Days of Dysevolution

From Diabetes to Athlete’s Foot, Our Bodies Are Maladapted for Modern Life:
Today’s humans are afflicted with ailments that virtually didn’t exist for our nomadic forbears. Can we adapt our way out of them?

By Jeff Wheelwright

I sat in my padded desk chair, hunched over, alternately entering notes on my computer and reading a book called The Story of the Human Body. It was the sort of book guaranteed to make me increasingly, uncomfortably aware of my own body. I squirmed to relieve an ache in my lower back. When I glanced out the window, the garden looked fuzzy. Where were my glasses? My toes felt hot and itchy: My athlete’s foot was flaring up again.

I returned to the book. “This chapter focuses on just three behaviors ... that you are probably doing right now: wearing shoes, reading, and sitting.” OK, I was. What could be more normal?

According to the author, a human evolutionary biologist at Harvard named Daniel Lieberman, shoes, books and padded chairs are not normal at all. My body had good reason to complain because it wasn’t designed for these accessories. Too much sitting caused back pain. Too much focusing on books and computer screens at a young age fostered myopia. Enclosed, cushioned shoes could lead to foot problems, including bunions, fungus between the toes and plantar fasciitis, an inflammation of the tissue below weakened arches.

Those are small potatoes compared with obesity, Type 2 diabetes, osteoporosis, heart disease and many cancers also on the rise in the developed and developing parts of the world. These serious disorders share several characteristics: They’re chronic, noninfectious, aggravated by aging and strongly influenced by affluence and culture. Modern medicine has come up with treatments for them, but not solutions; the deaths and disabilities continue to climb.
Harvard evolutionary biologist Daniel Lieberman.

An evolutionary perspective is critical to understanding the body’s pitfalls in a time of plenty, Lieberman suggests. His argument is not difficult, and he is not the first to advance it. It’s called the mismatch hypothesis: Our earliest, apelike ancestors foraged and hunted in small, mobile bands. For a million and more years in Africa, evolution adapted their bodies and behaviors in a give-and-take with a slowly changing set of environmental conditions — that’s natural selection. Randomly trying out new features, keeping what works (an adaptation) and rejecting what doesn’t, natural selection boosts an individual’s fitness and survival over another’s, to the benefit of the individual’s offspring.

However, the invention of agriculture about 10,000 years ago disrupted the tortoise-like pace of adaptation. Life in settlements rapidly exposed human beings to novel foods, diseases and customs. Hence the mismatch and, Lieberman contends, diseases that arise out of the transition from hunting and gathering to farming.

The Industrial Revolution, starting 250 years ago, accelerated cultural changes and left our bodies more out of sync with our environment. Consequently, our health suffered. Lieberman lists obesity, Type 2 diabetes, coronary heart disease, osteoporosis, hypertension and certain reproductive cancers as hypothesized noninfectious mismatch disorders, and likewise asthma, allergies, chronic insomnia, cavities, anxiety and depression, fallen arches, myopia and back pain. He later warns me “a majority of readers of the book are likely to suffer from and die from a mismatch disease.” He also counts broad-scale infectious diseases as mismatches, though they’ve been mostly tamed in developed nations.

Australopithecus afarensis
About 4 million years ago in Africa, a four-legged, chimpanzeelike hominin with a small brain atop a wide face stood on its hind legs and walked.

Flat nose and massive jaws: Thick molars and large chewing muscles broke down the tough stems and roots of its diet.

Bipedal: Walking upright, especially when having to trek long distances for food, was more efficient than four-footed rambling. Its spine was S-shaped and its neck vertically oriented, two other adaptations stemming from bipedalism.

Feet: It could still swing from branches, but its foot was stiff and slightly arched with long toes, the mark of a walker and a climber.

Dysevolution’s Loop

Natural selection lacks the time to correct mismatches because cultural evolution moves so much faster today than biological evolution. Therefore, Lieberman proposes an ominous new term: dysevolution.

It doesn’t mean that human beings are going backward or that all our hard-won adaptations, like big brains and springy legs, have lost their value. Dysevolution is what Lieberman calls “the deleterious feedback loop that occurs over multiple generations when we don’t treat the causes of a mismatch disease but instead pass on whatever environmental factors cause the disease, keeping the disease prevalent and sometimes making it worse.”

