



Diseases of food: looking beyond medicine, to causes

Symmetry is about being similar and different at the same time. As we saw in Chapters 2 and 3, about symmetries in the body, human hands are this kind of similar: each one like the other, but opposed in a functional sense and pushing against each other, albeit often for common purpose. Such is a hallmark of symmetry, to be similar, similar, similar, and then different.

Health and wealth symmetry

Two of life's most sought-after states, health and wealth, follow this same pattern of symmetry between them. For young adults, being well is often the ordinary condition of living, one which they can take for granted. But ageing brings less functionality and more infirmity, and health then asserts its true value: priceless. Health and wealth are both highly prized, though in a head-to-head contest health always wins out over wealth as the more basic foundation of happiness – Virgil tells us that the greatest wealth is health. But when we plan our personal life objectives, defining financial goals is common, while designing a plan for lifelong wellness and health is rare.

The fundamental factors that shape wealth and health are similar. A good start in life is a boon to either: initial conditions strongly predict future performance, setting the trajectory. The fortunate start with some assets, to be nurtured, protected, and taught how to build good habits beginning early in life, knowing that today's saving is

tomorrow's reward. Parental circumstances offer advantage or disadvantage, predicting likely outcomes. Both favorable genetic characteristics and family wealth can be passed from one generation to the next, helping to promote a secure future. But likelihoods are not certainties: a gambler can squander an inheritance just as substance abuse can poison a healthy body, and calamity can befall even the best-prepared, as external and unexpected conditions enter the picture too.

For those fortunate enough to have a little wealth, banks and modern investments can store our assets off-site and spread our risk. But not so for health, which doesn't allow us to save, store, or stockpile it. With the body as our only home, factory, and warehouse all rolled into one, we must store our energy right on the premises and carry it about with us, wherever we go. Too many reserves can burden the frame and overload the suspension, and overabundant stores will spill over and gum up the inner workings. Balance is the key for health and well-being, especially the balance between intake and expenditure: neither too much nor too little food or exercise. And while we know our banker cannot hold our hand when we walk through a store making spending decisions, we may lapse into assuming that our doctor is responsible for managing our health, forgetting that the absence of disease is primarily a function of a dozen small choices we make for ourselves every day.

After all these symmetries and parallels, health and wealth finally hit asymmetries, at points where



they intersect, one directly affecting the other. Two effects are most notable, as well as contradictory. One is the impact of wealth on health, which is usually positive: around the globe, an overall rise in one's standard of living and a general improvement in a community's quality of human life both contribute to greater health. Widespread increases in wealth allow for better nutrition, better hygiene, better health education and information, and better medical care – including preventive measures – all helping to insulate us from certain diseases. But, somewhat paradoxically, affluence then carries its own health risks, so the rich have a long history of painful diseases. Gout is one, long known; too much wine and rich food (such as were once available to only the well-off) can increase uric acid retention, depositing sharp crystals in the joint space at the base of the great toe, where they cause an intense reaction of bright redness, swelling, and excruciating pain, or triggering sudden colicky pains in the flank, as stones form in the kidneys and obstruct the flow of urine. This classic affliction of bishops and kings is a disease of excess.

Diseases of poverty, diseases of affluence

In impoverished nations, on the other hand, disease is an immense challenge, with multiple deadly diseases arising from global poverty today, the most common of them AIDS, malaria, and tuberculosis, together accounting for 1 in every 10 deaths worldwide each year. Measles, whooping cough, and polio also still exact a heavy toll, though there are well-known, effective treatments and prevention for these childhood diseases, making them the first targets for intervention from global health initiatives, which have taken great strides towards reducing their incidence.¹ Nutrition is vital for successful outcomes, because while well-nourished children may become ill from measles they rarely die of it, since resistance arises to fight off the effects of a pathogen if its human host is healthy. Just as the mobile home park sustains more damage from a tornado than do

houses of stronger construction and the people on the flood plains of Bangladesh suffer greatest losses in the floods of the rainy season, initial conditions set the scene and will largely determine the impact and severity of disaster or disease.

Diseases of wealth, on the other hand, differ from diseases of poverty, and as affluence rises around the world, so do its diseases. Where once we had a handful of health woes linked to wealth, we now have a panoply. Common illnesses of affluence include obesity, hypertension, heart disease, stroke, dementia, and cancer, with multiple factors conspiring to promote these conditions. Many are problems of diet, from foods now known to carry greater risk of disease.

Food marketers, in promoting their wares, eagerly cast doubt on what we know, but researchers without vested interests repeatedly report the same general themes about what foods are dangerous.² Even amidst the dueling camps of dietary fads, considerable research now confirms that foods with more fat and higher sugar content, consumed too regularly over time, carry threats to health. Fare heavy in refined white flour, calorie-rich offerings such as meat and dairy, and processed foods deliver a higher risk and offer a greater burden of disease. And onto the ostensible luxury of a sedentary lifestyle, we also replace physical exertion with increased use of alcohol and tobacco products, both known to have significant negative impacts on health.³

In America, the modern epidemic is obesity. More than one-third of US adults are now obese, and the percentage of children with obesity in the United States has more than tripled since the 1970s,⁴ so that today, about one in five school-aged children (ages 6–19) has obesity.⁵ To call it a disease of affluence hides the reality of its toll, however, because while access to problem foods makes everyone in a wealthy country vulnerable, the poor are at greater risk than the well-to-do. The two US states with the highest rates of childhood obesity, Mississippi and Georgia, are not two of the nation's poorest by coincidence.^{6–9} Obesity and malnutrition develop



hand in hand when the body does not receive the nutrients it needs in the amounts it requires for healthy tissues and full function; too much is just as bad as too little. Good nutrition is the foundation of health, but it is a casualty of poverty in a wealthy country. And illness itself, like poverty, can trap you and limit your freedoms of choice and opportunity.

Even before obesity was officially labeled a disease in 2013,¹⁰ overweight and corpulence have long been known to link closely with other conditions that lead to loss of life and lost quality of life: hypertension, heart disease, cancer, diabetes, and numerous other diseases are associated with increased inflammatory markers and oxidative stress. The processed food that has proliferated in recent decades, simultaneously heavier with calories but poorer in nutrients than similar quantities of whole foods, is part of this landscape of obesity.

Since 1950, the cardiovascular problems that have arisen along with obesity in the US have made heart disease our most serious health problem, and in spite of considerable investment in research, treatment, and prevention, heart disease continues to be the number one cause of death in the US and the world.^{11,12} The past 25 years have seen a somewhat better prognosis for those treated for symptoms of heart disease; a reduction in cigarette smoking, more emphasis on controlling blood pressure, and decreases in blood cholesterol levels (through both dietary change and medications that lower lipids) have reduced some of the risk. Any one cardiovascular event has also become less likely to kill you, as emergency medical care has improved to include diagnostic angiography, pharmaceutical interventions, and minimally invasive revascularization. But heart disease is still the most common cause of death for both men and women.

Food, the main contributor to obesity, is essential for the energy to stay alive, but it is not simply fuel: we rely on it to provide all of the essential building blocks for our bodies, including the many vitamins and minerals that the body itself cannot provide. For any life at all, we must rely on food to eat, water

to drink, and air to breathe, but for a healthy life, we need not just water but clean water, not just any air but fresh air – free of toxic chemicals, dangerous germs, heavy metals, and other pollutants – and the foods we eat must be nutritious.

