

Prologue

In June 2017, as I was beginning this book, I flew to Kenya, bought a treadmill, and transported it in a Land Cruiser to a remote place called Pemja, a community more than seven thousand feet above sea level in the western part of the country. Pemja lies at the edge of a verdant region of rolling hills and valleys dotted with giant granite outcrops. Scattered everywhere are small fields and simple homesteads, typically one-room houses made from mud and dung and roofed with thatch or tin. Pemja is beautiful but poor, even by Kenyan standards, and far off the beaten path. To drive there from Eldoret, the nearest city, which is just fifty miles away, takes nearly a day on roads that become increasingly treacherous the closer one gets to Pemja. On a good day, the journey requires navigating precipitous, twisting dirt lanes traversed by gullies littered with boulders and other obstacles. When it rains, the route becomes a steep, sticky river of volcanic mud.

Despite the horrendous roads, I have made this trip with my students and Kenyan colleagues nearly every year for the last decade to study how human bodies here are changing as the world rapidly modernizes. The people of Pemja are subsistence farmers who live much as their ancestors did for generations with barely any access to paved roads, electricity, and running water. Most Pemjans lack sufficient

means to buy shoes, mattresses, medicine, chairs, and other things I take for granted, and I find it deeply moving to observe how hard they work without assistance from machines to survive and improve their lives, especially the children's. By comparing them with people from the same Kalenjin ethnic group who live in the nearby city of Eldoret, we can study how our bodies change when we sit for much of the day in office jobs and no longer sustain ourselves with daily physical labor, go barefoot, and sit or squat on the ground.

Hence the treadmill. Our plan was to use it to study how efficiently women in this region walk while carrying heavy loads of water, food, and firewood on their heads. But the treadmill was an illuminating mistake. After we invited the women to stand on the machine and the belt started to move, they walked self-consciously, hesitantly, awkwardly. You, too, probably walked strangely the first time you got on one of these bizarre, noisy contraptions that force you to work to get nowhere. Although the women's treadmill-walking skills improved slightly with practice, we realized that to measure how they normally walked with and without loads, we had to abandon the treadmill and ask them to walk on solid ground.

As I grumbled about how much money, time, and effort we had wasted getting a treadmill to Pemja, it struck me how these machines encapsulate the main theme of this book: *we never evolved to exercise*.

What do I mean by that? Well, exercise today is most commonly defined as voluntary physical activity undertaken for the sake of health and fitness. But as such it is a recent phenomenon. Our not-too-distant ancestors who were hunter-gatherers and farmers had to be physically active for hours each day to get enough food, and while they sometimes played or danced for fun or social reasons, no one ever ran or walked several miles just for health. Even the salubrious meaning of the word "exercise" is recent. Adapted from the Latin verb *exerceo* (to work, train, or practice), the English word "exercise" was first used in the Middle Ages to connote arduous labor like plowing a field.¹ While the word has long been used to denote practicing or training to improve skills or health, to be "exercised" also means to be harassed, vexed, or worried about something.

Like the modern concept of exercising for the sake of health,

treadmills are recent inventions whose origins had nothing to do with health and fitness. Treadmill-like devices were first used by the Romans to turn winches and lift heavy objects, and then modified in 1818 by the Victorian inventor William Cubitt to punish prisoners and prevent idleness. For more than a century, English convicts (among them Oscar Wilde) were condemned to trudge for hours a day on enormous steplike treadmills.²

Opinions differ on whether treadmills are still used for punishment, but they illustrate the odd nature of exercise in the modern, industrialized world. Without seeming like a madman or an idiot, how would I explain to a hunter-gatherer, a farmer in Pemja, or even my great-great-grandparents that I spend most of my days sitting in chairs and then compensate for my idleness by paying money to go to a gym to make myself sweaty, tired, and uncomfortable on a machine that forces me to struggle to stay in the same place?

Beyond the absurdity of treadmills, our distant ancestors would also be perplexed by the way exercise has become commercialized, industrialized, and, above all, medicalized. Although we sometimes exercise for fun, millions of people today pay to exercise to manage their weight, prevent disease, and stave off decrepitude and death. Exercise is big business. Walking, jogging, and many other forms of exercise are inherently free, but giant multinational companies entice us to spend lots of money to work out in special clothes, with special equipment, and in special places like fitness clubs. We also pay money to watch other people exercise, and a handful of us even pay for the privilege of suffering through marathons, ultramarathons, triathlons, and other extreme, grueling, or potentially dangerous sporting events. For a few thousand dollars, you, too, can run 150 miles across the Sahara Desert.³ But more than anything else, exercise has become a source of anxiety and confusion because while everyone knows that exercise is good for their health, the majority of us struggle to exercise enough, safely, or enjoyably. We are exercised about exercise.

Okay, so exercise is paradoxical: salubrious but abnormal, intrinsically free but highly commodified, a source of pleasure and health but a cause of discomfort, guilt, and opprobrium. Why did this realization motivate me to write this book? And why might you wish to read it?

Myths of Exercise

For most of my life, I, too, was exercised about exercise. Like many, I grew up feeling unsure and insecure about my efforts to be physically active. It's a cliché, but as a pint-sized, nerdy kid, I really was picked last for teams in school. Although I dreamed of being more athletic, feelings of inadequacy and embarrassment about my mediocre abilities reinforced my inclination to avoid sports. In first grade, I once hid in a closet during gym. To me, the word "exercise" still summons up anxious memories of being humiliated by physical education teachers who shouted at me as I struggled, ashamed of my body, to keep up with my faster, stronger, and more talented classmates. I can still hear Mr. B—— bellowing, "Lieberman, climb that rope!" I wasn't a total couch potato in school, and throughout my twenties and thirties I occasionally jogged and hiked, but I did not exercise as much as I should, and I was largely ignorant and anxious about what kinds of exercise to do, how often, how vigorously, and how to improve.

Despite my mediocre athleticism, I fell in love with anthropology and evolutionary biology in college and chose to study how and why the human body is the way it is. At the beginning of my career, I focused on skulls, but for various accidental reasons I also became interested in the evolution of human running. That research in turn led me to investigate the evolution of other human physical activities like walking, throwing, toolmaking, digging, and carrying. Over the last fifteen years I have had the opportunity to traverse the globe to observe how hardworking hunter-gatherers, subsistence farmers, and others use their bodies. Because I strive to be adventurous, whenever possible I've tried to participate in these activities. Among other experiences, I've run and carried water on my head in Kenya, tracked musk oxen and kudu with indigenous hunters in Greenland and Tanzania, joined an ancient Native American footrace under the stars in Mexico, played barefoot cricket in rural India, and raced on foot against horses in the mountains of Arizona. Back in my lab at Harvard University, my students and I conduct experiments to study the anatomy, biomechanics, and physiology that underlie these activities.

