Notebook - Metabolical

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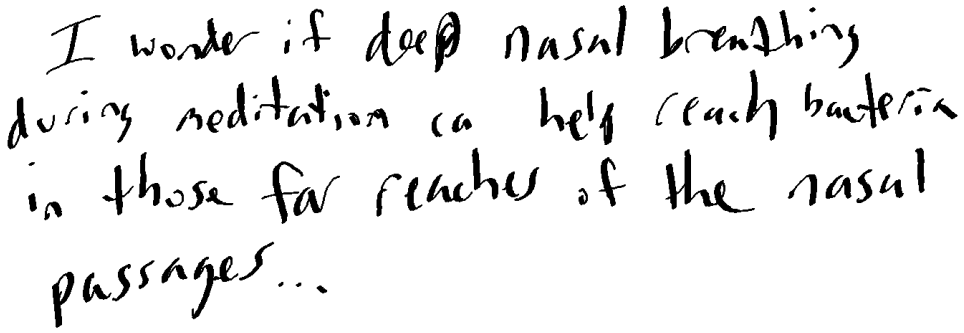
Lustig, Robert H.

Page 111 | Highlight

> 8). Oxygen also has the unique capacity to create an inhospitable environment for foreign invaders (like bacteria), but also for our own cells.

Note:



Page 128 | Highlight

> Insulin drives cancer cell growth because it's how the glucose gets into the cell in the first place; it's the key to the door,

Page 128 | Highlight Continued

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Note:

In other words (and what I've said before), sugar is cancer-food, as high-carb sugar foods predict an insulin spike

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Page 129 | Highlight

> But on the other hand, when a cell has too much ATP, AMP-kinase gets turned off. Mitochondria aren't burning, and the cell will divert the pyruvic acid to make structural components. Anything that impairs AMP-kinase will drive fat synthesis and worsen insulin resistance. And what food impairs AMP-kinase the most? Sugar, of course.

Page 130 | Highlight

> These three enzyme checkpoints together explain how the cell metabolizes energy: PI3-kinase imports glucose into the cell; AMP-kinase directs the energy to mitochondria for burning; and mTOR determines whether a cell lives or dies.

Page 139 | Highlight

> The good news is that for chronic disease, genetics only explains about 15 percent of the variance in risk. The other 85 percent is environmental, which means there's plenty you can do to mitigate your risk for diabetes, cancer, heart disease, dementia, and virtually every other chronic disease.

Page 142 | Highlight

> Adult males should have a waist circumference of less than 40 inches, and adult females less than 35 inches.

Page 142 | Highlight

> Fasting lab tests. There's a boatload of information to be gleaned from fasting lab tests, but it often takes an experienced clinician who's up-to-date in their medical knowledge and expertise to know how to order and interpret them properly. Here's the list of the tests you need to make sure your doctor orders: lipid profile (LDL-C, HDL-C, TG), homocysteine (Hcy) level, alanine aminotransferase and aspartate aminotransferase (ALT and AST), uric acid, fasting insulin, fasting glucose, and hemoglobin A1c.

Page 143 | Highlight

> The second thing to look at is the HDL. If it's over 60, it almost doesn't matter what the other fractions are, as this is a sign of good cardiovascular health. If the HDL is under 40 (men) or under 50 (women), then your predisposition for heart disease is much higher. The third thing to look at is the LDL-cholesterol. If it's below 100, the small dense fraction can't be high enough to be harmful. If it's over 300, you might have the rare genetic disease familial hypercholesterolemia (FH) and you can't clear your LDL, in which case a low-fat diet, and likely a statin added, will be essential to prevent a future heart attack. If it's between 100 and 300, then you need to look at the TG level. If the TG level is above 150, that's metabolic syndrome until proven otherwise. Finally, tell your doctor to look at your TG:HDL ratio. For reasons that are completely unclear, race matters with TG levels. If it's over 2.5 in Caucasians or over 1.5 in African Americans, that's a correlate of metabolic syndrome.