Food as building blocks

To understand the necessity of a varied diet that includes a full mix of nutrients, we need only look to a disease of deficiency, such as scurvy. For centuries, when sailors embarked on months-long sea voyages, some of them would become weakened and ill with this disease. Its symptoms and signs include mouth sores and swollen gums, dermatitis, diarrhea, bruising and bleeding, joint pain, eye problems, and anemia, sometimes leading to death. And the history of scurvy's diagnosis, testing, and treatment proves an illuminating case study as we consider how to apply our principles of symmetry.

As we glimpsed during our dive into individual cell metabolism, in Chapter 3, the collective of cells that make up the adult body is constantly reshaped, its building blocks like Lego, to be taken apart and rebuilt again. Red blood cells, for instance, have a life of only about 120 days before they break down and have to be replaced. Diseases of nutritional deficiency thus routinely show signs and symptoms of anemia. Cells of the skin (the dermis) and the lining of the mouth are continually shed and replaced, so if some of their essential building blocks are missing, the architecture of skin and gums will change. Like the outer skin, the inner lining of the gut is constantly remodeled too, and without its essential elements, drawn from nutrients in the diet, the structure of new cells will be incomplete and lack its normal resilience, changing both the form and the functioning of the gut as well.

When we imagine an embryo or a growing child, it is easier to embrace the idea of building blocks creating a new human from scratch, with the nutrients from food as those multicolored blocks. But bodies, once built, also demand constant maintenance,



renovation, and repair work. Like a multistory apartment complex or even an entire mixed-use city district, the body makes constant demands for new building materials, which can enter the premises in only one raw form: nutrition, in the foods we choose to eat.

Those sailors with scurvy were missing some essential building blocks: adequate amounts of vitamin C, found in most fresh fruits and vegetables, which were unavailable on their sea voyages. Humans need vitamin C for producing collagen – the molecular threads that the body weaves to make all kinds of connective tissues for fascia, tendons, teeth, and bone. Missing this vital nutrient, a person with scurvy first shows only mild symptoms that are subtle and hard to recognize, but over time the advanced disease becomes more florid and even life threatening.

In the modern world, patients with full-blown scurvy are rare, but as in all deficiency diseases, cases can range on a spectrum from mild to severe, and its milder features are not uncommon, even today. Investigators have recently demonstrated that pregnant women lacking vitamin C are prone to have babies with smaller heads and incomplete brain development, reflecting the pattern fundamental to symmetry-seeking: that deficits in earlier developmental stages will have more profound, sometimes devastating impacts. The insult of any dietary deficits will always land more heavily on the embryo, the fetus, and growing children than on adults, whose architecture is already fully formed – even if the result of those deficits in the fetus is not always apparent until later in the life cycle. Within the embryo, the brain is particularly sensitive to missing nutrients, and subtle features of dietary deficits are more likely to be manifest not only in brain size, as with inadequate vitamin C, but in cognitive dimensions of childhood development, such as attention deficit disorders or learning disabilities.

Food as toy building blocks is a useful metaphor, because construction may demand a specific size, shape, or color of brick, but little plastic bricks do not spontaneously click themselves together into

structures, nor do the cells of the body, even when all the essential pieces are present. Each edifice also requires some kind of plan – orderly directions for assembly that must be communicated to the building site. In living tissues, DNA contains the blueprint. RNA conveys the messaging to drive the ribosomes' protein synthesis, but hormones control the timing, order of events, and communication of instructions on the work site, to guide orderly construction. Nutrients and calories from food are essential materials for bodily construction work, but nutrition is only one necessary component: the project will be in equal jeopardy if any one of several required elements is compromised – especially if hormone messaging is disrupted.

The slow pace of change

James Lind, a British Navy ship's surgeon, was interested in this disease of sailors, and he recognized that the longer their time at sea, the worse were their symptoms and the greater their risk of dying. Discerning a possible cause in their diets, Lind made himself one of the first in the history of medicine to conduct a proper 'controlled trial'. He divided sailors into equal groups, treating some and deliberately not treating others; one group he gave two oranges and a lemon to eat with their rations, the others some cider. After months at sea, recording careful observations, Lind's study showed conclusive results: sailors eating citrus fruits remained healthier, while many of the others developed signs of scurvy, and some of them had even died of it.

He published his 'Treatise on the Scurvy' in 1753, and you might reasonably assume that within a few months, the admiralty had instituted new rules regarding rations for sailors, but your confidence would be misplaced. Instead, it took almost 50 years before the British Navy began to adopt Lind's recommendation to provide citrus fruit as a standard ration at sea. Recognizing the cause and then finding, testing, and offering an effective solution proved not enough to prompt the change these sailors' health and lives demanded. Rather, the new

ideas had to battle with then-prevailing scientific and medical beliefs and to change many minds, before they could change prevailing practice. Years had to pass to allow enough time for defeating the resistance of the senior practitioners with their fixed positions, giving doctors time to grow old and step down from their positions, retire, or die. Younger officers with fresh ideas, new knowledge, and open minds could then be promoted into positions of authority and effect change.

As we explore a few other well-known diseases in this chapter, you will see that this delay to adopt is typical, this reluctance to act on even well-tested evidence. Too often, the problems of a new disease, though recognized, have to get much worse before finally gaining the appropriate attention of the medical community, leading eventually to doctors at last embracing the more effective strategies. British admiralty leaders did finally take action and institute effective measures. Their choice of limes as the source of vitamin C - cheaper than other citrus, as they were more readily available from the West Indian colonies - led to the nickname of 'limeys' for Royal Navy sailors and, later, Brits in general.

Corn lacks vital bricks

The US medical literature first described a case of a new disease called pellagra in 1863, and by 1912 there were already more than 25,000 cases, with a mortality rate of 40%. Like scurvy, it was a gory disease, this one with severe intestinal symptoms, skin lesions, and mental illness, giving it the moniker 'the disease of three Ds': diarrhea, dermatitis, and dementia. When it first appeared, it was thought to be an infection, but then no doctors, nurses, or attendants ever fell ill. And instead of showing itself in densely crowded cities, where contagion would spread a typical infectious disease, pellagra occurred in more sparsely populated rural areas, and only poor people seemed to get it.

Pellagra also had a geography: it was a disease of the American South, with clusters of severe illness and deaths in government institutions such as

orphanages, jails, and mental hospitals. According to estimates of the years between 1906 and 1940, more than 3 million Americans were afflicted with pellagra and more than 100,000 died.

In addition to this new human disease, dogs in households on farms with pellagra sufferers had a new disease of their own, 'black tongue', which left the animals lethargic, anemic, and wasted, suffering like the humans from diarrhea, as well as from sores about the mouth. For dogs, though, the most distinct feature of pellagra was a jet-black tongue. Like the human disease, it took its course over weeks or months, after which the dogs would usually weaken and die.

Campaigns to recruit soldiers for World Wars One and Two brought special attention to pellagra, because it rendered many young men too weak to serve in military service. In the search for a cause, it became clear that its sufferers relied heavily on corn in their staple diet of meat, corn meal and molasses, corn grits, and corn biscuits, with only smaller amounts of other foods, such as some cabbage or sweet potatoes. The afflicted dogs, too, shared the same corn-based diet. Those studying the disease, thinking of it as perhaps an atypical infection, sought some kind of poisoning from a toxin in corn that might be responsible. But the critical element turned out to be not something hiding in corn, but rather what was missing. Corn-based diets lacked an essential vitamin from the B family known as nicotinic acid or niacin ('NIcotinic ACid vitamIN'). As is typical in other nutritional deficiency diseases, the lack made an impact not in a single organ system but in many.