My experiences and research slowly led me to conclude that because industrialized societies such as the United States fail to recognize that exercise is a paradoxically modern but healthy behavior, *many of our beliefs and attitudes about exercise are myths* (by “myth” I mean a claim that is widely believed but inaccurate and exaggerated). To be clear, I do not contend that exercise isn’t beneficial or that everything you have read about exercise is incorrect. That would be silly. I will, however, make the case that by ignoring or misinterpreting evolutionary and anthropological perspectives on physical activity, the contemporary, industrial approach to exercise is marred by misconceptions, overstatements, faulty logic, occasional mistruths, and inexcusable finger-pointing.

Chief among these myths is the notion that we are supposed to *want* to exercise. There is a class of people whom I define as “exercists” who like to brag about exercise and who repeatedly remind us that exercise is medicine, a magic pill that slows aging and delays death. You know the type. According to exercists, we were *born* to exercise because for millions of years our hunter-gatherer ancestors survived through walking, running, climbing, and other physical activities. Even exercists who discredit the theory of evolution think we are fated to exercise. When God expelled Adam and Eve from the Garden of Eden, he condemned them to a life of agrarian drudgery: “By the sweat of your brow you will eat your food until you return to the ground.” We are thus nagged to exercise because it is not just good for us but also a fundamental aspect of the human condition. People who don’t exercise enough are considered lazy, and physical suffering of the “no pain, no gain” variety is considered virtuous.

Other myths about exercise come in the form of exaggeration. If exercise, as we are told, is really a “magic pill” that will cure or prevent most diseases, why are more people living longer than ever despite being more physically inactive than ever? Are humans fundamentally slow and weak? Is it true that we trade off strength for endurance? Are chairs out to kill us? Is exercise useless for losing weight? Is it normal to be less active as we age? Is drinking a glass of red wine as beneficial as spending an hour in the gym?⁴

Inaccurate, sloppy, contradictory thinking about exercise gives us whiplash and sows confusion and skepticism. On the one hand we are advised to walk ten thousand steps a day, avoid sitting, and never take the elevator, but on the other hand we hear that exercising won't help us shed extra pounds. We are exhorted to spend more time being active and admonished to stop slouching, but then advised to sleep more and use chairs that support the lower back. Expert consensus is that we need 150 minutes of exercise a week, but we also read that just a few minutes of high-intensity exercise a day is enough to make us fit. Some fitness professionals recommend free weights, others prescribe weight machines, yet others reproach us for not doing enough cardio. While some authorities urge us to jog, others warn that running will ruin our knees and promote arthritis. One week we read how too much exercise may damage the heart and that we need comfortable sneakers, but the next we read it is almost impossible to exercise too much and that minimal shoes are best.

Beyond spreading confusion and doubt, the most pernicious consequence of many myths about exercise—especially the one about how it's normal to exercise—is that we fail to help people to exercise and then unfairly shame and blame them for not doing it. Everyone knows they should exercise, but few things are more irritating than being told to exercise, how much, and in what way. Exhorting us to “Just Do It” is about as helpful as telling a drug addict to “Just Say No.” If exercise is supposedly natural, why is it that no one, despite years of effort, has found an effective way to help more people to overcome deep-seated, natural instincts to avoid optional exertion? According to a 2018 survey of millions of Americans, about half of adults and nearly three-quarters of teenagers report they don't reach the base level of 150 minutes of physical activity per week, and less than one-third report they exercise in their leisure time.⁵ By any objective measure we are doing a lousy job promoting exercise in the twenty-first century in part because we have a muddleheaded approach to physical activity and inactivity.

Enough complaining. How can we do better? And what do I hope you will get out of this book?

Why a Natural History?

The premise of this book is that evolutionary and anthropological perspectives can help us better understand the paradox of exercise—that is, why and how something we never evolved to do is so healthy. I think these perspectives can also help those of us who are anxious, confused, or ambivalent about exercise to exercise in the first place. Consequently, this book is as much for exercise enthusiasts as it is for those who are exercised about exercise and struggle to do it.

Let me start by explaining how I *won't* approach this topic. If you've read any websites, articles, or books on exercise, you'll quickly realize that most of what we know comes from observing people in modern, industrialized countries like the United States, England, Sweden, and Japan. Many of these studies are epidemiological; they look for associations between, say, health and physical activity in large samples of individuals. For example, hundreds of studies have looked for correlations between heart disease, exercise habits, and factors like age, sex, and income. These analyses reveal correlations, not causation. There has also been no lack of experiments that randomly assign people (most often college students) or mice to contrasting treatment groups for short periods of time to measure the effects of particular variables on particular outcomes. Hundreds of such studies have looked, for instance, at the effects of varying doses of exercise on blood pressure or cholesterol levels.

There is nothing inherently wrong with these sorts of studies—as you'll see, I'll make use of them throughout the book—but they view exercise too narrowly. For starters, almost all studies of humans focus on contemporary Westerners or elite athletes. There is nothing wrong with studying these populations, but Westerners such as Americans and Europeans constitute only about 12 percent of humanity and are often unrepresentative of our evolutionary past. Studying elite athletes provides an even more skewed perspective on normal human biology. How many people have ever been able to run a mile in less than four minutes or bench-press more than five hundred pounds? In addition, how similar is your biology to that of a mouse? Just as

important, these studies fail to consider how exercise is abnormal without effectively addressing key “why” questions. Large epidemiological surveys and controlled laboratory experiments might elucidate how exercise affects the body, underscore the benefits of exercise, and quantify how many Swedes or Canadians are unmotivated and confused about exercise, but you wouldn’t learn much about *why* exercise affects the body as it does, *why* so many of us are ambivalent about exercise, and *why* physical inactivity causes us to age more rapidly and increases our chances of getting sick.

To address these deficiencies, we need to supplement the standard focus on Westerners and athletes with evolutionary and anthropological perspectives. To do that, we will venture beyond college campuses and hospitals in the United States and other industrialized countries to observe a wider range of humanity laboring, resting, and exercising in contexts in which most humans still live. We will look at hunter-gatherers and subsistence farmers in different environments on different continents. We’ll also delve into the archaeological and fossil records to better understand the history and evolution of human physical activity even as we compare ourselves with other animals, especially our closest ape relatives. And, finally, we will integrate these diverse lines of evidence about people’s biology and behavior into their proper ecological and cultural contexts. To compare how American college students, African hunter-gatherers, and Nepalese porters walk, run, sit, and carry things, and how these activities affect their health, requires knowing something about their different physiologies and cultures. In short, to really understand exercise, let’s study the natural history of human physical activity and inactivity.

