofu.

Methionine Restriction

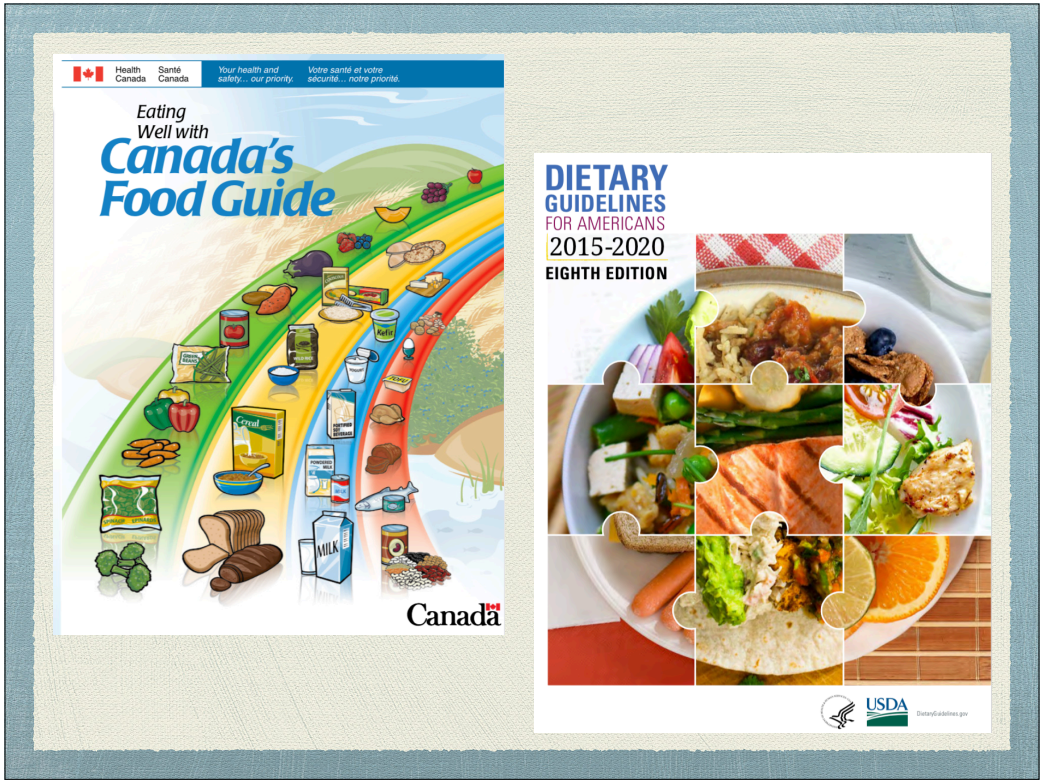


It turns out to be somewhat of a pain to find out which foods are low in methionine, so I made an app which runs on iOS devices like my iPhone or iPad. In addition to methionine, the app provides a great deal of other information about other nutrients in more than 8000 foods. I will demonstrate it after the talk, and tell you how to get the app.

Now let's turn to the third topic on that list of diet interventions, protein restriction. Studies in insects and mice have shown that low protein, high carbohydrate diets are associated with the longest lifespan in ad libitum fed animals. In humans, low protein diets reduce the risk for cancer and overall mortality in the population aged ≤65. In the 50 to 65 age range, subjects with high protein intake were more than 4 times as likely to die of cancer compared to those in the low protein group! This high cancer mortality seemed almost entirely due to animal protein intake, as opposed to plant protein.

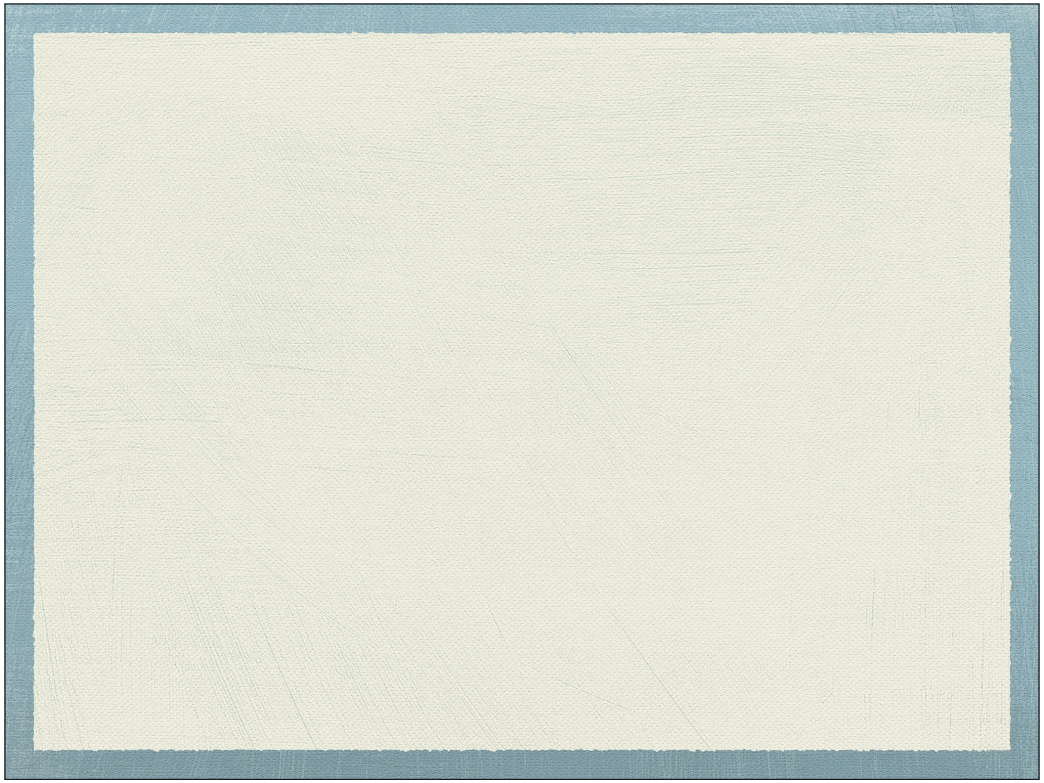
It's pretty clear that children need protein to support growth, and probably body-builders who are trying to bulk up their muscles. But older people, not so much.

