

Chapter 1

Sitting and Other Hazards of Office Work

Our grandparents breathed in coal dust all day, baled hay in the hot sun, and did backbreaking factory work. Now, with the economy shifted from agriculture and industry to services and information, most of us have moved from physically demanding jobs in mining, farming, and manufacturing to comfortable, indoor office jobs. It's tempting to regard that move as progress.

Now we are learning that cushy indoor office work comes at a high cost. Sedentary behavior is, quite literally, killing us. Reams of research show conclusively that sitting all day is deadly. Our immobile desk jobs put us at risk for cancer, diabetes, hypertension, heart disease, obesity, and what health researchers call "all-cause mortality," – the chance that you'll die for any reason. Joseph A. Knight, a scientist at the University of Utah, summarized these risks in a 2012 paper. His study also showed that sedentary behavior puts us at greater risk of osteoporosis, bone fractures, muscle loss, physical disability, depression, dementia, Alzheimer's disease, atherosclerosis, immune system dysfunction, and metabolic syndrome. The British Journal of Sports Medicine says that "physical inactivity is one of the most important public health problems of the 21st century, and may even be the most important." Think about that. Our sedentary ways could be a bigger public health problem than smoking, drinking, gun violence, and any number of infectious diseases.

The scariest detail in these research findings? It doesn't matter how much you exercise after work, how fit you are in general, or how genetically predisposed you are to a long and healthy life. "Sitting is an independent risk factor," says Peter Katzmarzyk, an

obesity researcher. No matter how active you are after work, if you sit all day, you will die sooner than you would have otherwise. You'll also suffer more disability for a longer period of time in your final years. End of story.

Yikes! That's some seriously scary news.

So, what's going on? Why are we sitting so much? And how exactly is sitting doing us so much harm?

Why We Sit

We sit because **we all have office jobs** now. Well, not all of us, but certainly a lot more than 60 or 80 years ago. Back then, many more of us worked in mining, farming, or manufacturing. Automation in those industries, along with other big changes in the economy have taken most of us out of farms and factories and put us into service jobs, many of which involving sitting at a desk all day.

We sit because **that's the way offices have been organized**, and mostly still are. Desks are a great place to put typewriters, piles of paper, staplers, telephones, and the other accouterments of traditional office work, and chairs are a great way to situate yourself in relation to your desk. In era in which most of us work on computers and share information electronically, the relevance of this set-up is an open question.

We sit because **we want to "take a load off."** We feel like the intellectual work that we're doing at our desks is trying enough, that we shouldn't have to tax our body while we're doing office work and that we need to conserve our energy to be productive for the task at hand. (Spoiler alert: Later you will see evidence of the opposite; we actually feel more vital and engaged and are more productive when we do office work while standing or moving.)

We sit because **it's "comfortable."** High-tech, overly designed chairs and other ergonomic innovations cradle us in cozy work cocoons that make us forget that we're sitting all day.

We sit because **employers make us**. You need special gear to stand up and get moving at work and many employers are reluctant to provide it. Even now, nearly a decade after widespread dissemination of information about how deadly sitting is, many employers still require a doctor's note or other documentation before they'll provide you with nonconventional office equipment – if they'll provide it at all.

We sit because **we don't want to call attention to ourselves**. Even in workplaces where standing and other alternative workstations are available, you may be understandably reluctant to be the pioneering standing-desk or treadmill-desk user in your office.

Outside of the office, we sit in the car. We sit to eat. We sit in front of the TV and game console. We sit in front of our home computer to pay bills. Sometimes it seems like every technological and cultural advance of the past century has been designed to take our feet out from under us and drop us into a chair. As noted in the Introduction, when you add up all the time we spend sitting, for most of us it's the majority of our waking day.

From an anthropological perspective, we sit because as we evolved to be active, upright walkers we found that a restful position between lying and standing would let us conserve energy while still keeping an eye on our surroundings.

There are lots of good explanations for why we sit, plenty of plausible reasons to keep sitting, and certainly a lot of inertia holding you in your chair. So why make the effort to sit less at work?

Oh, that's right, because, as headline after headline has reminded us, "Sitting Is as Deadly as Smoking."

The Science behind "Sitting Disease"

When you look at the science behind these news stories, you find three major bodies of research related to "sitting disease" and sedentariness.