Accordingly, in the chapters that follow, we will use evolutionary and anthropological perspectives to explore and rethink dozens of myths about physical inactivity, activity, and exercise. Are we born to exercise? Is sitting the new smoking? Is it bad to slouch? Do you need eight hours of sleep? Are humans comparatively slow and weak? Is walking ineffective for losing weight? Does running ruin your knees? Is it normal to exercise less as we age? What is the best way to persuade people to exercise? Is there an optimal kind and amount of exercise? How much does exercise affect our vulnerability to cancer

or infectious diseases? The mantra of this book is that *nothing about the biology of exercise makes sense except in the light of evolution, and nothing about exercise as a behavior makes sense except in the light of anthropology.*⁶

For those of you who already love to exercise, I will try to give you new insights into how and why different kinds of inactivity and physical activity affect your body, why exercise really does promote health without being a magic pill, and why there is no optimal dose or type of exercise. For those of you who struggle to exercise, I will explain how and why you are normal, help you figure out how to get moving, and help you evaluate the benefits and drawbacks of different kinds of exercise. But this is not a self-help book. I am not going to hawk “seven easy steps to get fit” or cajole you to take the stairs, run a marathon, or swim the English Channel. Instead, my goal is to explore skeptically and without jargon the fascinating science of how our bodies work when we move and take it easy, how and why exercise affects health, and how we can help each other get moving.

As a natural history, this book has four parts. After an introductory chapter, the first three parts roughly follow the evolutionary story of human physical activity and inactivity, with each chapter spotlighting a different myth. Because we cannot understand physical activity without understanding its absence, part 1 begins with *physical inactivity*. What are our bodies doing when we take it easy, including when we sit and sleep? Part 2 explores physical activities that require *speed*, *strength*, and *power* such as sprinting, lifting, and fighting. Part 3 surveys physical activities that involve *endurance* such as walking, running, and dancing, as well as their effect on aging. Last but not least, in part 4 we will consider how anthropological and evolutionary approaches can help us exercise better in the modern world. How can we more effectively manage to exercise, and in what ways? To what extent, how, and why do different types and doses of exercise help prevent or treat the major diseases likely to make us sick and kill us?

But we have a long way to go before drawing any conclusions. Let’s begin with what you’re probably doing right now as you read these words—not moving—to explore more deeply the biggest myth of them all: that it’s normal to exercise.

Exercised

Are We Born to Rest or Run?

MYTH #1 We Evolved to Exercise

It's true hard work never killed anybody, but I figured why take the chance?

—Ronald Reagan, interview with *The Guardian*, 1987

neither am nor want to be an exceptional athlete, and I have no desire whatsoever to swim around Manhattan, bike across America, climb Mount Everest, bench-press several hundred pounds, or pole-vault over anything. Among the many tests of extreme strength or endurance I will never attempt is a full triathlon. Not me. But I am curious about demanding athletic challenges. So in October 2012, I eagerly accepted an invitation to travel to Hawaii to observe the legendary Ironman World Championship and attend the sports medicine conference that precedes the race.

Paradoxically, this infamously grueling test of endurance takes place in the paradisiacal setting of Kona, Hawaii, a charming town largely dedicated to helping vacationers relax. In the days leading up to the race, everyone in Kona appears to be engaged solely in the pursuit of pleasure. People swim, snorkel, and surf on picturesque beaches, sip fruity cocktails while watching the sun set, and stroll through

town eating ice cream and buying souvenirs and sports equipment. Some also party late into the night in the town's many bars and clubs. If you are looking for a tropical resort in which to relax and be hedonistic, you couldn't do better than Kona.

Then on Saturday at precisely 7:00 a.m. the race begins. As the morning sun paints the sky rose as it emerges from behind the blue silhouette of the volcano that looms above town, about twenty-five hundred ultra-fit people dive off a pier into the Pacific for the race's first leg, a 2.4-mile swim across the bay and back. In case you were wondering, 2.4 miles is the equivalent of swimming seventy-seven lengths of an Olympic-sized pool. Many of the triathletes look apprehensive as they wait for the starting gun, but their spirits are buoyed by a band of Hawaiian drummers, thousands of cheering spectators, and loud, adrenaline-inducing music blaring from car-sized speakers. Once they start, there are so many swimmers churning the water it looks like a shark feeding frenzy.

About an hour later, the lead triathletes make it back to land. As they emerge dripping from the ocean, they rush into a tent, change into high-tech biking gear (including aerodynamic helmets), jump onto ultralightweight bikes that cost upwards of ten thousand dollars, and zoom out of sight for the next leg of the race, a 112-mile course across a lava desert. Because it takes the best riders about four and a half hours to cover this distance, I stroll back to my hotel and savor a tropical breakfast, made all the more pleasant by exercise *schadenfreude*. Yes, I do think my eggs Benedict and coffee taste better as I think about those two thousand fellow humans out there on the island under the blaring sun trying to bike more than 100 miles as fast as they can and still save enough energy to complete the final leg of their ordeal, a full-length marathon.

Rested and refreshed, I return to the race center to watch the elite triathletes leap off their bikes, lace on running shoes, and then head off on foot to begin their 26.2-mile run along the coast. While the competitors trudge through their marathon in brutally hot and humid conditions (it was 90°F), I enjoy a leisurely lunch and a brief nap. Shortly after 2:00 p.m., I amble back to watch the finish, one of the most exuberant scenes I have ever witnessed. As the first runners

arrive back at the town's main street, they are funneled into a chute lined by screaming friends and fans—all whipped into a feverish state by loud, pulsating music. At the finish line, a booming voice greets each finisher (male and female) with the time-honored phrase "YOU ARE AN IRONMAN!" and the crowd goes wild. The elite athletes, who finish about eight hours after they started, cross the line stony-faced, looking more like cyborgs than humans. Later, as the amateurs arrive to complete their ordeal, we glimpse what their achievement means to them. Many weep for joy; others kneel to kiss the ground; some pound their chests and bellow thunderously; a few look dangerously ill and are rushed to the medical tent.

The most dramatic finishes occur near midnight as the seventeen-hour deadline approaches. These intrepid souls desperately will their bodies to overcome crushing pain and fatigue, their minds forcing each leg to take just one more step. As they limp into town, some look near death's door. But the sight of the finish line and the emotional energy from the raucous friends, family members, and fans who line the race's final stretch pull them home. First they hobble; then they shuffle; finally they manage to break into a run to reach the finish line, where they collapse in a state of ecstasy. It is there at midnight where one truly understands why Ironman's motto is "Anything Is Possible."