Page 144 | Highlight

> But there is yet another dietary pathway to heart disease, and it has nothing to do with LDL or triglycerides. If you have a family history of heart disease, tell your doctor to look at your diet and epigenetics by drawing a serum homocysteine (Hcy) level. This is a lab test that is not routinely ordered because it's not correlated with genetics and heart disease, only with diet and heart disease. Hcy is an amino acid associated with heart disease, but it does not come from eating protein. Hcy should be completely cleared from the bloodstream and eradicated or it will build up in the blood vessel and cause inflammation. The enzyme that clears Hcy is responsive to the vitamin folic acid. But if you have low folic acid in your diet, or you're on chemotherapy, such as methotrexate, or you have a genetic problem with this enzyme, then your Hcy levels go up and your risk for heart disease goes up as well. Fourth, you need to assess diet and liver function. As stated

> before, while not specific for liver fat accumulation, the liver enzyme alanine aminotransferase (ALT) is easy to assess and reasonably sensitive and specific for measuring the degree of liver fat. If it's over 25, you definitely should investigate further. You also want to look at the aspartate aminotransferase (AST) level, which is a measure of mitochondrial function. AST levels rise acutely with alcohol or acetaminophen consumption, but also with hepatitis from any cause. If the AST is elevated, you can assume your liver is either under acute (infectious, alcohol-, or toxin-related) assault, and if your ALT is elevated, then it's likely under chronic metabolic assault (e.g., liver fat). If both are elevated, you then want to know whether there's been any liver damage. For that your doctor will need to order a nonstandard but inexpensive test called a gamma-glutamyl transpeptidase, or GGT. If this is over 35, you've got a problem, and likely need a liver ultrasound to assess your liver fat. You're also going to need to do something different about your sugar and alcohol consumption or both.

Page 145 | Highlight

> But in fact, a fasting blood glucose of 90 is already questionable. The same is true for hemoglobin A1c (HbA1c), the blood test that assesses glucose control over the preceding three months. By everyone's estimation, under 5.5 percent is normal, while over 6.5 percent is frank type 2 diabetes. It's what goes on in between that's up for grabs, and it's in this gray zone where most adults live. The higher it is, the greater the glycemic excursions, and the more risk for metabolic disease. The body will do everything it can to maintain a fasting serum glucose below 100, including increasing the insulin (that's insulin resistance!). So, irrespective of the fasting glucose, you want to have a simultaneous fasting insulin level, which tells you how hard the pancreas is working. A fasting insulin of greater than 15 microunits/ml usually means significant

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Page 145 | Highlight

> From the glucose and insulin levels together, you can calculate an index called the homeostatic model assessment of insulin resistance (HOMA-IR = glucose x insulin ÷ 405), which assesses your risk for diabetes. A HOMA-IR of less than 2.8 is excellent, 4.3 is average, and anything higher means trouble.

Page 147 | Highlight

> Your waist circumference is a key. If it's high, expect that there is some metabolic problem, and that you will have to change your diet to improve your insulin resistance. If your waist circumference is high and your blood pressure is also high, assume the problem is sugar, not salt. If your blood pressure is high and your waist circumference is low, the problem might be salt or

Page 147 | Highlight Continued

> stress.

Page 155 | Highlight

> New research shows that sugar consumption is associated with the development of Alzheimer's disease.

Page 155 | Highlight

> A processed food eating pattern has been shown to be predictive of future Alzheimer's disease, although no one has yet demonstrated that switching to Real Food lessens one's risk.

Page 157 | Highlight

> Insulin resistance has been shown to be a primary cause of clinical depression in humans. Sugar is a specific driver of insulin resistance, and one cause of depression in both rats and humans.