It's worth pausing for a moment to think about the consequences of the diseases for which sitting puts you at risk. I don't want to get too graphic, but it's worth reflecting on the fact that cancer, diabetes, and heart disease are horrific diseases that not only lop years off of your life but also dramatically reduce the quality of your life.

The research shows that taking care of yourself now can mean the difference between living a long, productive, care-free life and a shorter life filled with more doctor visits, hospital stays, and diminished physical capacity. These risks, of course, apply just as much to other health choices that you make. But the evidence shows that, if you have a desk job, improving your office fitness is

arguably the most important improvement you can make to enhance your long-term health prospects.

Enough with the fear mongering. On to the research.

- **Epidemiological, population-level studies** look at large numbers of sitters and non-sitters and report on their overall health.
- **Inactivity physiology studies** look at the troublesome physiological mechanisms associated with sitting, the underlying causes of the "sitting disease" identified in the population studies.
- **Intervention research** looks at the effectiveness of specific interventions that limit sedentary time.

Population-Level Research

In 1953 **Jeremy Morris** and his colleagues in London compared the health of trolley drivers and conductors. Both worked the same hours in the same double-decker trolleys, but the drivers sat all day while the conductors were standing and moving most of the time. The more sedentary drivers were twice as likely to get heart disease as the standing, walking, stair-climbing conductors. Morris also observed similar differences between more active "postmen" and less active "telephonists, executive officers, and clerks." His conclusion: "Men in physically active jobs have a lower incidence of coronary heart-disease in middle age than have men in physically inactive jobs. Moreover, what disease the conductors and postmen had was less severe." This study arguably launched the modern field of sedentary studies.

There had been a few random looks into the field before Morris's work. As early as the late 17th Century, the Italian occupational-medicine pioneer Bernardino Ramazzini had noted that messengers who ran from place to place all day had fewer diseases than sedentary cobblers and tailors. In the late 18th Century, researchers in London replicated Ramazzini's findings and also compared the health of other sedentary and non-sedentary workers and found similar results. And in the early 20th Century American doctors began to note an association between physical work and improved health. But it was the publication of Morris's findings in 1953 that really started the rigorous, scientific, ongoing

study of sedentary behavior. Morris continued his studies for nearly 50 more years, working well into his eighties and living to the age of 99. Given his long life and knowing his research interests, we can reasonably assume that even as he pursued a scholarly life he somehow managed to remain routinely active at work. The epidemiological case against sitting has grown considerably since Morris's time.

The next big wave of sedentary-studies activity began with research on **TV-watching couch potatoes**. In 1985, William Dietz asked in the journal *Pediatrics*, "Do we fatten our children at the television set?" He found that television viewing was a likely cause of obesity in children and adolescents. In 1996, Stephen Sidney and his colleagues reported in the *Annals of Epidemiology* journal that "heavy TV viewing is a modifiable behavior that is associated with increased prevalence of several cardiovascular risk factors." In 2000, Jo Salmon and her colleagues at Deakin University in Australia said that "public health strategies to reduce overweight and prevent weight gain may need to focus on reducing sedentary behaviors such as television viewing in addition to increasing physical activity" A 2001 study by Frank Hu and his colleagues suggested in the *New England Journal of Medicine* "the importance of reducing sedentary behavior in the prevention of type 2 diabetes." Adrian Cameron and a large team of researchers reported in 2003 on the 1999-2000 Australian Diabetes, Obesity and Lifestyle Study. They found strong associations between obesity and both television viewing time and lower physical activity time that "confirm the influence of sedentary lifestyles on obesity." A similar large study by David Dunstan and another large team in Australia reported in 2010 that "television viewing time is associated with an increased risk of all-cause and CVD [cardiovascular disease] mortality." A 2008 study by Genevieve Healy showed that even very active people who met recommendations for regular exercise had increased metabolic risk factors that rose with TV viewing time. These are just a few of dozens, if not hundreds, of studies that link prolonged sitting in front of a television to obesity, cancer, heart disease, diabetes, and other serious diseases.