When patients were treated with niacin supplements and those at risk adopted a more mixed and nutritionally balanced diet, the epidemic finally resolved. It had taken 80 years since the disease had first appeared in the literature and 35 years after one Dr. Joseph Goldberger and his team had discovered how to cure and prevent it. The path to wellness was to correct for an asymmetry - the missing B vitamin. And just as deficiency can be devastating, causing disease and dysfunction as in pellagra or scurvy, excess can also be damaging, too. (Overdosing on



a vitamin by eating vitamin-rich foods is almost impossible, but toxicity is common in those who take daily megadoses of vitamins over a long period of time.¹³)

Infection as a cause of disease

Medical history offers tale after tale of the challenges of diseases: the difficulty of establishing that a condition is a disease, with a discoverable cause; the extraordinary amount of detective work that the disease can demand, to track down and identify its specific causes; and the struggle to convince contemporaries of its existence and best treatments – amidst resistance, institutional inertia, and the painfully slow pace of change.

Among the first kinds of disease to have a recognized cause were the sexually transmitted infections such as gonorrhea and syphilis. Signs might appear within a few days after the encounter between a previously healthy sexual partner and an infected person, manifesting as genital symptoms. This short latency between exposure and onset of symptoms – as well as the identifiable mode of transmission, through specific sexual contact, with symptoms in the area of contact – helped the patient to recognize a likely causal relation and pointed physicians towards a diagnosis. (An unwelcome intruder like any infection, venereal disease earned unique labels between nationalities, the English calling it ‘the French disease’ and the French ‘the English’, each blaming the other as its source.)

Subsequent opportunities to study infectious disease included epidemics, with germs causing not only illness but death, such as in the cholera outbreaks of London in the mid-19th century. Characterized by severe, colicky abdominal pains, fever, and bloody diarrhea, cholera infection often brought death within a few days or in some cases just hours.

Prevailing beliefs in those days held that disease was carried by miasma vapors or stench in the air, and, like all major European cities, London was a stinky place – reminiscent of the over-crowded

animal farms of Chapter 7. As Steven Johnson depicts the city in *The Ghost Map: The Story of London's Most Terrifying Epidemic*,¹⁴ it had no sanitary systems or waste disposal; privies emptied into shallow cesspits, open pipes or cellars, and garbage rotted in the streets. Diseases were most common in the smelliest parts of town, where the poorest neighborhoods stank still worse than others. Many assumed the poor to be morally depraved as well, a state said to make them more vulnerable to disease. Studying the outbreak of 1848 after it ended, however, Dr. John Snow developed a contrary theory: he suspected that drinking water might have been the cause.

In September 1854, another outbreak of cholera struck, this time in the more well-to-do Soho district, close to where Snow lived. This time, backing up from individual cases to see them in a larger context, he was able to draw clues from the geography of the disease. Cases clustered together in certain areas, where the cholera affected some but not all of the people who lived within a limited range. Mapping the area of central London and recording deaths as they occurred, Snow saw a pattern revealed: the cases appeared around Broad Street.

Within only a few weeks, there were 578 deaths. But at the epicenter of the outbreak, the brewery on Broad Street, not a single brewery worker had fallen victim to the disease. Apparently, they had some advantage over others in avoiding disease, which turned out to be the perk of free beer that brewers consumed, instead of contaminated water. A public water pump in the street outside the brewery was the source of the epidemic, having been contaminated by a burst drain on neighboring Albion Terrace that had bled sewage waste into the water supply, weeks before the infections appeared. Discerning from its patterns of infection that the disease was in the drinking water, Snow had the handle removed from the pump, and within days the epidemic was over.

After the crisis had ended, he published his street map showing the distribution of cholera deaths and presented the evidence that the disease had been carried in the water supply. He made the case for

improving the quality of London's water supply and for better sewage disposal and waste management. His evidence that the contaminant lay in the water supply was more than strong – even though the specific causal agent was still unknown and unnamed, the case for its source was hard to dispute, when disabling the water pump had halted the epidemic.

But it was almost 50 years before the medical community would listen to Snow, and even longer before London's city officials would begin to embrace his theory and start to mobilize resources to engineer significant changes. They found the inconvenient news about risk in their water system annoying, as the proposed changes would be costly and disruptive, and anyway the epidemic had passed.

London did eventually reengineer their water and sewage systems, but elsewhere, in countries without clean water, cholera is still an important killer today. Now we know not only the delivery mechanism and how to stop an outbreak, but also the specific bacteria responsible for the disease (*Vibrio cholerae*), which Dr. Robert Koch isolated and confirmed in 1883, years after Snow's research. Nevertheless, the world still sees more than 4 million cases of cholera per year, and up to 142,000 deaths.¹⁵

Joining the dots in cancer cases

In the history of medical discovery, a telling test case is cancer, as it demonstrates the difficulty in recognizing symptom patterns that signal a disease, developing and propagating reliable treatments for it, and finally finding and promoting ways to prevent it. This dreaded disease – actually a collection of similar diseases, some with unique profiles – can occur in any part of the body, appearing as a wart, tumor or ulcer. Cancer may stay contained where it begins, or it may invade adjacent structures, traveling to other organs within the body, perhaps by spreading through the lymphatic system or bloodstream. Unlike infection, it does not pass from one individual to another, so it is not a danger to caregivers or other household members. Often, if a cancer problem presents and can be diagnosed, treatments

can contain and control the disease, even for some cancers that are difficult or impossible to cure. And research has finally taught us a great deal about prevention. In looking for the causes of cancers, a common trigger is often exposure to a particular chemical product or chronic irritant. Groups of workers can therefore be at increased risk for a particular kind of cancer, as they share repeated exposure to some trigger, such as asbestos, now widely known to be a cause mesothelioma.

In 1775, Sir Percival Pott described an unusual kind of cancer, unique both in its location – always on the underside of the scrotum – and because it occurred not in old men as would be more typical of cancer but in young boys. The disease appeared as a chronic warty growth that would ulcerate and bleed. Pott also noted his observation that all of the victims were 'climbing boys'. His was the era of *Oliver Twist*, and, like young Oliver, orphan boys were taken at a very early age to work with chimney sweeps, climbing up and down to sweep the filthy flues of London homes and smoke stacks.

Starting young and spending many years clambering inside chimneys, the climbing boys would make daily contact with soot that blackened their clothes and bodies from head to toe. It washed away more easily from the smooth skin of their faces, shoulders, and backs than from the deep folds of their hairy scrotal skin. And like smoke from cigarettes, smoke from coal fires contains not only soot and particles but also volatile hydrocarbons and tars, which provoke tumors and cancers when painted onto the skin.

This type of cancer in the climbing boys offered several unusual clues that were hard to miss: its unusual site on the body, the scrotum; the unusual age of those smitten, young boys; and the glaring coincidence that all the victims had worked for years in the sooty flues of London's dirty chimneys. These markers made it possible to join the dots and make the connection to its cause. Rather than scientific expertise, it was Pott's eye for pattern which noticed that it was young chimney sweeps who were at risk, just as it was not specialized knowledge that led



John Snow to the contaminated water pump but his eye for the geographical clustering of cholera deaths. We can all recognize patterns, whether in our own health or in public phenomena, and symmetry-seeking helps us to be even better at it.