Ernesto

Watching amateur Ironmen finish near midnight was inspiring. But I flew home with renewed conviction that no amount of money would entice me to do a full triathlon. Further, I couldn't help but feel that what I observed was not just abnormal but also concerning. What would motivate someone to train for hours upon hours a day for years just for the chance to put his or her body through that kind of hell and prove that "anything is possible"? Full triathlons require extreme obsession and money. If you consider airfare, hotel bills, and gear, many Ironmen spend tens of thousands of dollars a year on their sport. Although Ironman attracts diverse participants, including cancer survivors, nuns, and retirees, a large percentage are

wealthy Type A personalities who apply the same fanatical devotion to exercise they previously dedicated to their careers. Much as I admire these triathletes, are they damaging their bodies? For every Ironman who qualifies, how many would-be Ironmen were sidelined by crippling injuries? What kind of toll does all the training necessary to do a full triathlon have on the athletes' friends, families, and marriages?

With these and other thoughts percolating in my brain, a few weeks later I packed my bags and headed to the Sierra Tarahumara (sometimes called the Copper Canyons) of Mexico, far from the trappings of the developed world. There I met athletes so different from the triathletes of Kona and observed a competition so different from Ironman that I can only describe the experience as whiplash. And of all the people I encountered, the one who blew my mind the most was an elderly man, Ernesto (that's not his real name), whom I met on a remote mesa, seven thousand feet above sea level.

I had traveled to the Sierra to do research on Tarahumara Native Americans, famous for their long-distance running. Dozens of anthropologists over the last century have written about the Tarahumara, but in 2009 they gained an extra boost of worldwide fame from the best seller *Born to Run*. The book portrays them as a "hidden tribe" of barefoot, ultra-healthy, "superathletes" who routinely run unimaginable distances.¹ Intrigued, and to collect data on how they ran without modern, cushioned running shoes, I traveled up and down four-thousand-foot ravines on perilous switchback roads with a guide, an interpreter, and scientific instruments to measure people's feet and running biomechanics. By the time I met Ernesto, I had interviewed and measured dozens of other Tarahumara men and women and was beginning to have doubts about almost everything I had read about their running. Despite their reputation as extraordinary runners, I hadn't seen a single Tarahumara running anywhere, let alone barefoot. But I did observe them to be hard workers and indefatigable walkers. Most of the people I interviewed said they either didn't run or participated in just one race per year. Not all Tarahumara appeared to be skilled runners, and many of them had paunches or were overweight.

Not Ernesto. A slight man in his seventies who looks twenty or

thirty years younger, Ernesto was initially reticent as I measured his height, weight, leg length, and feet, and then used a high-speed video camera to record his running biomechanics on a small track I had set up. Thankfully for me, he gradually became increasingly garrulous and started to tell stories (through an interpreter) about the old days when he hunted deer on foot by running them down and sometimes danced for days in ceremonies. Ernesto told me he was a champion runner in his youth and that he still competed in several races a year. But when I asked him how he trained, he didn't understand the question. When I described how Americans like me keep fit and prepare for races by running several times a week, he seemed incredulous. As I asked more questions, he made it pretty clear he thought the concept of needless running was preposterous. "Why," he asked me with evident disbelief, "would anyone run when they didn't have to?"

Since I had just witnessed the intensity of Ironman triathletes, whose arduous training habits are legendary, I found that Ernesto's question made me both laugh and think. He put the exercise habits of many Westerners, myself included, into stark perspective. If you were a subsistence farmer like Ernesto who grows all his own food without the help of machines, why would you ever spend precious time and calories exercising just for the sake of keeping fit or to prove that anything is possible? Ernesto reinforced my conviction that what I observed at Ironman was bizarre, and he even caused me to question the sanity of my own efforts to train for a marathon. Ernesto also intensified my curiosity about Tarahumara running, which seemed more mythical than actual. Even though Ernesto never trained, and I hadn't seen any Tarahumara running on their own, I had heard and read numerous accounts about how Tarahumara men and women have their own Ironman-like competitions. In the women's race, known as *ariwete*, teams of teenage girls and young women run about twenty-five miles while chasing a cloth hoop. In the men's race, the *rarájjipari*, teams of men run up to eighty miles while kicking an orange-sized wooden ball. If the Tarahumara think needless exercise is foolish, why do some of them sometimes run insanely long distances like Ironmen? Just as important, how do they accomplish these feats without training?

Rarájipari Under the Stars

Not long after I met Ernesto, I got some answers to these questions when I had the privilege of witnessing a traditional Tarahumara *rarájipari* footrace. The competition took place on a mountaintop near a tiny Tarahumara settlement, about a two days' walk from the nearest town. The race involved two teams of men, eight on each side. Ernesto's team was captained by Arnulfo Quimare, a champion Tarahumara runner who figured prominently in the book *Born to Run*. The opposing team was captained by Arnulfo's cousin Silvino Cubesare, also a champion runner. By arrangement, the teams had set up two stone cairns about two and a half miles apart, and they agreed that the first team to complete fifteen circuits or to lap the other (in other words, get five miles ahead) would win.

The morning began with a feast. In addition to the runners, about two hundred Tarahumara had assembled from near and far to enjoy the event, socialize, and take a break from working in the fields. At breakfast, the runners somberly tanked up on chicken stew, while the rest of us devoured fresh tortillas, chilies, and an enormous quantity of soup that had been prepared in a former oil drum. The soup contained most of a cow along with corn, squash, and potatoes. In addition to feasting, people placed bets on the two teams, wagering pesos, clothes, goats, corn, and other sundry commodities. Then, at about 11:00 a.m., after several hours of relaxed chaos, the runners started off with no fanfare. As shown in figure 1, the runners wore exactly the same clothes they always wear: a bright tunic, a loincloth, and sandals (*huaraches*) cut from a tire and lashed onto their feet with leather thongs. Each team had its own hand-carved wooden ball, which the runners flick with their toes as far as possible, then run to find it, and kick again without ever using their hands. Although the two teams never stopped, some of the observers (myself included) occasionally jumped in for a lap or two to keep the runners company and offer encouragement by shouting, "*Iwériga! Iwériga!*" (which means both "breath" and "soul"). When the runners were thirsty, their friends offered them *pinole*, a Gatorade-like drink made of powdered corn dissolved in water.