Health deteriorates when cultural evolution becomes the driver and certain adaptations, like an ingrained taste for sweets, become mismatches. Although he is appreciative of modern drugs and surgeries, Lieberman considers them “Band-Aids,”
equivalent to eyeglasses or arch supports, because they don’t address ultimate causes or the possibility of prevention. “Once we get sick, treatment is part of the dynamic of dysevolution,” he says.

Of the figures shown in these pages, the first three are products of Darwinian evolution, and the rest illustrate Lieberman’s dysevolution. If we arrange the figures in a circle — a hominins’ Wheel of Fortune — the one occupying the most favored position would not be *Homo sapiens* the post-industrial desk jockey, flush with material advantages (that is, someone like me), but *H. sapiens* the hunter-gatherer.

These first members of our *H. sapiens* clan evolved in Africa some 200,000 to 300,000 years ago from more primitive Paleolithic foragers. Their anatomies were like ours. Researchers know a fair amount about them from archaeological and skeletal remains and also from examining bands of more recent hunter-gatherers. These people were in great shape; they ran like marathoners and napped like lords. They had a nutritious, if chewy, diet. And if they were not in perfect harmony with their environment, they were well adapted to it.

**Homo erectus**

This early member of our genus evolved 1.9 million years ago and lasted at least 1 million years. Snoutless, chinless, long-armed and long-legged, *H. erectus* had the body plan of contemporary humans.

**Big-brained:** An engine at high idle, the brain needed more energy than plant foods could provide, so *H. erectus* became a hunter and consumer of meat.

**External nose:** Known as the nasal vestibule, this feature may have helped it adapt to a hot, arid climate, humidifying breath and cushioning its impact on the lungs.

**Relatively hairless:** Scientists believe *H. erectus* could shed heat from millions of sweat glands.

**Large knees and ankles, fully arched foot:** Such adaptations could help cope with the high forces of running or walking.

It’s not true that hunter-gatherers died young, before heart disease and the like could manifest themselves. Those who survived infancy could live to around 70. Granted they had infections and parasites, but even at old age, they apparently didn’t suffer from the chronic health conditions of affluent societies. Our Paleolithic cousins affirm the case, by counterexample, for the mismatch hypothesis, raising an obvious question: How might we become more like them? Using myself as a guinea pig, I submitted to Lieberman’s analysis to find out.

**Back to Basics**

In a course he teaches at Harvard, Lieberman collects exercise and dietary information from his students. The students compare themselves to tribal groups in Botswana, Tanzania and Paraguay who approximate the traditional hunter-gatherers. Sending him the same records and also my health information, I asked Lieberman where I fell on the spectrum between an average hunter-gatherer and the worst case. Also, how strong was the evidence that my health conditions, including serious illnesses I didn’t have but was at risk for, were caused by evolutionary mismatches?

First, the basics. At 6-foot-2 and 198 pounds with a body mass index (BMI) of 25.4, I was at the “edge of overweight,” Lieberman says. Although not obese, I was certainly heftier than a hunter-gatherer. One modern review of hunter-
gatherer groups put their average BMI at 21.5, which health professionals consider low-normal. The lowest BMI provided by Lieberman, for female Bushmen (San people) in Botswana, was 18.2.

My systolic blood pressure (the pressure on arterial walls when the heart pumps), was 138, “a little on the high side,” he says, qualifying me for pre-hypertension in some diagnostic circles. In Bushmen and other foragers, systolic blood pressure ranges from 100 to 122, which is below normal in developed societies. At 67, I may merit a pass for my blood pressure since it usually trends upward with age, yet hunter-gathers my age aren’t ever hypertensive (systolic 140 or greater). According to field surveys, they don’t have atherosclerosis (hardening of the arteries), angina, electrocardiogram abnormalities or heart attacks, either.