So, how much protein do we actually need?



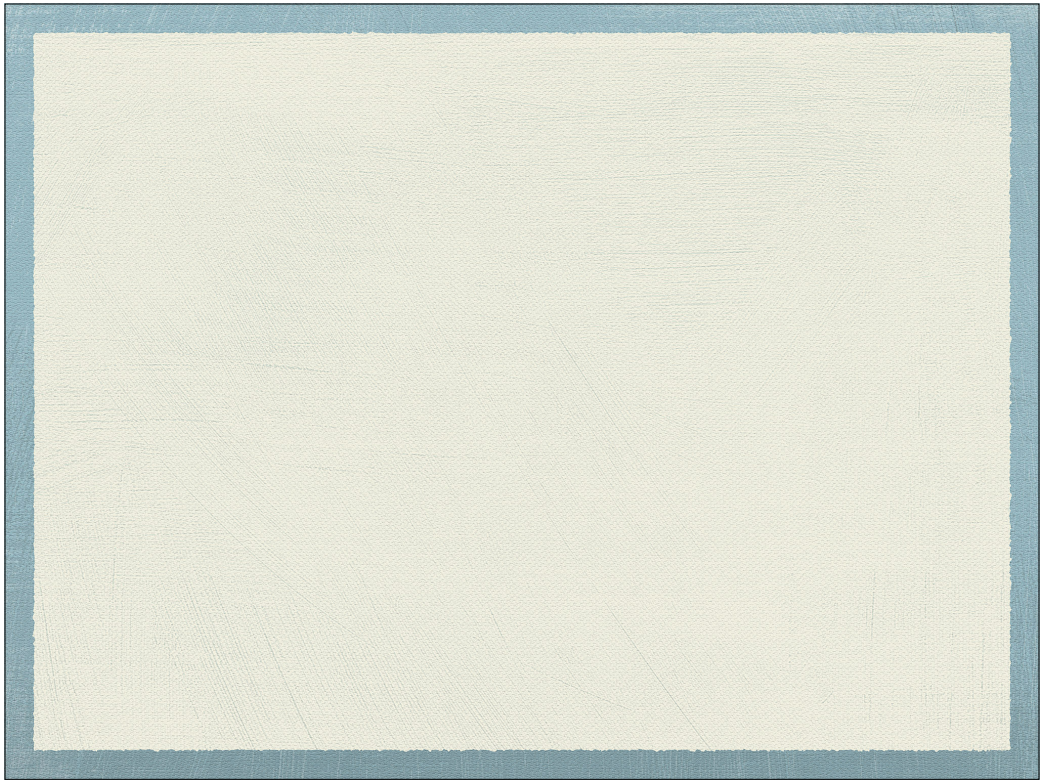
Every few years, government agencies in many countries publish dietary recommendations, such as Canada's Food Guide from Health Canada, or the Dietary Guidelines for Americans from the U.S. Department of Agriculture.

The Canadian guide does not address protein content directly, but if you add up the protein contained in the recommended 3 servings of meat and alternatives, 3 servings of milk and alternatives, and 7 servings of grain products, it works out to 130g protein per day for an over-50 male. That's huge, compared to the U.S. guidelines which suggest that active males consume between 73 and 78g protein per day. If you work through their serving recommendations, you will arrive at 91g protein per day.



The U.S. protein guidelines, as well as those of the World Health Organization and of the European Food Safety Authority are based entirely on a meta-analysis published on 2003, of nitrogen balance studies carried out in a total of 235 individuals. There are many reasons to be critical of this paper, including conflicts of interest. The largest food company in the world contributed to its funding, and this company named the principal author of the meta-analysis to its board of directors.

Other issues: these were all short duration studies, and only one study looked at the elderly.



So, as I said, I'm working on this, but it appears that a ratio of carbohydrate to protein of 10 to 1 may be optimal for experimental animals. And there are many studies suggesting that the protein should be plant-based.