FIGURE 1 Scenes from two different races. The Ironman World Championship in Kona, Hawaii (top), and a *rarájipari* in the Sierra Tarahumara, Mexico (bottom). The Tarahumara runner (Arnulfo Quimare) is chasing a ball that he has just flicked with his foot. (Photos by Daniel E. Lieberman)



For the first six or so hours of the race, it was impossible to tell who was going to win. Arnulfo's and Silvino's teams went back and forth along the course at a steady, gradual jogging pace of about ten minutes per mile. As the warm December day turned into a chilly, star-filled night, the runners kept going without pause, lighting their way with pine torches. I joined Arnulfo's team then and will never forget the magical feeling of running behind them under that splendid starry sky, a torch in hand, watching Arnulfo and his friends focused intently on that all-important ball, kicking, searching, but always running, running, running. Eventually, however, some of the runners started to drop out from cramps, and finally, around midnight, Arnulfo's team lapped Silvino's and the race was over after about seventy miles. Unlike Kona, there was no applause, no announcer, no triumphant music. Instead, everyone just sat down by an enormous bonfire and drank from gourds of homemade corn beer.

On the surface, that *rarájipari* was the antithesis of Ironman. It was a totally uncommercial, simple community event, part of an ancient tradition that probably dates back thousands of years.² There was no timing, no entry fee, and no one wore any special gear. But in other respects, much about the *rarájipari* was familiar. Although there were no trophies or prizes for the winners, the race was a serious competition, and the winning team amassed a small fortune thanks to all the betting. Instead of Gatorade, there was *pinole*. Like the Ironman triathletes, the Tarahumara runners suffered intensely, battling nausea, cramps, and crushing fatigue. And perhaps the most important similarity is that almost all the attendees were bystanders, not runners. While some of the spectators occasionally jumped into the race for a few laps, only a few Tarahumara compete in these races. Most are content to watch rather than run.

The Myth of the Athletic Savage

The races I saw at Kona and the Sierra Tarahumara were inspiring but also perplexing. Who is more normal from an evolutionary perspective: those of us who push our bodies to do nonessential physical activities, sometimes in extreme, or those of us who prefer to avoid

unnecessary exertion? And how do some Tarahumara manage to run several back-to-back marathons without training, while Ironmen practice and prepare obsessively for years to accomplish similar feats of endurance?

Answers to these questions typically run the gamut of beliefs about nature versus nurture. On one side of this venerable debate is the view that athletic proclivities and talents are innate. Just as genes make some of us taller or more dark-skinned, there must be genes that influence biological capacities and psychological inclinations to be athletes. If nature is more important than nurture, then to become an extreme athlete, you first need to have the right parents with the right genes. Decades of research have indeed confirmed that genes do play key roles in many aspects of sport and exercise, including our motivation to exercise in the first place.³ That said, intensive efforts have failed to identify specific genes that explain much about athletic talent including how and why Kenyan and Ethiopian runners currently dominate distance running.⁴ In addition, studies of professional athletes who push the limits of endurance reveal that the barriers they must overcome include physiological challenges like generating muscle force effectively, fueling themselves efficiently, and controlling their body temperature, but these competitors are even more challenged by psychological hurdles. To keep going, great athletes must learn to cope with pain, be strategic, and above all believe they can do it.⁵ We must therefore look just as much at the other side of the nature versus nurture debate and consider how environment, especially culture, contributes to everyday people's athletic abilities and impulses.

The most widespread and intuitively appealing line of thinking about the effects of nurture on physical activity arises from an idea known as the theory of the natural human. According to this view, championed by the eighteenth-century philosopher Jean-Jacques Rousseau, humans who live in what Rousseau termed a "savage" state of nature reflect our true, inherent selves uncorrupted by civilization. This theory has been warped into many forms, including the myth of the noble savage, the belief that nonwesternized people whose minds have not been polluted by the social and moral evils of civilized society are naturally good and decent. Although widely

discredited, this myth has persisted and found new life when applied to exercise in what I label the *myth of the athletic savage*. The essential premise of this myth is that people like the Tarahumara whose bodies are untainted by modern decadent lifestyles are natural superathletes, not only capable of amazing physical feats, but also free from laziness. By contending that the men I observed running seventy miles without training do so naturally, this myth implies that people like you and me who neither can nor will accomplish such feats are, from an evolutionary perspective, abnormal because civilization has turned us into etiolated wimps.

As you have probably divined, I object to the myth of the athletic savage. For one, it stereotypes and dehumanizes people such as the Tarahumara. Since that first trip when I spoke with Ernesto, I have talked with hundreds of Tarahumara all over the Sierra Tarahumara and can assure you no one there wakes up in the morning and thinks, “Gee, what a beautiful day. I think I’ll run fifty miles just for fun.” They don’t even go for needless five-mile runs. When I ask Tarahumara on what occasions they run, the most common answer is “when I chase goats.” Instead, I have come to appreciate that the Tarahumara are extremely hardworking, physically fit farmers who never do anything by half and whose culture deeply values running. The reason some Tarahumara run fifty or more miles on rare occasions is not much different from the reason Ironmen do triathlons: they think it is worth it. However, whereas Ironmen subject themselves to full triathlons to test their limits (Anything Is Possible!), Tarahumara run *rarájiparis* because it is a deeply spiritual ceremony that they consider a powerful form of prayer.⁶ Many Tarahumara I have interviewed say that the ball-game race makes them feel closer to the Creator. To them, chasing that unpredictable ball for mile upon mile is a sacred metaphor for the journey of life, and it induces a spiritual trancelike state. It is also an important communal event that brings money and prestige. Lastly, I think the *rarájipari* once had a vital practical function. As I watched Arnulfo and his team repeatedly try to find and then kick that dust-colored wooden ball, it struck me that the ball game is a terrific way to learn how to track while running—an essential skill for the way the Tarahumara used to hunt deer on foot.

The myth of the athletic savage mistakenly suggests that humans uncorrupted by civilization can easily run ultramarathons, scale enormous mountains, and perform other seemingly superhuman feats without training. Yes, the Tarahumara and other nonindustrial people rarely if ever “train” as we do by following a course of exercises to develop their fitness and prepare for a specific event. (When I travel to places like the Sierra, I am often the only person who goes for an apparently pointless jog in the morning to the amusement of the locals.) But nearly every day of their lives, hunter-gatherers and subsistence farmers engage in hours of hard physical *work*. Because they lack cars, machines, and other laborsaving devices, their daily existence requires walking many miles in rugged terrain, not to mention doing other kinds of physical labor by hand like plowing, digging, and carrying. When my colleague Dr. Aaron Baggish attached accelerometers (tiny devices, like Fitbits, that measure steps per day) to more than twenty Tarahumara men, he discovered they walked on average ten miles a day. In other words, the training that enables them to run back-to-back marathons is the physical work that is part and parcel of their everyday life.