Beginning in the 1990's and up until today, researchers have looked beyond television watchers, turning to the more generic problem of **physical inactivity**. Much of this research arose around the observation that sedentary behavior appeared to be an

independent risk factor, a problem regardless of your weight, exercise habits, or other fitness measures. In 1999, Steven Blair and Suzanne Brodney found that you can carry a few extra pounds but still be better off than a thin person who sits all day, or as they put it, "Overweight or obese individuals who are active and fit are less likely to develop obesity-related chronic diseases and have early death than normal weight persons who lead sedentary lives." In 2006, Lyn Steffen and her colleagues noted in their findings from the Minnesota Heart Survey that from 1980-2000 people reported the same amounts of exercise activity but more sedentary time at work. "It is significant that one easily identifiable sedentary activity, namely, sitting at work (instead of standing), increased markedly over 20 years and that, interestingly, men and women who sat less than half the time at work had a lower BMI [body mass index] than those who sat more than half the time." In 2009, Neville Owen and his colleagues reported in their paper "Too much sitting: a novel and important predictor of chronic disease risk?" that "even if people meet the current recommendation of 30 minutes of physical activity on most days each week, there may be significant adverse metabolic and health effects from prolonged sitting." Also in 2009, Peter Katzmarzyk and his colleagues found "a dose-response association [i.e., more of it is worse] between sitting time and mortality from all causes and CVD [cardiovascular disease], independent of leisure time physical activity" and urged physicians to "discourage sitting for extended periods."

I could go on — there are literally hundreds of other studies I could cite (many of them listed in the bibliography at sitless.com) — but you get the idea: Sitting is a huge public health problem. And, unfortunately, it is likely to remain so. As Marc Hamilton said in a 2007 paper in the journal *Diabetes*, "Given the increasing pace of technological change in domestic, community, and workplace environments, modern humans may still not have reached the historical pinnacle of physical inactivity."

Inactivity-Physiology Research

Marc Hamilton is not just a sedentary-studies prognosticator. He is also the leading pioneer in "inactivity physiology," a new field that looks at the physiological mechanisms that underlie "sitting

disease." Epidemiologists have shown that sitting is a problem. Hamilton and his crowd show how it is a problem.

Hamilton coined the phrase "inactivity physiology." A few key concepts have already emerged in this nascent field:

- "Humans naturally require a large amount of time in physical activity throughout the whole day for good health." Forty-five minutes of exercise can't offset ten hours of sitting. You need to move throughout the day.
- We don't spend enough time each day doing any physical activity. Muscular inactivity underlies the unique physiological problems of sitting.
- "The signals harming the body during physical inactivity are specific and distinct from exercise." Too much sitting is not the same as too little exercise.

Even before Hamilton coined the phrase in 2004, researchers were already looking at "inactivity physiology" (even if they weren't calling it that then). Much of the early research in this area came out of the air and space fields, where there is plenty of sitting and inactivity. In the early 1980s, for example, aviation-industry researchers curious about the impact of long-term airline flights found blood-pooling in the calves of people who sat for prolonged periods. Beginning in the 1990s, Joan Vernikos and her colleagues at NASA conducted experiments in which they tried to mimic the weightlessness of space with bed rest, culminating in a paper in 2010 that showed how space travel accelerates the aging process. Vernikos worries now that our sedentary ways may be accelerating the aging of sedentary office workers. Exercise physiologists and others have, of course, also looked at the problems of inactivity.

The upshot of all of this research is a long list of physiological problems associated with sitting. Let's look at some of them.

As soon as you sit down, **electrical activity in your muscles drops almost immediately**. "The muscles go as silent as those of a dead horse," said Hamilton in a 2011 article in the New York Times. Along with the drop in electrical activity comes a decrease in the release from your muscles of enzymes that help regulate blood cholesterol levels. "Good" cholesterol (HDL) levels decrease and "bad" cholesterol (LDL) levels increase, putting you at increased risk for atherosclerosis. The deep muscles that help us stand up and

maintain a vertical posture also release enzymes that help regulate your cholesterol levels. As soon as you sit down, you turn off this mechanism. Hamilton is probably the best-known researcher in this area, and he and his colleagues have conducted much of the research on the role of postural muscles in regulating cholesterol levels, which they have shown is related to the regulation of lipoprotein lipase (LPL).

When sitting, you **burn calories at a much lower rate** than when you are standing or walking, putting you at risk for obesity. Another sedentary studies pioneer, James Levine at the Mayo Clinic, estimates that you burn somewhere between 700 and 1000 calories in the typical office job if you sit most of the day and about 1400 calories if you stand most of the day (compared with 2,300 calories in strenuous occupations like farming). Following this math, simply standing instead of sitting most of the day burns enough calories to help you lose about 10 pounds a year, and walking at a leisurely two miles per hour on a treadmill desk could help you lose 40. Looking at this another way, going back to the start of someone's office career, you can see the almost-immediate impact of burning fewer calories. One study, for example, looked at the effects of sedentary work on previously active employees and found that the typical new office employee puts on 16 pounds within 8 months of starting a sedentary desk job.