Page 188 | Highlight

> Furthermore, the saturated fat story doesn't take into account that all saturated fats are not the same. For example, the saturated fats in red meat are even-chain fatty acids (16 or 18 carbons), meaning they're cardiovascularly neutral. The saturated fats found in dairy are odd-chain fatty acids (15 or 17 carbons), which are metabolized differently in the liver, and are associated with protection from chronic diseases like diabetes and heart disease. Therefore, the fat in dairy is likely protective

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Page 189 | Highlight

> However, you don't eat free fatty acids. They're produced and exist in only two places in the body. When stored triglyceride is released from the adipocyte (fat cell), the glycerol backbone must be cleaved off, liberating its three free fatty acids. It also happens when the liver turns excess sugar into triglyceride through the process of de novo lipogenesis (DNL), as it first must produce a free fatty acid. Both of these processes are related to each other through fructose, as fructose causes both insulin resistance and DNL.

Page 198 | Highlight

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> Bottom line is: processed food kills. Normally it kills the old-fashioned way, slowly, by causing chronic disease. But chronic disease puts you at risk for acute disease as well.

Page 222 | Highlight

> We thought that everything in cow's milk was good for growing kids—calcium, vitamin D, protein, phosphorus—except for the saturated fat, and so we made non-fat and low-fat options. But the saturated fat in whole milk, due to its odd-chain fatty acids and phospholipid content, is actually protective in preventing diabetes and heart disease.

Page 226 | Highlight

> Alcohol provides calories (7 kcal/gram), but it's not nutrition. There's no biochemical reaction that requires it.

Page 227 | Highlight

> Fructose, while an energy source (4 kcal/gram), is otherwise vestigial to humans; again, there's no biochemical reaction that requires it. However, fructose is metabolized in the liver in exactly the same way as alcohol.

Page 229 | Highlight

> three toddlers, eighteen months old, all on ventilators in congestive heart failure because their parents had placed them on a macrobiotic diet. These ostensibly well-meaning parents were trying to prevent their children from succumbing to the "toxins" associated with meats, oils, and dairy products, so instead they fed their tots grains, cereals, vegetables, and, of course, tater tots. As a result, their hearts ballooned and couldn't pump from the lack of iron, vitamin D, and calcium.

Page 230 | Highlight

> The vegan diet, by its very nature, is deficient in the fats necessary for babies.

Page 280 | Highlight

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> Americans are fast food junkies—up to 37 percent of adults eat some form of it every day. Fast food is highly processed, nearly all fiber and nutrients have been stripped, and it's designed to tickle your taste buds in colorful packaging. Is it just the calories, or is there something specific about fast food that generates the addictive response?

Page 281 | Highlight

> So-called high-fat foods preferred by people are almost always also high in carbohydrate (e.g., potato chips, pizza, donuts)—then add sugar, and preference for high-fat foods goes up even more. Conversely, if you take the carbs out and just eat the fat (as in low-carb and ketogenic diets), people eat less.

Page 282 | Highlight

> Some, but not all, self-identified food addicts describe sugar withdrawal as feeling "irritable," "shaky," "anxious," and "depressed," symptoms also seen in opiate withdrawal. Other studies demonstrate the transference of addiction from one toxic addictive substance to caffeine, nicotine, and/or sugar—meaning sometimes when you stop smoking, you start drinking. Sometimes when you stop drinking, you start eating. All of these behaviors activate the same dopamine reward system.

Page 283 | Highlight

> All in all, while sugar doesn't exhibit the DSM-IV standards of tolerance and withdrawal, it sure as hell meets the DSM-5 standards of tolerance and dependence. So, whatever criteria you decide to use, it's now obvious—sugar is addictive and many of us are junkies.

Page 283 | Highlight

> certain genetic traits increase risk for both sugar seeking and drug addiction. While these are correlation, not causation, it's not too far a stretch to imagine that some people are more susceptible to the addictive effects of sugar than others. This is similar to what is seen in alcohol—40 percent of Americans are teetotalers, 40 percent are social drinkers, 10 percent have a binge drinking problem, and 10 percent are bona fide alcoholics. We don't know the percentage of people who are addicted to sugar, but how many people say, "I have a horrible sweet tooth"?

Page 284 | Highlight

kindle

> The ultra-processed food category (see Chapter 17) is where 65 percent of the sugar in our diet lives—

Page 284 | Highlight

> there's only one place added sugar is not—Real Food.

