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In 2006, Jeffrey Gordon, MD, and his colleagues at the Washington University Medical School in St Louis published a paper in the journal *Nature* demonstrating that thin mice and obese mice have different populations of gut bacteria. Furthermore, they proved that one particular type of bacteria caused obesity, rather than obesity changing the types of bacteria.

When the scientists isolated a strain of Firmicutes bacteria from chubby mice and then introduced them into the bacteria-free guts of thin mice raised in a sterile environment, the skinny mice fattened up in just 10 to 14 days.[1]

Mice aren't the only species that harbor thrifty Firmicutes bacteria. Humans do, too. And just like mice, those of us who coexist with Firmicutes as part of our gut ecosystem are more likely to be fat.

Overeating may not be the fundamental reason why someone is overweight. The more weight a person carries, the less leptin (the satiety hormone) they secrete and the hungrier they'll be. It's like their off-switch is broken. But what if overeating is a symptom and not the main cause of obesity that's caused by something else?

I'm not saying this is true in every case because obesity is a complicated condition. But I do think that gut bacteria may revolutionize the way we think about weight. The question is, can we change the composition of our community of gut bacteria and will people lose weight when that happens?"

Naturally, researchers and Big Pharma are hot to answer that question.

Thrifty Firmicutes

Those clever Firmicutes that Dr Gordon and his colleagues studied are experts in extracting calories from food. They're good friends to have around in times of famine, when you might have to fill your belly with some pretty fibrous stuff like leaves, stems or even bark. The Firmicutes possess a rare metabolic talent that allows them to digest the complex sugars that fibrous vegetation contains, breaking them down into small, digestible components.

Dr Gordon's colleague Vanessa Ridaura carried out a landmark study of gut bacteria present in identical pairs of human female twins where one was thin and the other was fat. Twin studies are popular because the genetic influence on metabolism is controlled for.

When gut bacteria from a lean human twin were transferred into mice raised in sterile environments, the mice stayed thin. But when thin mice raised in a sterile environment received bacterial transplants from an obese twin, they got fat.[2]

It took the rodents a mere five weeks to gain 15 to 17 percent more weight than their uninfected mouse peers.

One of the star researchers in the field of nutrition and gut microbes is Dr Patrice Cani, a professor at Catholic University in Louvain, Belgium. His lab tracks the interaction between gut bacteria, metabolism and obesity. A recent BBC report on his research showed that when obese mice (fed a high-fat diet) are given a prebiotic (a fiber nutrient that certain strains of bacteria like to eat), the number of a species of mucin-degrading bacteria called *Akkermansia muciniphila* increases markedly. As a result, the rodents lose almost half their body fat without any change to their diet. Their insulin resistance also disappears.[3]

Hippocrates, the father of modern medicine, once said that all disease begins in the gut. Amazing as that may seem, he may well be correct.

When mice are fed a high-fat diet to make them obese, they promptly develop a syndrome called *leaky gut*. Normally the junctions between the cells that line your digestive tract are tight to prevent bacterial toxins and bits of unprocessed food or feces getting into your body.

If the tight junctions loosen up—the equivalent of a circle of people who are holding hands letting go—then bits of bacteria, food, feces or other stuff that is normally kept inside the gut can sneak into your circulation. When bits of bacterial cell membrane leak through the gut lining, the immune system mounts an attack that can also target the body's own cells—a condition known as *autoimmune disease*.

Inflammation, insulin resistance, metabolic syndrome and type 2 diabetes may also be—at least in part—the result of a leaky gut.

The gut harbors several varieties of Gram-negative bacteria, some of which are good guys and some of which are bad guys. The cell membranes of all Gram-negative bacteria consist, in part, of structural molecules called lipopolysaccharides (LPS), comprising a lipid (fat) molecule joined to a

polysaccharide (sugar).

LPS molecules are *endotoxins*, agents that stimulate a powerful immune response if they penetrate the gut wall and enter the circulation.[1] Not only can they cause autoimmune disease and potentially fatal *endotoxemia* (poisoning by endotoxins), but they may also be the elephant in the room of depression.

Dietary fat and leaky gut

If rats fed a high-fat diet develop leaky gut, obesity, inflammation and metabolic problems, what does that mean for us humans?

Jeff Leach, bacterial anthropologist and founder of the Human Food Project (www.humanfoodproject.com), wrote an illuminating report about bacteria and leaky gut entitled *Can a high fat Paleo Diet cause obesity and diabetes? Maybe, unless.* Reflecting on studies in which mice were fed a high-fat diet that caused weight gain, inflammation, insulin resistance and, ultimately, type 2 diabetes, Leach focused on the protective effects of friendly microbes known as *Bifidobacterium*.