“It’s also said they don’t get diabetes,” Lieberman adds, “but we don’t know. I say it’s extremely unlikely.” Insulin resistance, a harbinger of diabetes, seems “rare and nonexistent in foragers,” according to a 2007 paper by Boyd Eaton, Loren Cordain and Anthony Sebastian, experts on hunter-gatherer lifestyles. But, plucked from its formative environment, the hunter-gatherer is not immune to diabetes. Aborigines in Australia frequently become overweight and diabetic after they settle in urban areas. In the late ’70s, researcher Kerin O’Dea moved a study sample of Aborigines back to the bush for several weeks. Subsisting on lean kangaroo meat, fish and wild yams like their forbears, the Aborigines not only lost weight by foraging but also dramatically reduced their glucose levels and other metabolic signs of diabetes. Some were cured of the disease, at least temporarily.

Since there is no obesity, diabetes or heart disease in my corner, at least not yet, we turned to my less serious disorders that might be due to mismatches. Myopia? Nearsightedness is estimated to occur in just 3 percent of hunter-gatherers. “We know that in farming populations, it’s almost nonexistent, too,” Lieberman says. “I’d bet on that strongly as a mismatch.” If children are using their eyes in different ways today, we should get them outside more, he advises. What’s more, he suspects that eyeglasses are helping to keep genes for myopia prevalent in the human population. If so, that’s an example of dysevolution.

My lower back pain stems not just from my forebears who stood up and became bipeds. Back pain is a tricky condition, Lieberman notes, because the mismatch may entail both underuse and overuse. Hunter-gatherers may suffer from back pain (it hasn’t been assessed), but “we think they use their backs moderately,” he says. They don’t strain their backs like the farmers and factory workers who succeeded them, but they don’t sleep on soft mattresses and sit around in comfy chairs as we moderns do, either.
How about anxiety and depression? “There’s no data in hunter-gatherers,” Lieberman says. “So why do we hypothesize it’s a mismatch? Because stress levels are up. Less activity and sleep and modern diets all have proven effects on mood. I’ll bet a fortune that chronic insomnia is a mismatch disease, too, but no one has ever studied insomnia among hunter-gatherers.”

**Evolved for Action**

Lieberman has some personal insight on the benefits of physical activity, which he says has been helpful with his own anxiety levels. Running, in particular, is Lieberman’s strong suit — a hobby that blossomed into a research specialty. At age 49, he runs or jogs 30 to 50 miles a week and walks about 2 miles per day. In fine weather he sometimes runs barefoot, earning himself a certain notoriety in Cambridge. Barefoot running is not for everyone, he says, but he justifies it in his book: “I have almost never seen a flat arch in any habitually barefoot person, reinforcing my belief that flat feet are an evolutionary mismatch.”

Lieberman sees hunter-gatherers as professional athletes who never take a day off. Running barefoot after game and foraging for roots in the sub-Saharan heat, they would cover 5 to 10 miles every day. What happens to their descendants who don’t do that? A lack of regular vigorous physical activity “is one of the most fundamental causes of so many mismatch diseases, it’s hard to know where to start,” Lieberman says. Inactivity when young leads to “inadequate muscle, heart, bone and circulatory development” and when older leads to high blood pressure, cardiovascular disease and osteoporosis, which is rare in female hunter-gatherers. In archaeological deposits, the bones of the female forager don’t show osteoporosis-related fractures. A woman’s skeletal strength was forged by pounding, weight-bearing activity as she grew. Lieberman contrasts her with “today’s sedentary post-menopausal woman who didn’t exercise enough when she was younger.” Dysevolution rears its head again: “By not having more physical activity in schools, we’re actually condemning a large portion of our population to osteoporosis,” Lieberman says.

Lieberman’s aggressive workout regimen, along with his BMI of 21.5, might qualify him for the hunter-gatherer all-star team. But I likely would not make the cut. He had me wear a pedometer during my 2.6-mile morning jog, which is neither vigorous nor done every day. The walking or rowing I do on other days only moderately raises my heart rate. “In exceeding