Page 284 | Highlight

> Merriam-Webster Dictionary defines "food" as: "a material consisting essentially of protein, carbohydrate, and fat used in the body of an organism to sustain growth, repair, and vital processes and to furnish energy." Fructose supplies energy, so that makes it a food, right? But can you name an energy source that isn't nutrition by any dietitian's estimation, for which there is no biochemical reaction in the human body that requires it, and that causes disease when consumed chronically and at high dose implying addiction? Answer—alcohol. It has calories (7 kcal/gm), but it's clearly not nutrition. When consumed chronically and in high dose, alcohol is toxic, unrelated to its calories or effects on weight.

Page 285 | Highlight

> When you process and purify something, you change its properties. Coca leaves are medicinal in Bolivia, but cocaine is a drug. Opium poppies were medicinal, but heroin is a drug. Caffeine is found in coffee (medicinal for many), but concentrated caffeine (e.g., in weight loss remedies) is a drug. In ancient times, sugar was a spice. Through the Industrial Revolution, it was a condiment. Now that it's processed and purified, it's a drug. How is this any different from refined sugar? Refined sucrose is the same compound found in fruit, but the fiber has been removed, and it's been crystallized for purity. This process of purification turns sugar from food into drug, just like alcohol and caffeine. And just like these addictive consumables, sugar is a food additive. The minute the dose exceeds the liver's capacity to clear and metabolize it, it's in the brain, driving reward in all people, and addiction in some. And it's being added by Big Food to 74 percent of the food supply, because when they add it, we buy more.

Page 288 | Highlight

> it's estimated that up to 80 percent of Italian virgin olive oil is neither Italian nor virgin.

Page 289 | Highlight

> Organic. You might think that buying organic would save you from fraud. You would be wrong. The markup on organic is enormous, anywhere from 25 percent for avocados to 65 percent for milk. Furthermore, there's a clear economic impetus to mark individual items as organic, as the only way to be caught is through laboratory analysis. One fraudster netted $142 million for faking organic on the label, and then spent his ill-gotten gains on Las Vegas casinos and sexual escapades. He eventually committed suicide rather than go to jail.

Page 290 | Highlight

> The people who buy honey from around the world and put it in bottles are called packers. Most packers blend foreign honey with domestic, but the foreign honey (especially that coming out of Asia) is adulterated. So perfectly good domestic honey is cut with several different kinds of sugars to dilute the product, many of which are not detectable by testing. Others are cleansing honey in such a way as to remove its nutritional components. So even though American beekeepers produce 40 percent of the honey we consume, they also carry surpluses because the packers won't give them a fair price. The honest beekeepers are expected to compete with dishonest honey producers and exporters.

Page 291 | Highlight

> It is not unusual for processed foods to have five or more ingredients in them—for each additional ingredient, the chances of adulteration of that processed food increases to the 1.7 power. This is particularly true for the organic label on imported foods.

Page 293 | Highlight

> But why does Big Food outsource in the first place? Sometimes it's because certain foods only grow in certain regions, such as spices, vanilla, olive oil, cocoa, and coffee. However, the climate in the US is diverse enough to grow almost everything here. California, Florida, and Hawaii can sustain cocoa, coffee, and vanilla plants in addition to most citrus fruits. In other regions of the US, foods like honey, corn, wheat, cherries, grapes, pears, apples, peaches, plums, tomatoes, carrots, lettuce, grains, and a host of other produce can be grown in abundance. It would just cost more than our current outsourcing. Statistics vary slightly, but why does two-thirds of the apple juice in America come from China, and why does over 50 percent of orange juice and concentrate come from Brazil (especially since Brazil is dousing their oranges in glyphosate)? Why do we get milk powder from India, or seafood from Vietnam? Big Food has done the cost calculations down to the hundredth of a penny.

Page 295 | Highlight

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> In the meantime, what can you, the consumer, do to protect your health and your wallet from food fraud?