Personally, I have been on a methionine restricted diet since May 2013. Over several months, my weight decreased from about 185 lb to around 165, and symptoms of gastro-esophageal reflux disease, or GERD, improved.

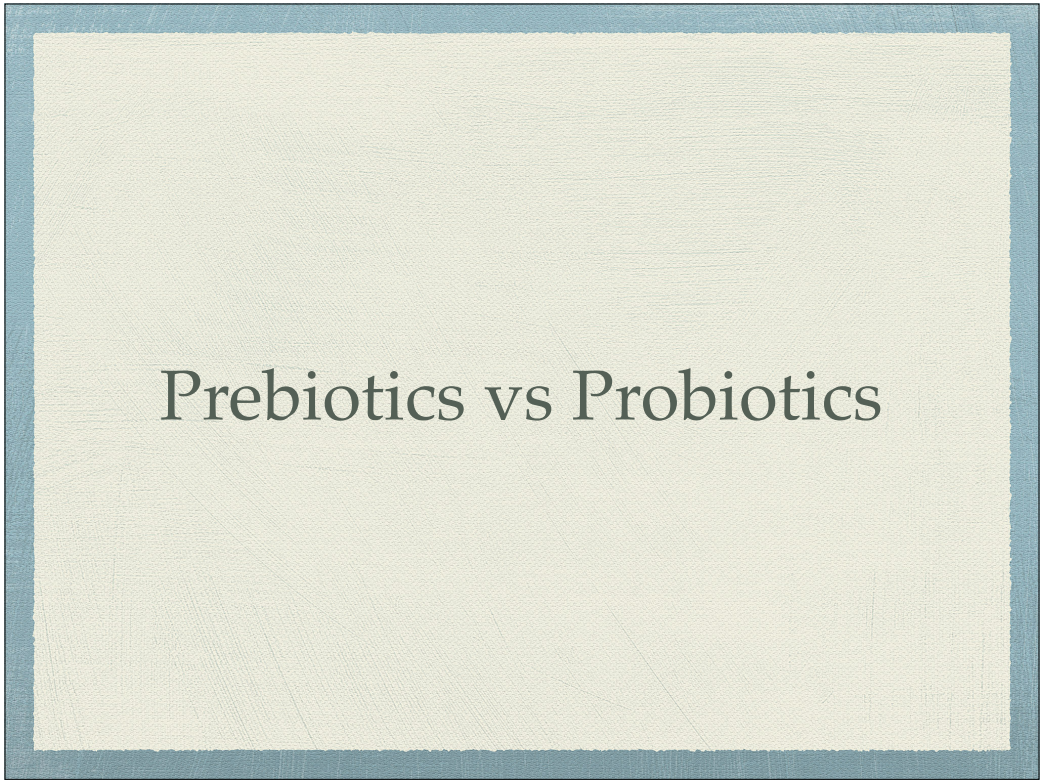
Spices

- Curcumin
- Ginger
- Cinnamon
- Capsaicin

A number of **spices**, such as curcumin, ginger, and cinnamon, have been found to have positive effects on healthy longevity. They also appear to lower insulin levels, possibly through an effect on the gut microbiome. The last one in this list, capsaicin, is not a spice; it's actually the substance that makes hot chili peppers taste hot.

I'll bet there are many people here just waiting and hoping to hear that chocolate is good for your health.

Dark chocolate is one of a number of foods with anti-inflammatory properties that is being investigated for anti-aging effects. In a study with postmenopausal women, dark chocolate (80%) given 90 minutes before a meal, suppressed food intake significantly more that milk or white chocolate. In comparison, white and milk chocolate caused transient increases in blood glucose and insulin levels.



Probiotics are live, beneficial bacteria that are naturally created by the process of fermentation in foods like yogurt, sauerkraut, miso soup, kimchi, and others.

Probiotics are also available in pill form and as an added ingredient in products like yogurt and health drinks.

Prebiotics are the non-digestible carbohydrate parts of plants, also called fibre. Because it cannot be digested and absorbed, it is available as food to the bacteria and other micro-organisms in our gut.

High Fibre Foods - inulin

- Plantain
- Burdock root
- Chicory root
- Garlic
- Jerusalem artichoke
- Jicama
- Leek
- Onion

Certain foods, including plantain ➽,
burdock root ➽,
chicory root ➽,
garlic ➽,
Jerusalem artichoke ➽,
jicama ➽,
leek ➽,
and onion ➽, have appreciable inulin content. Inulin, a non-digestible carbohydrate, is a prebiotic dietary fibre which reduces the insulin response after meals.