---

<table>
<thead>
<tr>
<th><strong>Homo sapiens (hunter-gatherer)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Our species arrived, scientists think, 200,000 to 300,000 years ago. Dark-skinned, narrow-hipped and fleet-footed. A rounder head had a face tucked below the brain.</td>
</tr>
</tbody>
</table>

| **Long vocal tract, dexterous tongue:** H. *sapiens* was able to produce the first languages. |
| **Athletic:** During the hunter-gatherer era, our species was as fit as today’s pro athletes. |
| **Energy storage:** H. *sapiens* had to develop a system to store energy as fat, an adaptation that took place under pressure of the current on-again, off-again ice age. Our craving for sugars and fats may have begun here. |
| **Adaptable:** The most impressive trait. Our ancestors emerged from Africa about 50,000 years ago and adapted quickly to every habitable niche on the planet. |
150 minutes of moderate or vigorous exercise per week, you’re in the top 20 percent of Americans,” he says. “But you’re at the low end of a typical hunter-gatherer. Maybe you’re one-fourth hunter-gatherer.”

Still, I am skilled at something that hunter-gatherers do: resting. Twentieth-century researchers often remarked that hunter-gatherers lie around a lot. Having no surpluses of food, they need to husband their calories. “Under such conditions,” Lieberman tells me, “resting must be adaptive because it allows you to divert the remaining energy into reproduction and/or storage [fat to be used later].”

In lectures, Lieberman has speculated that people today aren’t motivated to exercise because hunter-gatherers needed a lot of rest. To do nothing when you didn’t have to was adaptive once, but it’s maladaptive now. Thus, activity and inactivity were complementary traits, skillfully balanced by the hunter-gatherer but mismanaged by overweight moderns. The reasoning here seemed too easy. Although Lieberman has elucidated “tons of features” supporting our capacity to run and be active — among them springy Achilles tendons, muscular buttocks, big knees and myriad sweat glands — where was the scientific evidence for the evolution of human relaxation? “There’s no good anatomical evidence for the adaptation for resting,” Lieberman acknowledges. “It’s supposition.”

<table>
<thead>
<tr>
<th>Homo sapiens (farmer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the Paleolithic period gave way to the Neolithic, about 10,000 years ago, the only hominin on Earth was Homo sapiens. They settled down and began to raise crops and domesticate animals. This departure from the hunter-gatherer lifestyle led to most of the mismatch diseases from which we currently suffer, Lieberman says.</td>
</tr>
<tr>
<td><strong>Shorter:</strong> Poor health compared with hunter-gatherers may have led to diminished height.</td>
</tr>
<tr>
<td><strong>Sicker:</strong> Infectious disease, crowding and poor sanitation are common. Families produce more food, but more babies, too. The net result was nutritional stress. Bone records show anemia, malnutrition and cavities.</td>
</tr>
<tr>
<td><strong>Paler:</strong> As H. sapiens moved north into Europe, paler skin developed, the better to generate vitamin D in response to sunlight.</td>
</tr>
</tbody>
</table>

**The Dysevolution Diet**

Finally, Lieberman appraised my diet. “I eat fewer cookies than you,” he says at the outset. My meals were a far cry from those of the average hunter-gatherer. The number of calories consumed was comparable, about 2,500 per day. But whereas my ancestor got most of his carbohydrates (starches and sugars) and about one-third of his calories from plants, nuts and seeds, my carbohydrates and the majority of my calories were derived from processed foods and dairy products, including cereal, bread, cheese, ice cream and, yes, cookies.

The tough wild plants and fruits of the Paleolithic foragers were high in fiber. I was dismayed to hear that my large helpings of salad and occasional grilled turnips contained only modest fiber, thanks to agricultural tinkering. “Veggies have been domesticated to have low fiber,” Lieberman says. “Your turnips are lower in fiber than wild tubers.” Although the hunter-gatherers ate much more meat and fish than I do, my dinner of, say, lamb shoulder chop contained more fat than their lean game.
Sugars, whether in the form of carbohydrates or the straight-up simple sugars, are Lieberman’s bête noire. “The word addiction should be applied to sugar,” he says. The hunter-gatherer was lucky to get a scoop of honey now and then, its sweetness a marker for an energy-rich food. Once the foragers learned about sweets, he or she must have wanted more. Indeed, the development of a taste for sweets, starches and fats, formerly a helpful trait, contributes to a number of mismatch disorders.