Page 295 | Highlight

> The more ingredients, the more risk (e.g., salted peanuts have three ingredients, Oreos have eleven ingredients). Avoid highly processed food. Buying organic may decrease your risk for cancer, but it increases the risk of fraud because fraudsters focus on organic due to the higher profit margin. Buy from the supplier directly (e.g., the farmer or the farmer's market). Fewer middlemen mean fewer entities jacking up the price and people to hide behind, as well as more direct and face-to-face responsibility to the consumer. We are years, perhaps decades, away from truly fraud-free food.

Page 299 | Highlight

> As dramatized in Dark Waters (2019), E. I. du Pont consistently stonewalled for nineteen years to avoid litigation regarding its use of perfluorooctanoic acid (PFOA or Teflon) in pots and pans. We learned the hard way that big money industries will do anything they can to turn a profit at whatever cost to lives, the environment, and society at large. The sugar industry is one of the most egregious villains in the bunch. Based on our current recognition of sugar's toxicity and their responses to litigation thus far, one might assume that Big Sugar learned its tricks from Big Tobacco.

Page 300 | Highlight

> 1954. In any case, the playbooks are almost identical—deny, deflect, distract, delay. The entire processed food industry has adopted this policy.

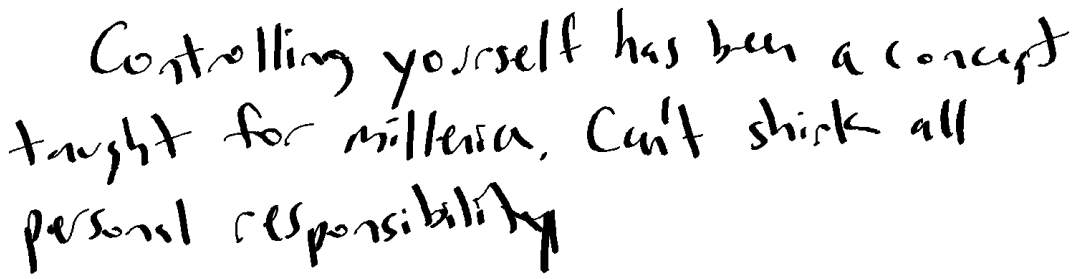
Page 302 | Highlight

> It turns out that sugar has two effects on weight gain. One is an immediate function, where year by year consumption predicts year by year weight gain; the second function is what your mother ate before you were even born. As explored earlier, mother's consumption of sugar reaches across the placenta, goes to the liver to turn sugar into liver fat, and to the pancreas to make extra insulin, which drives fetal fat cell development. This is why obesity rates keep going up in the US, even though sugar consumption has dropped slightly in the last decade—the current

Page 304 | Highlight

> But who invented personal responsibility anyway?

Note:



Page 311 | Highlight

> Hank Cardello, a former executive at Coca-Cola and chief strategist at the Hudson Institute, argues in his book Stuffed (2009) that the food industry has a problem, yet only the food industry can fix it. However, the simple fact of the matter is that no one inside the food industry can or will fix this, because of Wall Street, shareholders, and quarterly earnings reports. Nope, change is going to have to come from the outside.

Page 319 | Highlight

> when it comes to food, the charter only provides for screening for acute toxicity—things that will make you keel over and die, like melamine in milk, botulism in vichyssoise, E. coli in apple cider, Salmonella in eggs, and Listeria in spinach. The FDA has done most of that pretty well, save for the occasional hamburger recall. But nowhere does the FDCA mention chronic toxicity, where one exposure isn't toxic but rather cumulative exposure will kill you. This loophole lets the food industry get away with all sorts of slow murder.

> the risks of carbon dioxide are immediately offset by the fact that it's an essential nutrient for plants; they need it for photosynthesis. We could live perfectly fine without methane, but we'd be dead without carbon dioxide. The problem isn't the carbon dioxide itself, but that there aren't enough plants to metabolize it, due to deforestation. This is where the deforestation of the Amazon—the "lungs" of the Earth—comes into play. About 15 percent of the Amazon rain forest has already been cleared for cattle farming. But the biggest danger in Brazil is the "next big thing"—sugar farming. Because of the world's sweet tooth, the Bolsonaro government has approved 19 million hectares of Amazon rain forest to be plowed over to make way for sugar farms. People worldwide were horrified by the Amazon "burning" in 2019, which they attributed to climate change. This is untrue—the real reason was to feed our hunger for processed food.