Smoke screens and cancer

Pinning down the source of the climbing boys' cancer proved much easier than recognizing and responding to the link between cigarettes and cancer a couple of centuries later. The habit of smoking was spread wide, across millions of people. Many smokers never developed the diseases now linked closely to smoking, such as lung cancer, and some people who had never smoked did (and do) contract those diseases too. Today, most people are finally convinced that cigarettes are bad for you and that smoking can damage your health – that the behavior of cigarette smoking carries many health risks and increases the likelihood of many diseases, especially lung cancer, and of premature death. But even after the medical evidence was in, it took decades for doctors and researchers from other fields to persuade their colleagues of this fact – to establish the connection between tobacco and its risks so irrefutably and insistently that dangerous public policies and private behaviors began to change.

First reports linking cancer and tobacco products surfaced as early as 1928, on nasal cancer in snuff users. Then in 1938 we saw lip and tongue cancer in pipe smokers, and by 1948 the literature reported increased risk of premature death in cigarette smokers. By 1952, there was little doubt that this risk was real and significant. Still, stalwart resistance remained, and some voices vehemently denied the dangers of tobacco products. As with the causal connection between drinking water and cholera, science was very slow to arrive with the definitive proofs necessary to bring consensus across the medical community.

'Big Tobacco' fought for decades to redirect responsibility for the diseases of tobacco use, always blaming the smokers who chose to use their products,

but the sources of the problem were multisystemic. The US government promoted tobacco heavily by subsidizing farmers to grow it, and vast numbers of people therefore depended on tobacco products for their livelihood, involved as they were in the manufacture, promotion, and distribution of tobacco products. Starting in World War One, the military also allowed tobacco companies to target US troops with cheap and free cigarettes, even including cigarettes in soldiers' rations, alongside their food, in World War Two – a practice that did not flag until 1975, and which guaranteed that several generations of men and women would return from US wars addicted to a smoking habit.¹⁶

Commercial success gave the tobacco industry vast resources for political lobbying and influence, so the public received very mixed messages about the consequences of smoking – the louder voices more positive than negative. Some doctors aligned with Big Tobacco, and advisory groups of salaried spokespeople, ostensible experts, spoke out strongly in defense of smoking and tobacco products. Big Tobacco sponsored 'tobacco science' to publish favorable spin about the supposed health benefits of smoking, and others provided smoke screens and distractions to play down the associated health hazards, rebut concerns about addiction, and deny the risks of heart disease and cancer.

Massive advertising campaigns promoted tobacco products to young people and women, and reputable news sources supported the benefits of smoking. Promotional initiatives linked professional sports' celebrities to branded tobacco products with collectables such as cigarette cards. As news of any risk made it through the hype, tobacco stayed one step ahead, constantly presenting itself as a work in progress, ever improving, making newer and healthier products to try with lower nicotine content or lower tar, tipped with filters or flavored with menthol. Every new twist promised that less risk to human health was just around the corner, while Big Tobacco worked tirelessly to resist accurate labeling, disclosure of health risks, and explicit warnings on packaging. All the while tobacco continued

to sicken and kill untold numbers of human beings worldwide.

In this environment of resistance to the truth about tobacco's health implications, the US government also proved reluctant to require that tobacco products be marked with warning labels of their dire risks, like those generally used elsewhere. In Britain and Europe, cigarette packets carry large-print cautions that 'SMOKING WILL KILL'. Unequivocal warnings take up at least one third of the package: 'WARNING: Cigarettes cause cancer' and 'SMOKING CAUSES FATAL LUNG CANCER', a skull-and-crossbones symbol, and the labeling which has proven most effective: graphic images of lung disease, from amputated toes to the postmortem face of a human corpse.¹⁷ As a matter of public health, more than 100 countries have adopted unsparing language and dramatic, dogmatic warnings in their efforts to discourage cigarette smoking.¹⁸

Finally in 1966, more than 50 years later, states in the US began to enact some measures to curb smoking and other tobacco use through product labeling, public awareness campaigns, limits on advertising and restricted sales to minors. Doctors finally stopped appearing in cigarette ads and started counseling their patients about the undeniable health consequences of smoking. But this fatally slow process of reducing tobacco use gained traction only very recently – in the late 20th century – a lag that should give us pause if we're tempted to dismiss the slow public health responses to cholera or scurvy as a reflection of their pre-modern times. So far, in medicine's ability to respond to a widespread public health problem, little seems to have changed in the modern era.

In 2011, the US FDA announced new rules for cigarette warning labels that would mirror the European style that requires large, graphic images and warnings to appear on every pack sold in the United States and in every cigarette advertisement. These rules, drafted in compliance with the federal Family Smoking Prevention and Tobacco Control Act, were signed into law in 2009, but their future remains uncertain. The warnings were scheduled

to appear on US tobacco packs by September 2012, but a coalition of tobacco companies successfully sued the FDA, arguing that the new law would violate their free speech. Big Tobacco having won their injunction, the labeling requirements of the Tobacco Control Act remain on hold for now, and packaging in the US has not changed.¹⁹ The text-only Surgeon General's warning first introduced in 1966 has not been updated in over 30 years!

So even today, having caught up after the delay between knowing that tobacco is a killer and proving it with science, our US commercial messaging does not make that reality clear to smokers. We need to push for change, a full paradigm shift, in the way we approach colossal public health challenges – not only within medicine but across multiple systems, most especially at the level of empowering individuals with accurate information and the authority to act in their own best interests. Big Tobacco is a most powerful and formidable adversary, able to resist the laws of the land with lobbying, to defy government regulations, and to shape the market forces that promote increased sales with bulk marketing and discounts. And now that public health reports and cultural changes have finally begun to reduce domestic sales, they are pushing to expand their sales in other countries around the globe – a strategy begun long ago, to globalize smoking.^{20,21}

Borrowing Big Tobacco's playbook

Because diseases of tobacco use pose massive public health problems, our responses to it – both institutional and individual – offer an apt template for considering how we might deal with our most pressing current health crisis, diseases of food. Both the partial successes and the failures of the US response to Big Tobacco can help chart a path for pushing back against the dubious assertions and problematic practices of 'Big Food' and 'Big Soda'. If we pay attention to the lessons offered by smoking – across industries, institutions, and continents – we can do better this time, shortening our response time and saving both lives and quality of life.



Today Big Food and its cousin, Big Soda, have adopted strategies identical to Big Tobacco's. Indeed, when domestic sales of tobacco finally started to flag in the 1980s, tobacco companies' strategy for shoring up against the financial losses was to buy food companies.²² The match was fundamentally well-suited: the tactics of disguising unhealthy products when marketing them for immense financial gain are Big Tobacco's well-worn specialty, so Big Food was a natural next step, and the current generation of food marketers is well-prepared. Like cigarette companies, food companies redirect responsibility for the diseases of food and soda onto those who use the products. Only when it became clear that it was a public relations problem with potential investors for food divisions to be owned by a recognizable tobacco brand did the companies later make efforts to separate the businesses and change their names.

As with tobacco, though, the problems with dangerous food are multilayered, systemic, and buried under misinformation – an array of obstacles to the average citizen who is seeking to make healthful choices and wanting access to safe food. Some of these barriers will remain insurmountable for consumers until we make systemic changes in our food supply.