For example, my atavistic craving for Pepperidge Farm Double Chocolate Nantucket cookies no doubt is responsible for the 10 cavities I have in my mouth. “Cavities are an easy mismatch, a no-brainer,” Lieberman tells me, noting that in paleontological specimens, cavities are common in teeth only after humans began to cultivate grain and to milk cows — and nearly unknown in hunter-gatherers.

Largely because I keep my daily calories under control, “a nutritionist would say you eat a healthy diet,” says Lieberman, “and not an unreasonable amount of processed foods.” But from the perspectives of the true hunter-gatherer and his modern acolyte, the paleo dieter, “what pops out are the levels of dairy, the amount of sugar in ice cream, the cookies and pie. Looking at the dairy, processed foods and relative lack of fiber, the paleo-diet person would faint.”

For all that, a health and nutrition panel hired by U.S. News & World Report gave the paleo diet its lowest ranking. The diet was faulted for having too much animal protein and not enough carbs and calcium. Its good points are its fiber and potassium and the absence of salt. Lieberman is dismayed that beans and lentils are verboten. “Just because something is novel and was not eaten by our ancestors, that doesn’t mean it must be unhealthy,” he says. “That helps explain why I am content to eat legumes and moderate amounts of dairy even though my Stone Age ancestors didn’t eat peanut butter sandwiches washed down with a glass of milk.”

### Cultural Counterattack

<table>
<thead>
<tr>
<th>Homo sapiens (industrial/post-industrial)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The past 250 years have seen more change in culture than the previous 250,000 years, dwarfing the changes to the human body. The world’s population booms, straining the world’s natural resources.</td>
</tr>
<tr>
<td>Smaller jaws and faces: Agriculture and cooking have changed our eating habits. We don’t have to work as hard to get energy from food.</td>
</tr>
<tr>
<td>Vision: Technology provides all manner of advantages and comforts, but also new pressures. Eye and vision problems result.</td>
</tr>
<tr>
<td>Bad backs: Stiff labor and overuse was the culprit at first. Underuse is the main cause today.</td>
</tr>
<tr>
<td>Reproductive cycle changes: Modern women experience 400 menstrual cycles, compared with about 150 for the hunter-gatherer. Cumulative exposure to more reproductive hormones may elevate <em>H. sapiens</em>’ risk of breast, ovarian and uterine cancer, Lieberman suggests.</td>
</tr>
<tr>
<td>Less athletic: Sedentary lifestyle burns less energy, which we store against lean times that never come. The result: obesity, diabetes and heart disease.</td>
</tr>
<tr>
<td>Foot problems: Shoes cover our feet, but they also expose us to ailments such as fallen arches and athlete’s foot.</td>
</tr>
</tbody>
</table>
Although human beings are still evolving, Lieberman doubts that natural selection can overtake our quicksilver culture and rectify our health problems. “I care about my children and grandchildren. I’m not going to wait for natural selection. It’s not that rapid,” he says. He favors fighting dysevolution on its own terms, by cultural means. Unhealthy habits and products will be passed down the generations as long as the advantages — convenience, low cost, appealing taste — are seen to exceed the disadvantages. What he calls cultural buffering, from protective clothing to antibiotics, screens the body from the harshness of the environment and of evolution. “Lack of selection, because of antibiotics, say, leads to an increase in [human] variation. People who might have been filtered out won’t be. They’ll pass on their genes,” he says.

“I’m not opposed to cultural buffering, to taking care of the weak. But treating takes away time and energy from preventing. We don’t hear about preventing cancer. For example, exercise can lower the risk of breast cancer by 20 or even 50 percent. Who does preventive ophthalmology? Preventive podiatry?” In short, if more doctors preached evolutionary medicine, patients might understand the big picture of why it’s hard for them to lose weight or eat right, which might make them amenable to learning how and trying harder. To substitute a mismatch condition for a failure of will might do great things for motivation.

The hunter-gatherer is an important messenger in Lieberman’s public health campaign, but his lifestyle isn’t a panacea. “Arguably, people in the developed world are better off than hunter-gatherers ever were,” he says. “We are living longer and healthier today. Infectious diseases have been conquered. Life wasn’t necessarily better back then. We’ve just swapped challenges.”