The myth of the athletic savage also erroneously implies that running an ultramarathon or performing other feats of extraordinary athleticism is somehow effortless for the Tarahumara and other indigenous peoples compared with Westerners. It encourages a racist stereotype akin to the disturbing fiction that Africans raised in the jungle or in slavery did not experience pain in the same way as Europeans do.⁷ Moreover, it embraces the fallacy that if only you and I had grown up leading a wholesome lifestyle uncorrupted by sugar and chairs and requiring lots of natural movement, then we could be super-healthy superathletes for whom running a marathon would be child’s play. Not only is the myth of the athletic savage an example of truthiness—something that *feels* true because we *want* it to be true—it trivializes the physical and psychological challenges faced by all athletes everywhere, the Tarahumara included. I have observed several *rarájiparis* and *ariwetes* and seen how Tarahumara runners struggle just as much as the Ironmen of Kona to overcome cramps, nausea, bloody toes, and other forms of physical pain. They also suffer

mentally and, like other athletes, draw strength from bystanders who urge them on.

It's time to discard once and for all ancient, insidious stereotypes about the physical superiority and virtuousness of people who don't grow up surrounded by laborsaving machines and other modern comforts. But debunking this myth doesn't address the fundamental question: What kind of physical activity and how much of it is normal for a "normal" human being?

Are "Normal" Humans Couch Potatoes?

Imagine you have been asked to conduct a scientific study on how much, when, and why "normal" people exercise. Because we tend to think of ourselves and our societies as normal, you'd probably collect data on the exercise habits of people like you and me. This approach is the norm in many fields of inquiry. For example, because most psychologists live and work in the United States and Europe, about 96 percent of the subjects in psychological studies are also from the United States and Europe.⁸ Such a narrow perspective is appropriate if we are interested only in contemporary Westerners, but people in Western industrialized countries aren't necessarily representative of the other 88 percent of the world's population. Moreover, today's world is profoundly different from that of the past, calling into question who among us is "normal" by historical or evolutionary standards. Imagine trying to explain cell phones and Facebook to your great-great-great-grandparents. If we really want to know what ordinary humans do and think about exercise, we need to sample everyday people from a variety of cultures instead of focusing solely on contemporary Americans and Europeans who are, comparatively speaking, WEIRD (Western, educated, industrialized, rich, and democratic).⁹

To go a step further, until a few hundred generations ago, all human beings were hunter-gatherers, and until about eighty thousand years ago everyone's ancestors lived in Africa. So if we genuinely want to know about the exercise habits of evolutionarily "normal" humans, it behooves us to learn about hunter-gatherers, especially those who live in arid, tropical Africa.

Studying hunter-gatherers, however, is easier said than done because their way of life has almost entirely vanished. Only a handful of hunter-gatherer tribes persist in some of the most remote corners of the globe. Further, none are isolated from civilization and none subsist solely on the wild foods they hunt and gather. All of these tribes trade with neighboring farmers, they smoke tobacco, and their way of life is changing so rapidly that in a few decades they will cease to be hunter-gatherers.¹⁰ Anthropologists and other scientists are therefore scrambling to learn as much as possible from these few tribes before their way of life irrevocably disappears.

Of all of them, the most intensely studied is the Hadza, who live in a dry, hot woodland region of Tanzania in Africa, the continent where humans evolved. In fact, doing research on the Hadza has become something of a cottage industry for anthropologists. In the last decade, researchers have studied almost everything you can imagine about the Hadza. You can read books and articles about how the Hadza eat, hunt, sleep, digest, collect honey, make friends, squat, walk, run, evaluate each other's attractiveness, and more.¹¹ You can even read about their poop.¹² In turn, the Hadza have become so used to visiting scientists that hosting the researchers who observe them has become a way to supplement their income. Sadly, visiting scientists who want to emphasize how much they are studying bona fide hunter-gatherers sometimes turn a blind eye to the degree to which the Hadza's way of life is changing as a result of contact with the outside world. These papers rarely mention how many Hadza children now go to government schools, and how the Hadza's territory is almost entirely shared with neighboring tribes of farmers and pastoralists, with whom they trade and whose cows tramp all over the region. As I write this, the Hadza don't yet have cell phones, but they are not isolated as they once were.

Despite these limitations, there is still much to learn from the Hadza, and I am fortunate to have visited them on a couple of occasions. But to get to the Hadza is not easy. They live in a ring of inhospitable hills surrounding a seasonal, salty lake in northwestern Tanzania—a hot, arid, sunbaked region that is almost impossible to farm.¹³ The area has some of the worst roads on the planet. Of the

roughly twelve hundred Hadza, only about four hundred still predominantly hunt and gather, and to find these few, more traditional Hadza, you need sturdy jeeps, an experienced guide, and a lot of skill to travel over treacherous terrain. After a rainstorm, driving twenty miles can take most of the day.

Many things surprised me when I first walked into a Hadza camp mid-morning on a torrid, sunny day in 2013, but I remember being especially struck by how everyone was apparently doing *nothing*. Hadza camps consist of a few temporary grass huts that blend in with the surrounding bushes. I didn't realize I had walked into a camp until I found myself amid about fifteen Hadza men, women, and children who were sitting on the ground as shown in figure 2. The women and children were relaxing on one side, and the men on another. One fellow was straightening some arrows, and a few children were toddling about, but no one was engaged in any hard work. To be sure, the Hadza weren't lounging on sofas, watching TV, munching potato chips, and sipping soda, but they were doing what so many health experts warn us to avoid: sitting.



FIGURE 2 What I saw when I first arrived in this Hadza camp. Almost everybody is sitting. (Photo by Daniel E. Lieberman)

My observations since that day along with published studies of their activity levels confirm my initial impression: when Hadza men and women are in camp, they are almost always doing light chores while sitting on the ground, gossiping, looking after children, and otherwise just hanging around. Of course, Hadza men and women head out almost every day to the bush to hunt or gather food. The women typically leave camp in the morning and walk several miles to somewhere they can dig for tubers. Digging is a relaxing and social task that usually involves sitting in a group under the bushes in the shade and using sticks to excavate edible tubers and roots. As Hadza women dig, they eat some of what they extract while chatting and minding their infants and toddlers. On the way there and back, women often stop to collect berries, nuts, or other foods. On the few occasions when I have accompanied Hadza men on hunts, we walked between seven and ten miles. When they are tracking animals, the pace is varied but never so fast that I wasn't able to keep up, and often the hunters stop to rest and look around. Whenever they encounter a honeybee hive, they stop, make a fire, smoke out the bees, and gorge themselves on fresh honey.

Among the many studies of the Hadza, one asked forty-six Hadza adults to wear lightweight heart rate monitors for several days.¹⁴ According to these sensors, the average adult Hadza spends a grand total of three hours and forty minutes a day doing light activities and two hours and fourteen minutes a day doing moderate or vigorous activities. Although these few hours of hustling and bustling per day make them about twelve times more active than the average American or European, by no stretch of the imagination could one characterize their workloads as backbreaking. On average, the women walk five miles a day and dig for several hours, whereas the men walk between seven and ten miles a day.¹⁵ And when they aren't being very active, they typically rest or do light work.