High fibre foods - glucomannan

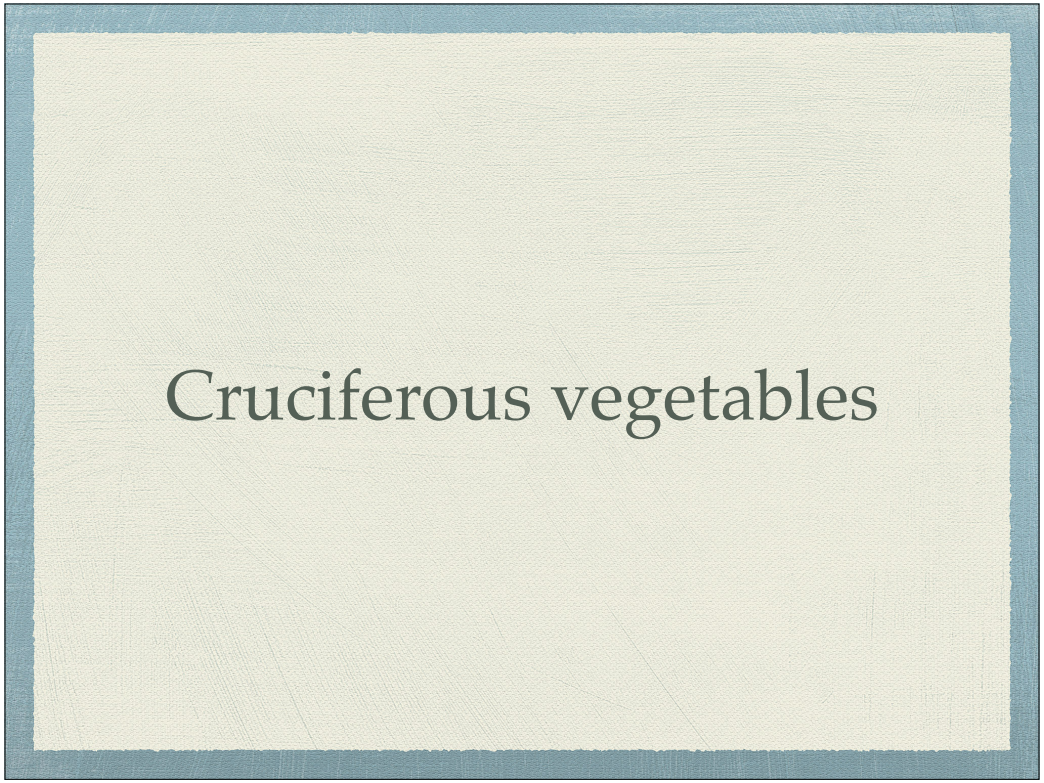
- Konjac

Another such non-digestible carbohydrate is glucomannan, which makes up 40% of the dry weight of the roots of the konjac plant. Glucomannan has been shown to promote weight loss.

Humans do not possess the enzymes necessary to break down inulin or glucomannan so they can be absorbed. However, in individuals with a healthy mix of gut bacteria, inulin and glucomannan are fermented by some of these bacteria, producing gas but also short-chain fatty acids such as butyrate, which suppresses inflammation and has other health benefits.

In other cultures, certain foods have been found that have an anti-obesity and anti-diabetic effect. For example, bitter melon, which originated in India, is widely used in China and in the Caribbean, and goes by a variety of names, including bitter apple; bitter gourd; bitter squash; balsam-pear, or kerala). It is effective in metabolic syndrome and shows promise as an anticancer agent. Bitter melon has been shown to lower insulin levels and body weight in rodents.

OK, pop quiz! Who can identify these vegetables? I'll point to each one, and just yell out it's name.
Kale
Brussels sprouts
Rapini
Cauliflower
Collard greens
Turnip
Broccoli
Rutabaga
Bok choi
Purple cabbage
Radishes
Daikon
Watercress
Kohlrabi



Why are these cruciferous vegetables, and there are others, important? They have been found to have a high content of compounds with anticancer activity. And again, it appears that some of these compounds reduce insulin levels in rodent models, or interfere with the insulin/insulin-like growth factor signalling pathways. Maybe they also act through microRNAs!

Next on our list of dietary interventions that promote healthy longevity: beverages. And first on the list of beverages is coffee. Coffee consumption reduces risk of type 2 diabetes, certain cancers, dementia, and cardiovascular disease. Coffee also reduces mortality risk.

Coffee, both regular and decaf, is a rich source of chlorogenic acids, which reduce the absorption of glucose from the intestine and in that way lower insulin levels. Chlorogenic acids increase longevity of those C. Elegans worms by 20%! Of course, you can undo all of the good stuff by adding sugar to your coffee!

In spite of all the studies showing health benefits from coffee consumption, it remains controversial, as I said earlier, and as I'm sure you're aware from many media reports.

Who here was told as a child, “Coffee will stunt your growth”? Show of hands.

True or false? Well, it appears that in some countries, Guatemala being a good example, even babies are given coffee. The average adult height for women in Guatemala is just under 5 feet. And a study in which the researchers convinced women to stop giving coffee to their infants showed that those babies grew at a faster rate when coffee was stopped.

Coffee stunts growth likely because it interferes with insulin and insulin-like growth factor.

What about other beverages? Green tea is associated with significantly reduced risks for stroke, diabetes, depression, and mortality.