Like all food questions, the story has its origins on the farm and continues through the supply chain, to mouths around the world. In the US, industrial monoculture grows a massive excess of corn, with subsidies from the US government, and many thousands of people are employed in its manufacture, promotion, and distribution. Soda and junk food products, filled with corn ingredients, are actively promoted to children and sold in schools, and they travel the globe with US troops. Promoting Big Food and Big Soda, salaried experts and advisory panels speak out to advocate on behalf of these non-nutritious calories, publishing reports that minimize the hazards of obesity, diabetes, hypertension, and heart disease while also serving as public relations vehicles, putting a favorable spin on the corn products in hopes of propagating favorable reports about ostensible health benefits.

Massive advertising campaigns promote junk food and soda products to young people especially, aligning products with Olympic health and fitness. As for cigarettes a few decades ago, the ads tout constant tweaks to food and soda products, always with the promise of less risk to human health. Meanwhile corporations wrestle to maintain perennial resistance to genuine disclosure, blocking revisions to clearer labeling that would lay bare the truth about their soda and food products. Bulk marketing discounts promote sales, and toys and promotional items target children with fast food and junk food products.

Because they have sprung from Big Tobacco corporations, Big Food companies know exactly how best to advertise toxic, addictive products. Tobacco primarily targeted teens and adults, but children were off-limits, protected by legal regulation; not so for Big Food and Big Soda, who target children deliberately, with their highly toxic, addictive, and disease-promoting products, using the same battle plan that was so effective for tobacco and the same tactics.²³ Openly reveling in the addictive quality of their products, food companies have boasted 'Bet you can't eat just one!' of potato chips, or named a sweet cereal for breakfast 'Crave'. Pushing junk food and soda, the game is the same as pushing tobacco but with even higher stakes, since everyone eats, at every age. Having learned their lessons well from tobacco, food companies too sponsor favorable research, lobby politicians, and use propaganda to spread doubt about the undeniably harmful effects of their sickening products.

To understand how to rally an effective response to the epidemic of diseases stemming from food, symmetry-seeking offers multiple paths and strategies, replicating those that have been proven to work well in other countries to constrain the popularity of cigarette smoking or to moderate the use of alcohol. Information is key, and accurate, unequivocal, and readily understandable labeling on packages is critically important. Without accurate information there can be no informed decision making. As on the cigarette pack, warnings about food must be

displayed prominently on the front of the package, not hidden away on the side, and images and symbols speak louder than text. Advertising and promotion of harmful products should be restrained or discouraged, and products known to provoke disease should be subject to additional taxation. Public service announcements, campaigns to promote health, and local ordinances such as reducing serving sizes of soda beverages can each play a role.

On medicine and change

When disease looms large, we might expect our doctors and medical teams to be first on the field, well-suited to lead the charge and mount a coordinated response. So where are the doctors and health care providers, why are they not doing more about childhood and adult obesity? And where is the pushback to challenge the corporate grand deception? But as this chapter has demonstrated, the pace of medical advances is slow, and it is difficult to push for multisystem changes, even for known diseases with known causes, such as scurvy or cholera. The history of smoking shows us that some doctors with vested interests can even make themselves part of the problem, promoting unhealthful practices. Still more fundamentally, though, to look to our physicians to resolve our vast problem with diseases of food is to misunderstand what doctors do and misjudge the business of medicine.

Medical doctors are trained to recognize and treat symptoms and disease. They make their living by diagnosing diseases, counseling patients about their prognosis and helping to select the best course of treatments or management strategies for their symptoms and other complaints in the body such as minimizing their painful effects. These skills require knowledge and training, so medical education is lengthy and expensive, transferring protected secrets of the trade that are not to be lost, diluted, or even, historically, shared with those outside the field. To maximize their success in treating diseases, doctors follow simple, standard principles: that early detection is better than late, and that early treatments

are more effective than later efforts. Their desire to treat problems early therefore drives the popularity of screenings, increasingly common because they generate more opportunities for doctors to treat diseases while they are likely to be easier to treat. And the more doctors look for problems, ever broadening the dragnet of screenings, the more such favorable treatment opportunities they will find.

Unfortunately, while such an approach may be marketed as focused on wellness, it isn't: medicine, by definition and by its business model, inevitably focuses on disease, on diseases already present, with an ever-more laser-like focus from a specialist who will seek out any abnormality within that particular organ or body system, where disease might possibly exist. After years of studying the workings and disorders of the human body, doctors might understand the underlying course and causes of disease, but by the time a patient reaches the medical clinic with symptoms, it is all too late and time instead for the doctor to get to work, diagnosing and treating. Screening healthy subjects can lead to early detection and start the doctoring sooner, but if a disease is indeed present, detected, and worthy of treatment, wellness has already been lost.

Fundamentally, people hope not to become patients but instead to live without needing the help of doctors and hospitals. We do not dream of enduring plenty of successful treatments but the exact opposite: to be well and stay well, with as little medical intervention as possible, for as long as possible. We seek wellness, which is totally different in every respect from disease.

Upton Sinclair captured a truth we all know implicitly: 'It is difficult to get a man to understand something when his salary depends on his not understanding it'. And if we are to understand how best to make use of physicians' expertise, it is important to remember what their salary depends upon, which is illness and disease. Wellness – health – is not their bailiwick and never will be. The best doctors may know a great deal about the underlying causes of the conditions they treat, but they are not well-placed for effective prevention, and they would



be out of business if it were their focus. And since the majority of fatal diseases today are the result of lifestyle choices – especially, of what we take into our bodies, whether from the farm or the factory – we are foolhardy to turn the task of maintaining our health and wellness over to doctors and the medical business, which can never succeed in keeping us truly healthy. Wellness is not their job, even if they would like it to be, even if hospitals advertise themselves as centers of wellness, and even if a doctor is supremely well-intentioned, ethical, skilled, and wanting the best for every patient seeking to regain health.

Some aspects of your personal health were decided before you were born. Equipped with the lens of symmetry-seeking, tuning in to your own body can help you and your care providers better understand what you see – how your body parts and body systems interrelate and what they are telling you about your best personal paths to wellness. If you are a health care professional who provides preventive care and guidance on wellness, these symmetry-seeking, whole-body questions are the place to start with your patients or clients. And even traditional, disease-treating doctors, including specialists, can support integrated care, and they will do best by their patients when they seek opportunities to practice whole-body medicine. The wide view is a good starting place, looking back to before the onset of symptoms, considering the whole, looking for patterns, and asking the symmetry-seeking questions about one's own body. Remembering how one part affects the others will give clues to the need for care in other parts of the body.

Even before the recent advances in genetics began to illuminate why, medicine had come to understand that inherited traits determine not only visible similarities across generations but inner similarities and risk factors for certain diseases. Symmetry-seeking sharpens our focus on the kinds of questions we should be asking to determine what some of those similarities might be, beyond the short list of family history questions standard on most medical forms. We can each learn a great deal from more thorough

inquiry into the health and illnesses of our family members, and well-informed guidance from health professionals can hone our knowledge of what to look for. Looking upstream, you can broaden your perspective on the range of traits, vulnerabilities, and habits you may share with your family, including mental health tendencies, shared ways of family living, and traditions of food choice and cooking practice, which point and project us on similar trajectories towards shared health destinations. The more you know of your family's health profile, the better prepared you can be to steer your personal course away from predictable hazards.