The fiber oligofructose from chicory root is known to stimulate the growth of *Bifidobacterium*. Leach reviews the results of a study that looked at the interaction between fat and fiber: "[The fiber] was added to a high fat diet fed to one group of mice, but not to the same high fat diet fed to another group. In the high fat only group, endotoxemia was significantly increased, but in the high fat diet that also included the prebiotic, *Bifidobacterium* levels predictably went up and the LPS levels were normalized. This also correlated with improved glucose tolerance and a normalized inflammatory 'tone.'"[3]

> You're not eating just for yourself; you're eating for the 100 trillion bacteria that are part of who you are. Which beasties you choose to feed has a major effect on your physical and even mental health

Bifidobacterium are metabolic heroes. They synthesize the short-chain fatty acids butyrate, propionate and lactate, which nourish the gut epithelium, protect the integrity of tight junctions and keep the gut barrier intact. To perform their magic, bifidobacteria need prebiotics (fiber that feeds them) from onions, garlic, dandelion greens, chicory root and tubers like Jerusalem artichokes. Americans get only 1 to 4 g of those prebiotics, on average, daily.

Leach continues: "If in fact the levels of *Bifidobacterium* in our microbiota mediate gut permeability… then our chronic low intake of prebiotic dietary fibers may be a significant player in our epidemic of metabolic syndrome. It is interesting to think that all of the attention that has been given to various substances that might lead to a leaky gut might be missing the 800 pound gorilla in the room—*Bifidobacterium*."[3]

Leach makes the point that the US government MyPlate dietary recommendation is way behind the times (as is the UK's Eatwell Plate). We need to eat a BioPlate instead. That sage advice is based on the fact that the usual government dietary advice ignores the rather astounding fact that 90 percent of our cells aren't even human. They're bacterial. And they're hungry, too.

The number of good bacteria in the gut can be increased in a couple of ways. You can eat foods or take supplements rich in the prebiotics that the bacteria prefer, or bacteria can be grown in a broth and then you can take it directly.

The moral of the story is that you're not eating just for yourself. You're eating for the 100 trillion bacteria that are an integral part of who you are. Which beasties you choose to feed has a major effect on metabolism, and physical—and yes, even mental—health.

Bacteria, leaky gut and depression

Anxiety, depression, autism spectrum disorders (ASD), attention-deficit/hyperactivity disorder (ADHD), schizophrenia, and a host of neurological, mental health and mood disorders are related, at least in part, to our gut microbes. Feeding your kids low-fiber foods high in bad fats—oxidized fats, trans fats, polyunsaturated fats like supermarket-brand oils, processed cheese spreads or slices, and commercial pizza made with cheap 'analogue cheese' whipped up by food chemists to mimic the characteristics of real mozzarella—increases the possibility that they will develop leaky gut syndrome. Once thought to be a fiction that circulated largely in the alternative medical community, even mainstream physicians now know that leaky gut is a real phenomenon linked to a host of immune-related inflammatory conditions, including depression.

When the food we give our kids is fake food (what American author and activist Michael Pollan calls '*food-like substances*'), we're altering the environment of their gut bacteria, starving out some of the good guys and setting up conditions for both obesity and leaky gut, as well as planting the seeds of depression and anxiety.

The millennials (those born between 1977 and 1992)

Eliminating the problem

A 2013 study from the Netherlands, published in the prestigious *New England Journal of Medicine*, prepared fecal solutions from healthy volunteers and placed them in the small intestines of patients infected with *Clostridium difficile*, the notorious *C. diff* that kills about 13,000 Americans annually. This bug can be exceptionally difficult to eradicate even with powerful antibiotics like vancomycin.

The results of the fecal transplants were spectacular. The bacterial implants cured the infection in over 85 percent of recipients—a much higher rate than with antibiotic therapy.[1] For those whose transplants didn't vanquish the *C. diff* infection the first time around, a second transplant usually did the trick.

An earlier 2012 study from the same Dutch team investigated the role that bacteria might play in reversing metabolic syndrome. They infused intestinal microbes from thin people (with normal metabolism) into men with metabolic syndrome.

They then studied the effect of the transplants on the composition of the recipients' microbiomes and glucose metabolism. Six weeks after infusion, the insulin sensitivity of recipients had increased significantly.