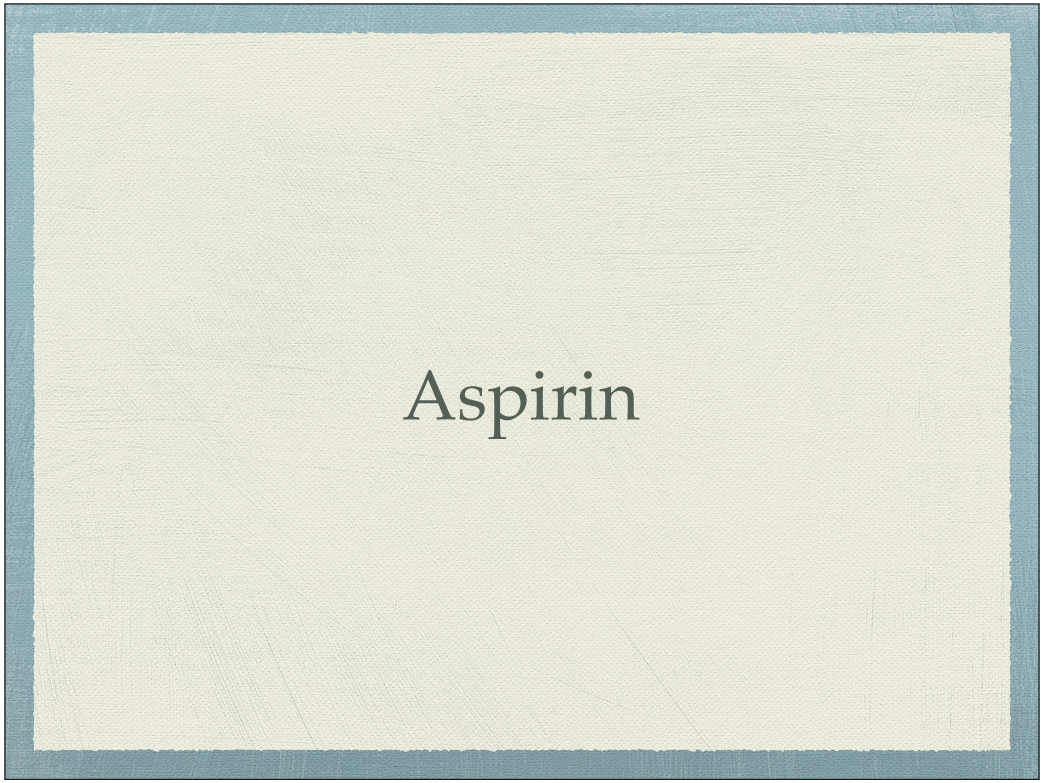
Then there's Yerba maté, a type of bush used to produce a tea that is widely consumed as an energy drink in South America. It has been found to have anti-obesity and anti-inflammatory effects.

And let's not forget about red wine, which contains resveratrol. Resveratrol, found in grape skins, is believed to be responsible for the health effects of red wine. It's a polyphenol which has antioxidant, anti-inflammatory, and anti-carcinogenic effects. And it increases longevity!

Medications for healthy aging

- Aspirin
- Metformin
- Rapamycin
- Liraglutide
- Acarbose

These are some of the medications which have been shown in experimental animals to be beneficial for healthy longevity. I will talk a bit about the first two, aspirin and metformin.



Aspirin extends the healthy lifespan of C. Elegans worms. In humans, it reduces the risk of cardiovascular events by about 25%; with respect to cancer, daily aspirin use for 5 years or longer reduced cancer mortality by 20% for solid tumours and by 35% for colorectal cancers.

It's been known since at least 1876 that aspirin and other salicylates lower blood glucose levels in type 2 diabetics; experimental studies suggest that this effect is due to a decrease in glucose absorption by the small intestine. Less glucose being absorbed means less insulin, which may explain aspirin's beneficial effects.

I tried a daily baby aspirin for a month or so, but I'm afraid it worsened my abdominal discomfort and GERD symptoms, so I had to stop.

Metformin is the most widely used oral antidiabetic medication. It reduces risk of certain cancers, dementia, cardiovascular disease and increases longevity. It is known to reduce insulin levels, possibly its effects on the gut microbiome.

Knowing that metformin is effective for weight loss, I asked my doctor to prescribe it for me as I was still suffering from GERD, which is related to overweight. He agreed, and I've been taking 1000 mg twice a day for several months. I've lost another 12 lb, and my GERD symptoms have certainly improved.

Supplements for healthy aging

What about dietary supplements for healthy aging?

In general, I think that dietary supplements should be avoided if our diets are adequate when we're older. However, my research suggests that the following supplements may be beneficial.

Supplements

- Melatonin

Melatonin, a hormone secreted by the pituitary gland, regulates sleep and wakefulness. It also inhibits insulin release.

As melatonin levels decrease with age, it is possible that the resulting higher insulin levels contribute to the conditions of aging.

I take 10 mg of double action melatonin every night, just when I get into bed. Double action refers to a portion which is immediate release and a second portion which is timed release.