The Hadza, moreover, are typical of other hunter-gatherer groups whose physical activity levels have been studied. The anthropologist Richard B. Lee astonished the world in 1979 by documenting that San hunter-gatherers in the Kalahari spend only two to three hours a day foraging for food.¹⁶ Lee might have underestimated how much

work the San do, but more recent studies of other foraging populations report similarly modest physical activity levels as the Hadza.¹⁷ One especially well-studied group is the Tsimane, who fish, hunt, and grow a few crops in the Amazon rain forest. Overall, Tsimane adults are physically active for four to seven hours per day, with men engaging in vigorous tasks like hunting for only about seventy-two minutes a day and women engaging in almost no vigorous activity at all but instead doing mostly light to moderate tasks such as child care and food processing.¹⁸

All in all, assuming that what hunter-gatherers do is evolutionarily “normal,” then comprehensive studies of contemporary foraging populations from Africa, Asia, and the Americas indicate that a typical human workday used to be about seven hours, with much of that time spent on light activities and at most an hour of vigorous activity.¹⁹ To be sure, there is variation from group to group and from season to season, and there is no such thing as a vacation or retirement, but most hunter-gatherers engage in modest levels of physical effort, much of it accomplished while sitting. How different, then, are such “normal” humans from postindustrial people like me (and perhaps you), not to mention farmers like the Tarahumara, factory workers, and others whose lives have been transformed by civilization?

Activity over the Ages

In 1945, in the aftermath of World War II, the United Nations created the Food and Agriculture Organization (FAO) to eliminate hunger, food insecurity, and malnutrition. But when FAO scientists and bureaucrats first tried to figure out how much food the world needed, they realized they didn’t know in part because they were ignorant of how much energy people spent being active. Of course, a bigger person must eat more calories per day than a smaller person, but how much more food do you need to eat if you are a factory worker, a miner, a farmer, or a computer programmer? And how do those needs vary if you are male, female, pregnant, young, or elderly?

FAO scientists decided to measure people’s energy expenditures using the simplest metric possible, the physical activity level, or

PAL.²⁰ Your PAL is calculated as the ratio of how much energy you spend in a twenty-four-hour period divided by the amount of energy you would use to sustain your body if you never left your bed. This ratio has the advantage of being unbiased by differences in body size. Theoretically, a big person who is very physically active will have the same PAL as a small person who does the same activities.

Ever since the PAL metric was conceived, scientists have measured the PALs of thousands of people from every walk of life and every corner of the globe. If you are a sedentary office worker who gets no exercise apart from generally shuffling about, your PAL is probably between 1.4 and 1.6. If you are moderately active and exercise an hour a day or have a physically demanding job like being a construction worker, your PAL is likely between 1.7 and 2.0. If your PAL is above 2.0, you are vigorously active for several hours a day.

Although there is much variation, PALs of hunter-gatherers average 1.9 for men and 1.8 for women, slightly below PAL scores for subsistence farmers, which average 2.1 for men and 1.9 for women.²¹ To put these values into context, hunter-gatherer PALs are about the same as those of factory workers and farmers in the developed world (1.8), and about 15 percent higher than PALs of people with desk jobs in developed countries (1.6). In other words, typical hunter-gatherers are about as physically active as Americans or Europeans who include about an hour of exercise in their daily routine. In case you are wondering, most mammals in the wild have PALs of 3.3 or more, nearly twice as high as hunter-gatherers.²² Thus, comparatively speaking, humans who must hunt and gather all the food they eat and make everything they own by hand are substantially less active than average free-ranging mammals.

Here's another, startling way of thinking about these numbers: if you are a typical person who barely exercises, it would take you just an hour or two of walking per day to be as physically active as a hunter-gatherer. Even so, few Americans or Europeans currently manage to achieve those modest levels of activity. The average PAL of industrialized adults in the developed world is 1.67, and many sedentary individuals have even lower PALs.²³ These declines, moreover, are relatively recent and largely reflect changes in how we work, espe-

cially the growth of desk jobs that glue us to our chairs. In 1960, about half of all jobs in the United States involved at least moderate levels of physical activity, but today less than 20 percent of jobs demand more than light levels of activity, an average reduction of at least a hundred calories per day.²⁴ That modest amount of unspent energy adds up to twenty-six thousand fewer calories spent over the course of a year, enough to run about ten marathons. And outside our jobs, we walk less, drive more, and use countless energy-saving devices from shopping carts to elevators that whittle away, calorie by calorie, at how much physical activity we do.

The problem, of course, is that physical activity helps slow aging and promotes fitness and health. So those of us who no longer engage in physical labor to survive must now weirdly choose to engage in unnecessary physical activity for the sake of health and fitness. In other words, exercise.

How Exercise Became Weird

Modern biomedical research relies extensively on millions of mice that spend the entirety of their brief lives in animal facilities where they live in tiny, clear plastic cages eating nothing but mouse chow and never seeing the light of the sun. Because these unlucky animals are naturally social, they are usually housed in groups of about five, and because they are naturally active, it is standard practice to place a little rodent wheel in each cage so they can run in endless circles, not unlike humans on a treadmill. And, boy, do they run. Typical laboratory rodents voluntarily and repeatedly run on their wheels for one- to two-minute bouts, sometimes totaling three miles a night. Curious whether wild rodents would do the same, the Dutch neuroscientist Johanna Meijer placed one of those rodent wheels in an overgrown corner of her garden in 2009 with food as bait, set up a night-vision camera to record what happened, and went to bed. When she viewed the tape the next morning, she found to her delight that dozens of her garden's small wild denizens had run while she slept. After nibbling on the bait, the local mice, rats, shrews, frogs, and even snails (yes,

you read that correctly) hopped onto the wheel and enjoyed a few minutes of running in place before disappearing back into the night.²⁵

Were these animals exercising, playing, or just running from instinct? No one knows, and the answer partly depends on how we define exercise and play. Samuel Johnson didn't consider either word worthy of an entry in his celebrated dictionary, but subsequent dictionaries generally define "exercise" as a "planned, structured physical activity to improve health, fitness, or physical skills," and "play" as "an activity undertaken for no serious practical purpose." As far as we know, all mammals play when they are young, helping them acquire social and physical skills. Humans are one of the few species that also sometimes play as adults, and uniquely in the context of sports, a distinctive human behavior common to all cultures. Not all sports, however, are exercise (consider darts and auto racing). My opinion is that while many animals are driven by deep instincts to move, sometimes causing pleasure, exercise as we define it—discretionary, planned physical activity for the sake of physical improvement—is a uniquely human behavior. In fact, I think it is fair to make two generalizations about human exercise. First, while youngsters have always played and sports are a human universal, exercise outside the context of sports was extremely rare until relatively recently. Second, as recent technological and social developments have diminished industrialized people's need to be physically active, a growing chorus of experts has never ceased to raise the alarm that we aren't exercising enough.