Wellness is each person's own job – an inside job, for every individual. Just as your banker is not in charge of your personal finances, your doctor is not responsible for day-to-day decisions about health. For wellness, prevention is the key: enacting the behaviors that maintain health and avoiding known causes of disease. Medicine – the business of treating disease – will never be more interested in prevention than in diagnosis. To try to turn the medical establishment into the curators and purveyors of wellness is to place the fox in charge of the henhouse, just as pharmaceutical companies will never be the best protectors of drug safety and the food industry will never be the best defenders of accurate food labeling. Notwithstanding the good intentions of any one individual or corporation, their bread is not buttered on the side of our individual health. Sometimes our interests in health and theirs in profits dovetail, especially when a company's primary focus and marketing is towards healthful ingredients and production. But when our need for health diverges from food distributors' need for profit, that conflict of interest makes them one more fox in the henhouse.

To guide us towards achieving wellness, research – not only medical research but studies and data collection in all the many fields that touch human health – must focus on causes, not simply on honing doctors' ability to detect symptoms and signs after they appear. Armed with knowledge of an illness's origins, we can act long before any diagnosis or treatment, perhaps forestalling the need for either.

But if we are to prevent or avoid disease, we need to know how to stay away from what causes it, when we can. Now that we understand how foodborne infections occur – most commonly the result of eating raw foods of animal origin – we know to favor hot foods, and if eating meat, poultry or shellfish, to be sure that it is well cooked.²⁴

It was research which taught us that smoking kills, generating knowledge about the dire effects of tobacco use, which public health campaigns could then disseminate, successfully persuading millions of Americans to stop smoking or avoid starting. Such knowledge has effectively reduced the percentage of the US population who smokes from more than 42% to less than 17% over fifty years.²⁵

We have seen similar successes in environmental initiatives that affect human health, in city rivers cleaned up from their status as dumping grounds for toxic waste a few decades ago, or in the recent report that the hole in the ozone is actually shrinking.²⁶ In both instances, progress has occurred in response to science alerting us to a threat, organizations campaigning for public awareness, citizens expressing concern and support for change, and industry and government enacting policies to reduce pollutants: in the case of ozone protection, a 1996 ban on chlorofluorocarbons – also known as CFCs, gases used in aerosols, as cleaning solvents and in refrigeration units – in consumer products. The clean-up of US rivers was part of the impetus for the formation of the Environmental Protection Agency (EPA) in 1970.

Mapping patterns

To make policy changes, decision makers and policy changers need a weight of evidence, irrefutable data from multiple fields without confounding contradiction. In major public health decisions, much hangs in the balance. Fortunately, we do have topics with just such consensus among a broad, diverse array of experts, on many matters related to health, such as those which serve as case studies throughout this book. Much of our best knowledge about the behaviors, institutions, and substances which affect our

health comes from just such interdisciplinary teams of experts, in public health organizations such as the Centers for Disease Control in the US or the Public Health Service in the UK. Here professionals devote their careers to inter-systems questions of public health trends, looking for patterns and possibilities in preventive medicine, community or industrial health, advocacy, and policy making.

When we talk about ‘your doctor’, we usually picture your primary care physician, but some of the most important doctors whose work affects our lives are in public health. Typically, we never meet them, because these physicians may not work with patients, if they spend all their time doing field work, in research laboratories, or in the offices of organizations that tap their expertise as a resource for decision making. But they are well positioned to have a profound impact on our health – to put medical knowledge to work more effectively and efficiently than in the past, through the work of clinical health professionals and directly through individuals, by shortening the timetable turnaround from the days of scurvy and cholera and cigarettes, to the benefit of all of us.

Our public health and preventive medicine specialists serve critically important functions such as monitoring patterns of disease and administering annual flu vaccination initiatives, but resources are always limited in government, so political resolve will be essential if we are to mount effective, broad-based strategies for wellness.

Medical research, public health research, and epidemiology have already given us more than enough information and analysis to establish that highly processed calorie-rich junk foods kill. Now, making the best case for change in corporate practices, public policy, and, most important, personal choices for the prevention of obesity requires clear messaging from all sides that reveals the linkages and makes the connections between diet and disease. And symmetry-seeking can point the way to the clearest, most powerful messages – the most persuasive data – if experts from multiple disciplines, across widely varying fields, take the initiative to look



outside their own silos and learn from one another, to apply symmetry-seeking principles to what they learn, finding out how the observed pattern in one system parallels patterns in others.

As both the London cholera and the Southern pellagra epidemics demonstrated, a prime tool for pattern-hunting in public health is mapping, because the geography of disease can paint a picture and point to possible causes. In today's obesity epidemic – fast becoming a pandemic – clustering of cases helps us to see its patterns through a different lens and begs for further exploration. Colorado, the mountain-high state, has the lowest obesity rate in the nation, while Louisiana, Alabama, and Mississippi, clustered at the mouth of the Mississippi River, have the highest.²⁷

The geography of human obesity in the US follows the watershed of the river, from the cornfields of Iowa in the north to the Gulf of Mexico in the south, suggesting a strong link between land use and human health in this watershed. Researchers seeking the causes of obesity and its companion diseases will do best to look for systems with corollary geography: of nitrate runoff, poverty, dietary habits, soil, and water quality, characteristic industries and most common types of work in the areas where obesity is most common and most severe.

Slow systemic responses

We've seen how hard it can be to identify a disease and recognize its causes, and that even after medical science has found both an effective treatment and a way to prevent it, many decades may pass before medical practice, institutional policies, and personal behaviors begin to effect the changes necessary to manage, minimize, or eliminate a problem. A contained and straightforward condition such as sailors' scurvy or climbing boys' scrotal cancer can focus and hasten scientific success, but even in such cases, practical progress is still slow, with lives lost in the meantime. For a global challenge such as cigarette smoking or HIV infection, connecting the dots takes even longer, and policy and behavioral change

take longer still, even after all the science is in place. How much more challenging, then, is the quest to link diets and diseases whose causes spill from every pot and pan to dish and plate, intertwined with everyone's daily fare and touching all corners of the planet.

When seeking to apply the principles of symmetry-seeking and stepping back to look for broader perspective, searching for patterns and connections between food and health, we face infinite possibilities about the angle or level at which to set our lens. Nevertheless, given humans' inevitable, eternal, necessary interest in food, we now have millennia of human experience with the omnivore's dilemma of what to eat, centuries of science noting our body's reactions to certain foods, and now increasingly sophisticated data about those connections. Still more important, despite the overwhelming volume of that data and even amidst individuals' unique dietary needs and preferences, an impressively broad consensus emerges as to what kinds of foods can carry the vast majority of us further away from heart disease, cancer, diabetes, and dementia and towards longer, healthier lives. While research from year to year occasionally indicates that one food or another is better or worse than we had thought, the overall arc of nutritional advice has not changed in some time: to consume hearty amounts of vegetables, whole grains, fruits, and fish, and to keep intake of sugar to a minimum.²⁸

An individual consumer may feel buffeted by conflicting nutritional advice, but many of the shifting edicts on particular foods derive from two main sources. Some come from vested interests seeking to promote a food as healthful with advertising, such as the 'Got Milk?' campaign – and in Chapter 9, we will consider the impact from media and advertising. These messages may actively seek to drown out widely accepted science to the contrary, even in some cases influencing public policy for USDA dietary recommendations or agricultural subsidies, towards food crops such as corn, which is not our best source of nutrition. Another source of news that a food is unexpectedly