Vitamin B12

- intranasal hydroxocobalamin spray

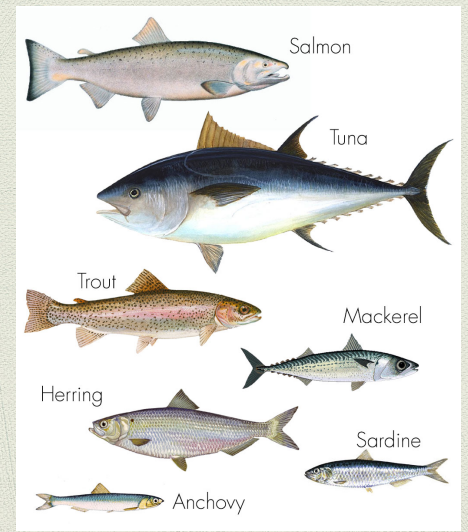
Only bacterial cells retain the capacity to synthesize vitamin B12, but almost all organisms, except plants and fungi, require B12. In humans, the absorption of B12 from food is a highly complicated process, and gets worse with aging. About a quarter of community-living elderly are B12-deficient. That increases to 46% for nursing home residents.

In the wild, the consequences of B12 deficiency, such as anemia, lower extremity weakness, loss of postural balance, and dementia, would quickly result in death. Could it be that B12 deficiency in the elderly has been “built in” by evolution as another mechanism to kill off the eldest generation?

As animal-based foods are the only sources of food B12, the vegan or quasi-vegan nature of methionine and protein restricted diets is already likely to result in B12 deficiency, unless supplements are taken.

Since no bad effects of excessive B12 have been identified, I would typically recommend to my older patients to take 1000 mcg daily. Unfortunately, in individuals with pernicious anemia, even this dose may be insufficient. So, weekly injections of 1000 mcg B12 may be necessary. I personally use this nonprescription alternative, intranasal hydroxocobalamin spray (available online).

Omega-3 fatty acids



Although the research evidence is mixed on whether supplements of fish-derived omega-3 fatty acids are beneficial, a diet with oily fish is believed by many scientists to be important for brain, psychiatric, and cardiovascular health, and decreased mortality.

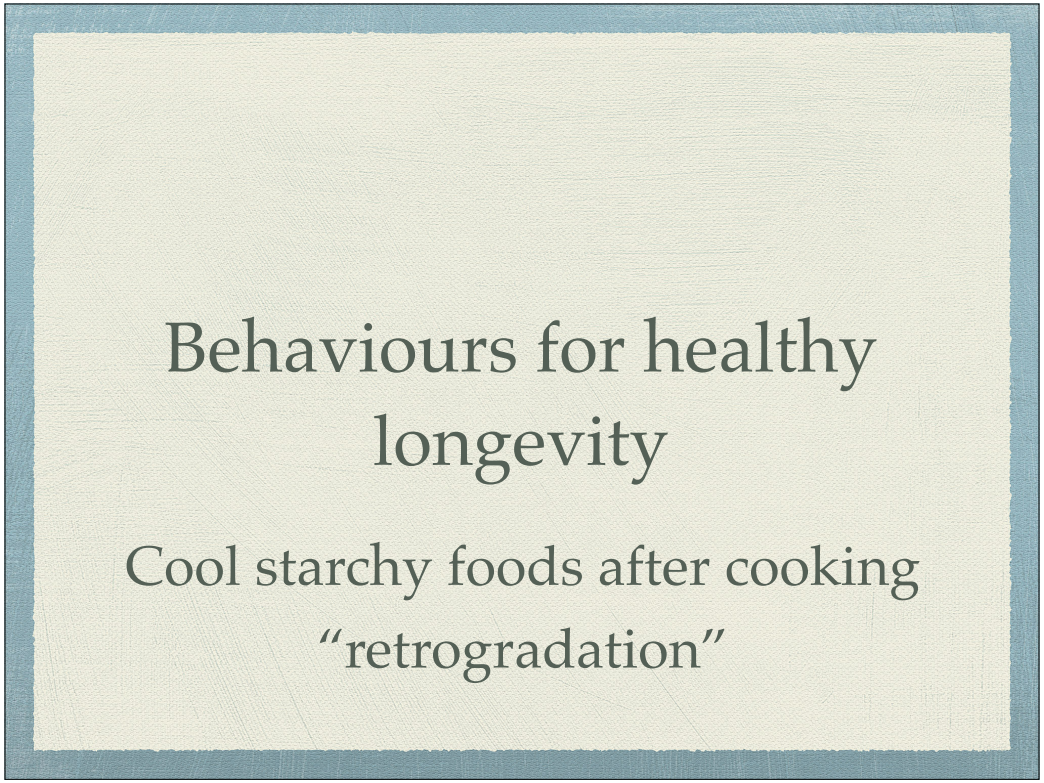
Given that methionine restriction and protein restriction both severely limit our fish intake, we take an omega-3 supplement , one capsule every other day.