The researchers concluded that intestinal microbes "might be developed as therapeutic agents to increase insulin sensitivity".[2]

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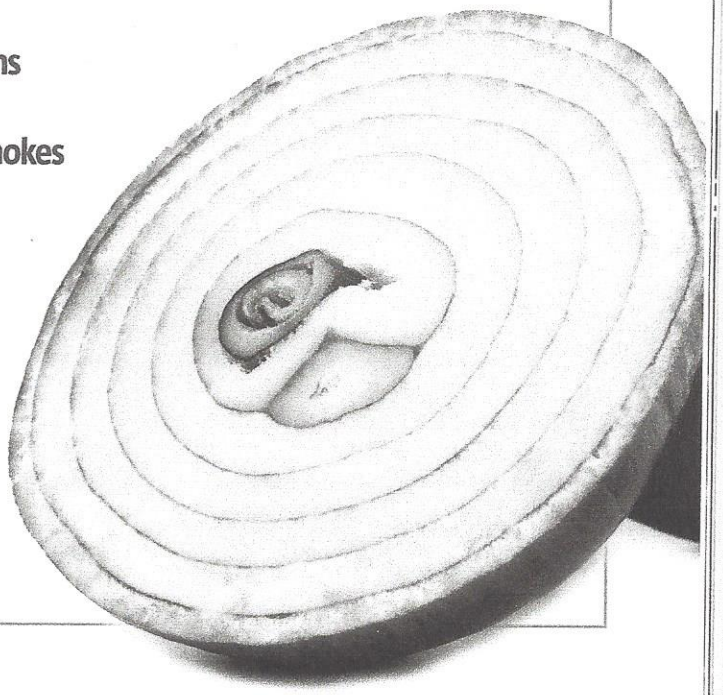
3 types of PRE-BIOTICS

Feeding your gut bacteria

Eating liberal amounts of the following foods provides your gut microbiota with their preferred fiber.

Onions
Garlic
Dandelion greens
Chicory root
Jerusalem artichokes
Yams
Leeks
Jicama
Taro
Parsnip
Potato
Sweet potato
Radish
Ginger
Rutabaga



are reported to be the most stressed, depressed and anxious generation in recent history. Of course they're under a lot of other stress, living in a world of unpredictable change, scarce jobs and electronic communication. The latter can trump the all-important face-to-face connectivity that stabilizes our brain and immune system. But the younger generations are also victims of the fake-food legacy.

According to journalist Ann Brown's article online at Madame Noire: "Depression has been diagnosed for 19 percent of millennials, compared with 14 percent of Generation X (ages 34 to 47), 12 percent of Baby Boomers (ages 48 to 66) and 11 percent of those ages 67 and older. Anxiety disorder has also been cited in millennials more than other generations, 12 percent, compared with 8 percent of Gen X, 7 percent of Boomers, and 4 percent of seniors."[6]

It's humbling to think that depression and anxiety could be as related to our gut bacteria as are our mothers.

A new look at fiber

All plant foods contain fiber, which Jeff Leach defines as "any part of a plant that cannot be digested and absorbed in the small intestine and ends up in the large bowel (colon). Once in the colon, dietary fiber is broken down and utilized by our good bugs for their own growth and turned into energy (calories) for us."[5]

Like people with individual metabolic needs, various strains of bacteria also thrive on different types of fiber. That's why a diversity of vegetables, fruits, beans and whole grains (for those of us who can eat the latter two foods) cultivates healthy bacterial growth.

Unfortunately, the microbiome of most modern Britons and Americans is a rather pitiful shadow of what it might be. The average adult American eats only 12–15 g of fiber a day. According to an Institute of Medicine formula based on getting 14 g of fiber for every 1,000 calories, women are supposed to eat 25 g/day and men 38 g/day. According to ethnographic and fossil data combined with studies of contemporary hunter–gather populations, government recommendations are off by several orders of magnitude. *Aiming for 100 g of fiber or more daily would be a lot more beneficial.*

Oligofructose and inulin are types of fiber found in garlic, onions, yams, chicory root, bananas, wheat, the tuber known as a Jerusalem artichoke, dandelion greens, leeks and jicama. You can't get away with taking a fiber pill that contains just a single source of fiber either. Only by eating a variety of whole-plant foods can you increase the biodiversity of your gut bacterial community.

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The bottom line is that the less processed any food is and the more fiber it contains, the better it is for your gut microbes and therefore for you.

The kind of food you eat is a powerful modifier not only of your microbial community and its genes (your microbiome), but also of the community of your mammalian cells and their genes—and ultimately your weight.

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