Page 354 | Highlight

> The public health criteria for regulation of a substance are: Ubiquity. Sugar has been added to virtually every processed food, limiting consumer choice. Evolutionarily, sugar as fruit was available to our ancestors for only one month a year (harvest time) or as honey, which was guarded by bees. Nature made sugar hard to get, while man made it easy (see Chapter 20). Now it's in everything that we eat. Toxicity. Every country consuming the Western diet has increased its prevalence of NCDs, and sugar is the driver. Fructose increases liver fat, drives the glycation reaction, and inhibits mitochondrial function, all of which underlie NCDs (see Chapters 7 and 8). Abuse. Sugar is clearly abused, because it's addictive in a percentage of the population. Like tobacco and alcohol, it acts on the reward center to encourage subsequent intake. It also meets the criteria for tolerance and dependence (see Chapter 21). Externalities. Your consumption affects me, therefore I get to say something about it (see Chapter 23).

Note:

NCD = Non-communicable disease

Page 360 | Highlight

> there's no economist on the planet who believes in food subsidies, because they distort the market. They make the wrong stuff available while making the right stuff harder to afford. As long as commodities are cheap, Real Food will stay out of reach for much of the population. Furthermore, the American commodities market is rife with hedonic substances. In fact, numbers one (crude oil), two (coffee), four (sugar), five (cocoa), and eight (corn, which is turned into alcohol) are all hedonic. It drives our economy. Today, we tax cigarettes and alcohol, but the US government still subsidizes tobacco production. We toy with a carbon tax. And now six cities have soda taxes, on an item for which the government exerts price controls. How about just ending the food subsidies, quotas, and price controls? People say that the price of food would go up, but the Giannini group at UC Berkeley modeled what food would actually cost, and the only two items that would increase in price are sugar and corn. Not surprisingly, these are two of the major industries fighting to maintain the status quo.

Page 372 | Highlight

> Here are the seven shopping rules to abide by, even before you walk into the store (or order online), that will keep you from stepping on any of the landmines the store has placed in your way. Don't go shopping hungry. Shop the edges of the supermarket. If you've gone into the aisles, you've gone off the rails. If a product is on the endcap of the aisle, the company paid to have it placed there. Don't be a stooge. Any food that has a logo you've heard of or any food with a Nutrition Facts label has been processed. If a product lists a structure-function claim on the package, don't buy it. Example: any food that says low-fat or no trans-fats is poison, because something else is in there instead. If it doesn't say whole grain, it isn't. And even if it does say whole grain, it probably isn't. If the carbohydrate to fiber ratio is greater than 10 to 1, don't buy it. If any form of sugar is one of the first three ingredients, it's a dessert.

Page 377 | Highlight

> Recently, Annals of Internal Medicine reported a case of a thirteen-year-old boy who went blind eating only junk food. Even after the cause of the blindness was determined and shown to be due to micronutrient deficiencies resulting in retinal and neural dysfunction, replacement of these micronutrients didn't restore the boy's eyesight. Now, this is an isolated event, but it explains the power of food—and foreshadows what will happen if we don't address the problem.

Page 378 | Highlight

> In 2014, at the LA premiere of Fed Up, I had the great fortune to meet Jane Seymour. From Solitaire to Dr. Quinn, Medicine Woman to Wedding Crashers, she's always been at the top of her game. At

> the time she was sixty-three, but looked thirty-six, and with virtually no makeup. She confided in me that her father was a country obstetrician/gynecologist in the UK, and he was very wary of the processed food industry. She said she owed her good looks to the fact that she had never consumed processed food in her entire life. Knowing what I know about sugar, glycation, and wrinkles, she was a living testament to the work that I was doing.