Behaviours for healthy longevity

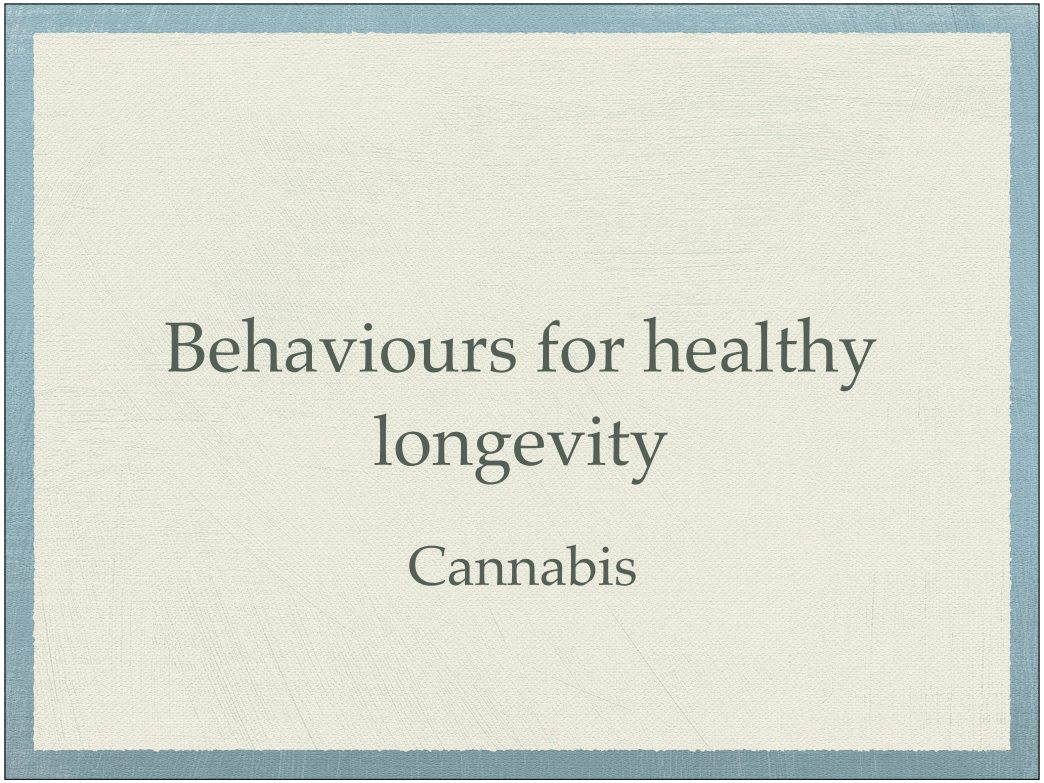
Exercise

And finally, are there things we can do that will improve both lifespan and health span? There sure are!

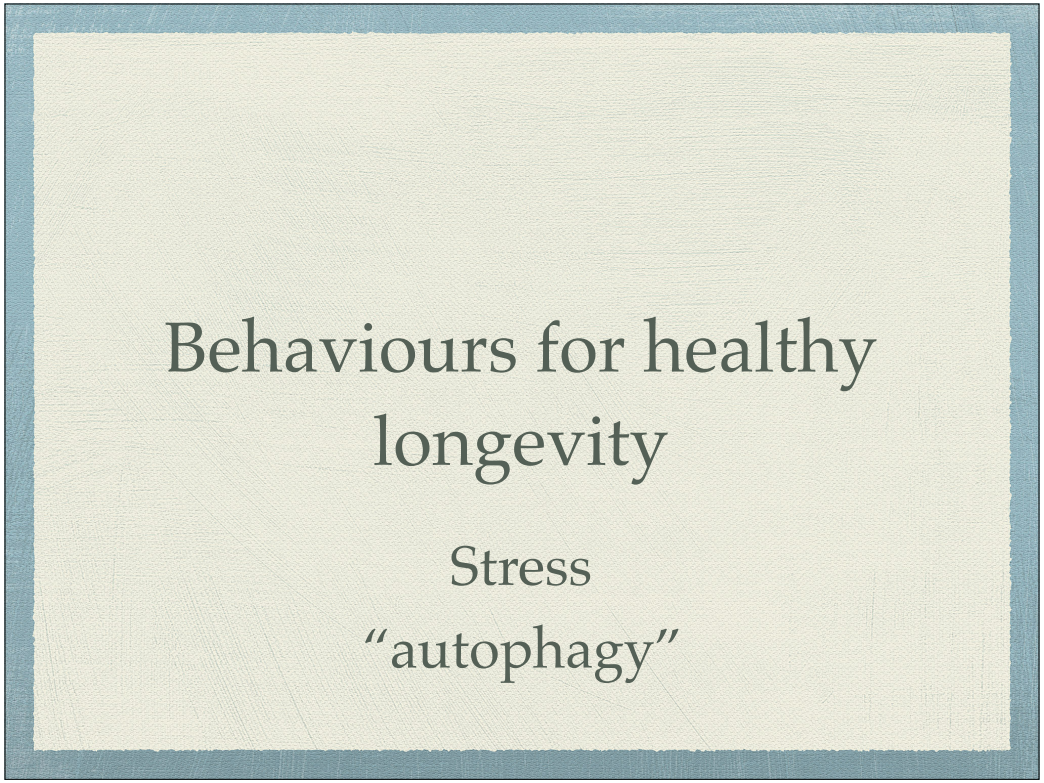
First, exercise. ➽ Aerobic exercise has been shown to decrease fasting blood glucose and fasting insulin, for example in pregnant women at risk for gestational diabetes. Interval training may provide even better glucose control, and may improve compliance because of significantly reduced time requirements.