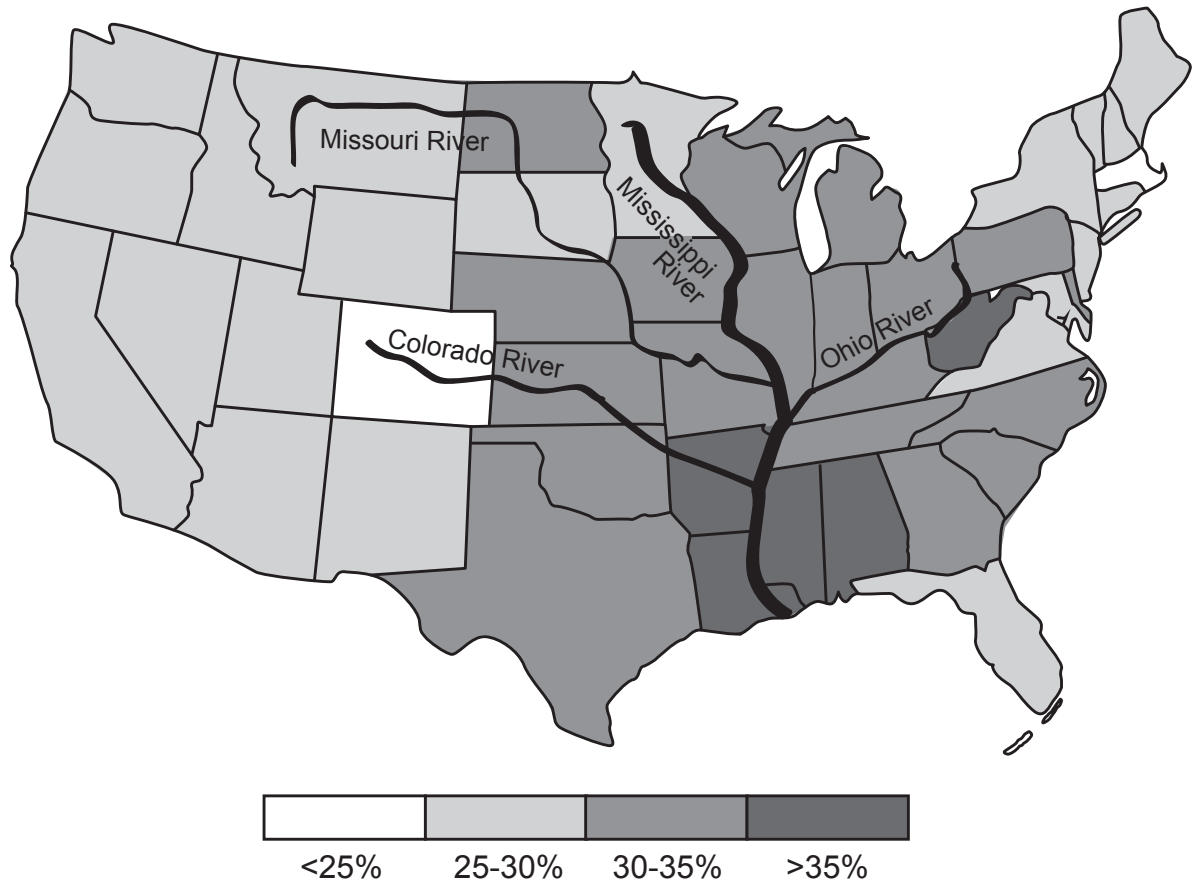


Figure 8.1

Prevalence of Self-Reported Obesity Among US Adults by State and Territory, 2016. Note how the rate of obesity is lowest in Colorado, in the head waters of the Colorado River that drains into the Mississippi, and increases steadily as you travel downstream. The corn-belt states are drained by the Missouri, Mississippi, and Ohio Rivers that together become the Mississippi, and with the exception of West Virginia which drains mainly to the Chesapeake Bay and Atlantic ocean, the highest rates of obesity are all clustered in the lower third of the river watershed – Arkansas, Louisiana, Mississippi, and Alabama. (Data from Behavioral Risk Factor Surveillance System, <https://www.cdc.gov/obesity/data/prevalence-maps.html>.)

detrimental to health comes from scientific discoveries about problems with how a product is grown or processed, usually due to industrial methods of production or preparation.

One by one, we are learning what some of the problems are in the foods we eat, many of which we address in this book. But there is much left to

learn, especially when we consider the research indicating that an adult today, eating the same foods in the same amounts as his parents, is more likely to be overweight.²⁹ Clearly, we need some new perspectives beyond the simple advice to eat less, to understand what is causing our obesity epidemic, and symmetry-seeking offers a way of seeing with a



fresh eye. It directs us to look beyond an isolated meat or fish product to consider what was the food that fed your food. Was it grass-fed meat or wild-caught (plankton-fed) fish? They will be rich in omega-3, a building block to be disassembled by your digestion and made available again for reassembly, providing a plentiful supply of key ingredients for healthy cells and tissues for your body and brain.³⁰

Still, while we track the multifarious causes of current problems with our food supply and eating habits, it is basically good news to discover that there are no enormous surprises from the increasingly thorough research into food. We might wish for the novelty of some surprises – for difference, for the entertaining asymmetry of a grapefruit diet, a paleo or a vegan diet – but the boring reality of healthful eating holds steady to what we already know from our parents: to eat our vegetables and not too much ice cream. Ultimately, it is reassuring to realize that, notwithstanding some slippery slices of misinformation, we need not start from scratch on understanding what to eat, because we already know a lot. We will be busy enough figuring out how to conquer the challenge of changing our eating habits to act on what we know (also part of Chapter 9).

For the person who wants to maximize her odds of living a long life, with as much vitality as possible, still more good news lies within the grim statistics about these diseases of food. This chapter has revealed how slowly the great ship of medicine turns, even when danger is looming. Treatments and prevention for obesity and its companion health problems are apt to be a long time coming, requiring changes in the multiple industries discussed in this book, and in the meantime, we can expect these diseases to continue as the main causes of chronic illness and early death. But most of us have a great deal of say-so in what we eat, so we need not wait for the ship to turn. In the main, the science on what's best to eat is already clear. We don't have to wait for the Royal Navy to change its rations, and no need for cities to pass ordinances outlawing supersized soft drinks; we can

avoid them ourselves. Anyone paying a modicum of attention to health news understands the risks, so we know what to do, as individuals, to reduce our chances of disease.