The first generalization, that adult exercise is modern, is kind of obvious. As we have already seen, early farmers had to toil as hard as if not harder than hunter-gatherers, and for the last few thousand years farmers primarily exercised, often through sports, to prepare for fighting. Ancient texts like *The Iliad*, paintings from pharaonic Egypt, and Mesopotamian carvings testify that sports like wrestling, sprinting, and javelin throwing helped would-be warriors keep fit and hone combat skills. But not all exercise in the ancient world was combat related. If you were wealthy enough to attend one of the great Athenian schools of philosophy, you would have been advised to exercise as part of your overall education. Philosophers like Plato, Socrates,

and Zeno of Citium preached that to live the best possible life, one should exercise not only one's mind but also one's body. This idea is not just Western. Confucius and other prominent Chinese philosophers also taught that exercise was equally essential for physical and mental health and encouraged regular gymnastics and martial arts. In India, yoga was developed and popularized thousands of years ago to train both body and mind.²⁶

Like so many pursuits, exercise in the Western world took a backseat to other worldly and spiritual concerns after the fall of Rome and didn't have a renaissance until the Renaissance. But primarily for the privileged upper classes. While peasants still toiled in the fields, fifteenth-to-seventeenth-century educators and philosophers such as John Locke, Mercurialis, Cristóbal Méndez, John Comenius, and Vittorino da Feltre advocated exercises like gymnastics, fencing, and horseback riding for the elites to promote vigor, teach character and values, and enrich minds. Then as the middle and upper classes expanded rapidly during the Enlightenment and the Industrial Revolution, Jean-Jacques Rousseau, Thomas Jefferson, and other liberal luminaries enthusiastically extolled the natural value of physical activity and fitness to growing numbers of the newly affluent. Physical culture spread rapidly throughout Europe, the United States, and elsewhere in the nineteenth century, most especially in schools and universities. Exercise and education became inextricably linked.

And yet for the last few centuries, experts have worried incessantly that we aren't exercising enough. Nationalism is one major source of this anxiety. Just as ancient Spartans were required and Romans were urged to be fit enough to fight as soldiers, flag-waving leaders and educators increasingly exhorted ordinary citizens to participate in sports and other forms of exercise as preparation for military service. An especially influential proponent of this movement was Friedrich Jahn, the "Father of Gymnastics." Following Napoleon's humiliating string of victories over German armies in the early nineteenth century, Jahn argued that educators had a responsibility to restore the physical and moral strength of his nation's youth with calisthenics, gymnastics, hiking, running, and more.²⁷ Later, similar worries in America were spurred by the embarrassing lack of fitness among

many men who enlisted or were drafted for World Wars I and II and by the pathetic state of fitness among schoolchildren at the start of the Cold War.²⁸ National movements to drum up fitness for the sake of the state still occur in China and elsewhere.

The other source of anxiety has been the health consequences of exercising too little. Many people think today's physical inactivity epidemic is a novel crisis, but this state of alarm has been mounting ever since machines started to replace human physical activity. Over the last 150 years, worried physicians, politicians, and educators have regularly raised concerns that the youth of their day are woefully less active, less fit, and thus less healthy than the previous generation. My university, Harvard, is no exception. At the turn of the last century, Dudley Allen Sargent, who founded the modern physical education movement in America (and for years directed the gym where I sometimes work out), worried that "there never was a time in the history of the world when the great mass of mankind could meet the simple exigencies of life with so little expenditure of time and energy as today," and that "without solid physical education programs, people would become fat, deformed, and clumsy."²⁹ A hundred and twenty years later, a comprehensive survey of college students from Harvard and elsewhere found less than half exercised regularly, thus contributing to "poor mental health and increased stress."³⁰

And so we promote exercise. Just as we put wheels in cages for mice in labs, over the centuries we have invented a stunning variety of ways and means for our fellow humans to undertake optional physical activity for the sake of health and fitness. Unsurprisingly, exercise has become increasingly advertised as virtuous and has been commodified, commercialized, and industrialized. To use the weight machines, treadmills, ellipticals, and other contraptions in the gym around the corner from my house costs seventy dollars per month. When I head out for a morning run, I wear specialized running shoes, chafe-preventing shorts, a snazzy moisture-wicking shirt, a washable cap, and an expensive watch that connects to satellites overhead to track my speed and distance. Oscar Wilde once quipped, "I approve of any activity that requires the wearing of special clothing," but I suspect even he would be shocked at the popularity of "athleisure"—workout

clothes for everyday activities like sitting that help us look athletic without ever having to break a sweat. Worldwide, people spend trillions of dollars a year on fitness and sportswear.

We have also medicalized exercise. By this I mean we pathologize a lack of physical activity, and we prescribe particular doses and types of exercise to help prevent and treat disease. The U.S. government recommends I engage in at least 150 minutes of moderate or 75 minutes of vigorous exercise a week and weight train at least twice a week.³¹ Epidemiologists have calculated that this level of activity will reduce my risk of dying prematurely by 50 percent and lower my chances of getting heart disease, Alzheimer's, and certain cancers by roughly 30 to 50 percent.³² Insurance companies offer me incentives to exercise, and entire professions have sprung up to motivate me to exercise in the first place, help me work out, and fix me up once I get injured.

There is nothing wrong with medicalizing, commercializing, and industrializing exercise. In fact, these trends are necessary. But they rarely make exercise more fun. To me, the apotheosis of what's good and bad about contemporary exercise is the treadmill. Treadmills are incredibly useful, but they are also loud, expensive, and occasionally treacherous, and I find them boring. I sometimes use treadmills to exercise but struggle as I trudge monotonously under fluorescent lights in fetid air with no change of scene, staring at those little flashing lights informing me how far I've gone, at what speed, and how many calories I've supposedly burned. The only way I endure the tedium and discomfort of a treadmill workout is by listening to music or a podcast. What would my distant hunter-gatherer ancestors have thought of paying lots of money to suffer through needless physical activity on an annoying machine that gets us nowhere and accomplishes nothing?

I have little doubt they would have considered it abnormal to exercise this way. But to understand what kinds of physical activities we did evolve to do and how they affect our health requires, counterintuitively, first grappling with what our bodies are doing when we are physically *inactive*.

PART I

Inactivity