Then there’s how we cook our foods. When starchy foods such as potatoes, beans, or white rice are cooled after cooking, the links between the glucose molecules in the starch are rearranged, making the starch more difficult to digest; more of the starch becomes “resistant”. This process, called retrogradation, reduces the amount of insulin produced as a result of eating that starchy food. Additionally, the resistant starch acts as a prebiotic, thus reducing inflammation.



Let’s move from cooking, to toking. Did you know that marijuana smokers have lower rates of obesity, metabolic syndrome, and diabetes? There is also evidence that cannabinoids may have anticancer activity but this effect may be dose-dependent, as there is also evidence that these molecules may stimulate cancer cells. At present, only medical cannabis is legal, but that’s going to change next week!

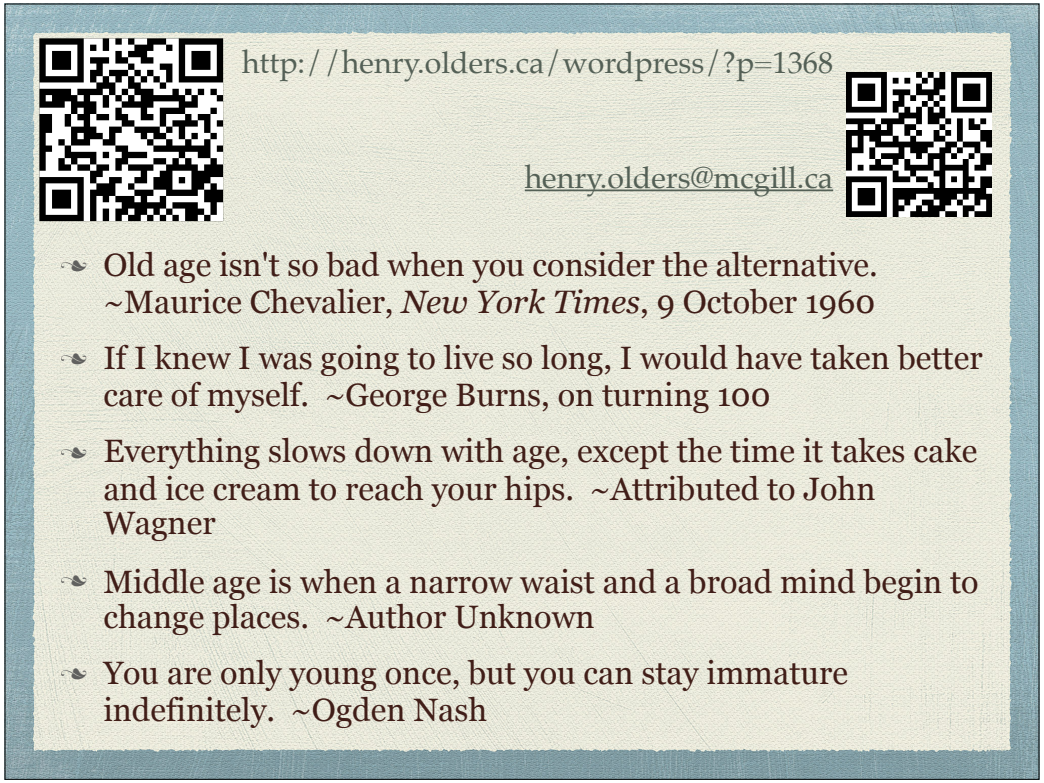


And finally, stress for success. Most of the lifespan-prolonging interventions in various experimental organisms are stresses, whether food stress, heat stress, or cold stress. Even stresses such low-dose ionizing radiation, or exposing worms to low concentrations of the herbicide paraquat, have been shown to increase longevity! And of course, the stresses induced by exercise increase muscle strength, cardiorespiratory fitness, and bone strength.

So stress is not something to avoid, but rather to welcome, at least in low doses! “What doesn’t kill you, makes you stronger”. The mechanism may be autophagy, which is the fancy name for the cellular tear-down of worn-out components for recycling. So turn the thermostat down a bit. Do you really need an SPF-80 sunblock? Walk or cycle instead of driving. Stairs instead of the elevator. Are you obsessive about keeping your house clean, or scrubbing your fruits and vegetables? Consider getting up earlier if you have insomnia or depressive symptoms such as fatigue.

That’s it! Done!

You know, while preparing this talk, I realized something very important. Now that I’m mostly retired, in looking back over my life (so far!) my passion, and my greatest source of satisfaction, whether as parent, teacher, engineer, or doctor, has been to offer tools which give my children, students, clients, or patients more control over their lives and over their wellbeing. My hope is that you will be able to make use of these ideas, that it has been my great pleasure to share with you today. Thank you.



I will leave you with a few quotations, and also with a link to my website where I've posted the lists of do's and don'ts, complete with references. Questions or comments, anyone?