Even while we work towards better mass-produced food choices, better public policy regarding food safety, and better access to healthy food and nutrition education – for everyone, across the socioeconomic spectrum – we can also start right away eating foods that lend themselves to better health now and better health later in our lives. On your next trip to the grocery store this very week, you can choose to skip that one box of snacks made with undecipherable, non-food, chemical ingredients and select something your grandmother would have recognized as food instead. In increments as we manage our own eating, we can invest in our current and long-term health and simultaneously be making a choice that is better for the planet's ecosystem, better for our city's waste systems, and much better for unborn children. Furthermore, every purchase of a product that is part of a more sustainable chain of symmetries is a vote towards turning the ship of interlocking institutions and policy – away from fatal food flaws and towards better alternatives for health and wellness. We can be on the lookout for such products to appear, such as Stonyfield yogurt's reducing its sugar content in response to customer health concerns.³¹ In the UK, Public Health England has researched and published official guidelines to reduce sugar content in foods marketed to children, targeting the fare they eat most, such as breakfast cereals and fruit spreads.³²

Knowing what is most advisable to eat is not the same as following that advice, however, as we all know. Healthy eating presents a formidable challenge to many of us, as evidenced by the multi-billion-dollar diet industry and by those statistics on heart disease. As we explored in the earlier chapters, the roots of our challenge lie in a problem of evolutionary mismatch, for we evolved to live in an ancient world of intermittent famine and drought, and our bodies were built to tolerate hunger and thirst. Some of the dimensions of this mismatch

may be familiar, such as why we crave fats and sweets so endlessly, when large amounts of them are so bad for our health. But to understand why healthful habits can be a battle to establish, we must turn our symmetry-seeking lens back to the human body, to look at the form and function of a part we have only touched on thus far: the human brain.

References

- World Health Organization (2017). Children: reducing mortality. Online: www.who.int/mediacentre/factsheets/fs178/en/.
- Davis RJ (2012). Coffee is Good for You: From Vitamin C and Organic Foods to Low-Carb and Detox Diets, the Truth about Diet and Nutrition Claims. New York: TarcherPerigee.
- Mineo L (2017). Good genes are nice, but joy is better. Online: <https://news.harvard.edu/gazette/story/2017/04/over-nearly-80-years-harvard-study-has-been-showing-how-to-live-a-healthy-and-happy-life/>.
- Fryar CD, Carroll MD, Ogden CL (2014). Prevalence of overweight and obesity among children and adolescents: United States, 1963-1965 through 2011-2012. Atlanta: National Center for Health Statistics.
- Ogden CL, Carroll MD, Lawman HG, et al. (2016). Trends in Obesity Prevalence Among Children and Adolescents in the United States, 1988-1994 through 2013-2014. *Journal of the American Medical Association*, 315(21): 2292-2299.
- Ogden CL, Carroll MD, Kit BK, et al. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Journal of the American Medical Association*, 311(8): 806-814.
- Ogden CL, Carroll MD, Curtin LR, et al. (2006). Prevalence of overweight and obesity in the United States, 1999-2004. *Journal of the American Medical Association*, 295(13): 1549-1555.
- Ogden CL, Flegal KM, Carroll MD, et al. (2002). Prevalence and trends in overweight among US children and adolescents, 1999-2000. *Journal of the American Medical Association*, 288 (14): 1728-1732.
- United States Census Bureau. Small Area Income and Poverty Estimates (SAIPE) Program. Online: <https://www.census.gov/programs-surveys/saipe.html>.
- American Medical Association House of Delegates (2013). Recognition of Obesity as a Disease. Online: <http://www.npr.org/documents/2013/jun/ama-resolution-obesity.pdf>.
- Centers for Disease Control and Prevention. National Center for Health Statistics: Heart Disease. Online: <https://www.cdc.gov/nchs/fastats/heart-disease.htm>.
- World Health Organization (2017). The top 10 causes of death. Online: <http://www.who.int/mediacentre/factsheets/fs310/en/>.
- Rosenbloom M (2017). Vitamin toxicity. Online: <https://emedicine.medscape.com/article/819426-overview>.
- Johnson SB (2006). The Ghost Map: The Story of London's Most Terrifying Epidemic - and How It Changed Science, Cities and the Modern World. New York: Riverhead.
- Ali M, Nelson AR, Lopez AL, et al. (2015). Updated global burden of cholera in endemic countries. *PLoS Neglected Tropical Diseases*, 9(6): e0003832. <http://doi.org/10.1371/journal.pntd.0003832>.
- Blondia A. Cigarettes And Their Impact In World War II. Online: http://www.calstatela.edu/sites/default/files/groups/Perspectives/Vol37/37_blondia.pdf.
- Centers for Disease Control and Prevention (2012). Current Cigarette Smoking Among Adults - United States, 2011. Online: <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6144a2.htm>.
- Action on Smoking and Health (2016). More than 100 countries now require graphic picture warnings on cigarette packs - UK goes further by requiring plain standardised packaging. Online: <http://ash.org.uk/media-and-news/press-releases-media-and-news/more-than-100-countries-now-require-graphic-picture-warnings-on-cigarette-packs-uk-goes-further-by-requiring-plain-standardised-packaging/>.
- Bardi J (2012). Cigarette Pack Health Warning Labels in US Lag Behind World. Online: <https://www.ucsf.edu/news/2012/11/13151/cigarette-pack-health-warning-labels-us-lag-behind-world>.
- Campaign for Tobacco-Free Kids (2017). The Global Cigarette Industry. Online: https://www.tobaccofreekids.org/assets/global/pdfs/en/Global_Cigarette_Industry.pdf.pdf.
- World Health Organization (2013). WHO Report on the Global Tobacco Epidemic, 2013. Online: https://books.google.com/books?hl=en&lr=&id=hrIXDAAAQBAJ&oi=fnd&pg=PP1&dq=tobacco+markets+world&ots=xk72qjg5ik&sig=eky5Qy_JIZyG4lPr1oZXyeSBHQ#v=onepage&q=to%20markets%20world&f=false.
- Caplinger D (2016). A Short History of Big Tobacco's Fling With Food. Online: <https://www.fool.com/investing/2016/09/23/a-short-history-of-big-tobaccos-pling-with-food.aspx>.
- The Fifth Estate (2013). The Secrets of Sugar. Online: <http://www.cbc.ca/fifth/episodes/2013-2014/the-secrets-of-sugar>.
- Centers for Disease Control and Prevention (2018). Food Safety. Foodborne Illnesses and Germs. Online: <https://www.cdc.gov/foodsafety/foodborne-germs.html>.
- Centers for Disease Control and Prevention (2016). Trends in Current Cigarette Smoking Among High School Students and Adults, United States, 1965-2014. Online: https://www.cdc.gov/tobacco/data_statistics/tables/trends/cig_smoking/index.htm.
- Stierwalt S (2017). Why Is the Ozone Hole Shrinking? Online: <https://www.scientificamerican.com/article/why-is-the-ozone-hole-shrinking/>.
- Centers for Disease Control and Prevention (2016). Adult Obesity Prevalence Maps. Online: <https://www.cdc.gov/obesity/data/prevalence-maps.html>.
- Hamblin J (2017). New Nutrition Study Changes Nothing. Online: <https://www.theatlantic.com/health/archive/2017/09/moderate-intake-of-things-linked-to-health/538428/>.



29. Khazan O (2015). Why It Was Easier to Be Skinny in the 1980s. <https://www.theatlantic.com/health/archive/2015/09/why-it-was-easier-to-be-skinny-in-the-1980s/407974/>.
30. Hjalmsdottir F (2017). 17 Science-Based Benefits of Omega-3 Fatty Acids. Online: <https://www.healthline.com/nutrition/17-health-benefits-of-omega-3>.
31. Kowitt B (2017). Stonyfield Gives Its Yogurt a Makeover. Online: <http://fortune.com/2017/02/13/stonyfield-yogurt-sugar>.
32. New Food Magazine (2017). Guidelines on reducing sugar in food published for industry. Online: <https://www.newfoodmagazine.com/news/36537/guidelines-reducing-sugar-food-published-industry/>.