Reduced moving time and increased sitting time reduces your body's ability to process glucose and **increases your risk for diabetes**. One study found that having non-exercising men reduce their daily number of steps taken from 10,000 to 1,500 for just two weeks significantly reduced their insulin action (Rikke Krogh-Madsen 2010). Another found that "a single day of prolonged sitting can dramatically reduce insulin action in healthy young adults" (Stephens 2011). John Buckley and his colleagues in the UK (2013) conducted the first study to look specifically at the effects of standing vs. sitting in an actual office setting. They found a 43% improvement in blood glucose levels when subjects did their work standing up. (They also found that standing workers burned about 50 more calories per hour).

Sitting has also been implicated in **systemic inflammation**, a prime suspect in many chronic diseases. A 2012 study found chronic low-grade inflammation in women in sedentary occupations (but, curiously, not in men). Given the growing interest

in inflammation as a contributing factor in many serious diseases, I predict we'll soon see more research on the role sitting and sedentary behavior on chronic inflammation.

When you sit down, your "second heart" – deep muscles in your calves that help pump blood back up to your heart – is turned off, **impairing your blood circulation**. Those muscles have to be used to do their job, and they are shut down when you sit. Among the many problems this can cause is a very serious, potentially life-threatening condition called deep vein thrombosis. Sitting also impairs microvascular function. Subtle, regular movements of your body help the tiny blood vessels in your arms and legs work properly. When you sit down and stop moving this microvascular activity drops dramatically, further impairing your circulation.

Sitting also **alters your body's ability to regulate blood pressure**. Joan Vernikos, the former head of Life Sciences at NASA, and her colleagues found that the motion of simply standing up activates mechanoreceptors in your neck that help regulate blood pressure. Plop down in your office chair and stay there for several hours and this mechanism never gets a chance to work.

Sitting physically shortens, lengthens, and otherwise **distorts your muscles, tendons, and ligaments**, and the fascia and other tissues around them, causing postural distortions that lead to everything from low-back pain to headaches. The muscles that flex your hips shorten up as you passively flex them in your chair, causing back trouble when stand up. Your back muscles turn off, causing passive structures like ligaments and intervertebral disks to take up the slack in an attempt to hold you upright, leading to back pain and other conditions. Your intervertebral disk, the big thick pads between each pair of bones in your spine, need regular movement to nourish them, and sitting, of course, prevents this. Adding insult to injury, your hamstrings and buttocks are crushed between your torso above and a poorly designed office chair below. I'll talk much more about these kinds of orthopedic issues later in this chapter as well as in the Posture chapter.

Finally, when you sit down the **muscles that hold you upright flicker off** and forget how to work properly, leaving you at risk for injury when you do try to use them. Perhaps the most dramatic example of this is a "weekend warrior" injury to an underused muscle that snaps under sudden exertion. Personal trainers who work with desk jockeys spend a lot of their time teaching chronic

sitters to reengage muscles like these that have atrophied after years of misuse and neglect.

Other physiological problems are associated with sitting, and certainly more will be discovered, but I think you get the idea: Sitting all day is not kind to your body.

Intervention Research

A growing body of emerging research looks at the effects of specific interventions designed to counteract the effects of sitting. Most of the research has been conducted in the past couple of years, so much remains to be learned and discovered in this brand new field. So far, though, it looks like the hypothesis is sound: Moving more and sitting less can improve your health.

Several studies have shown that **breaking up sitting** with light or moderate physical activity every 20 to 60 minutes reduces levels of biomarkers associated with diabetes. Teatske Altenburg, a sedentary studies researcher in The Netherlands, and her colleagues found that interrupting prolonged bouts of sitting with eight minutes of moderately intense bicycling every hour reduced levels of proteins associated with diabetes. Having both a bicycle and ten minutes free every hour isn't typical for most office workers, of course. In a more realistically designed study, David Dunstan, a sedentary-studies researcher in Australia, found that taking a two-minute break every 20 minutes to do "light- or moderate-intensity walking lowers postprandial [after a meal] glucose and insulin levels in overweight/obese adults." So, if you can somehow find a way to take a two-minute walk every twenty minutes (say, by sharing a treadmill desk with your colleagues), you can reduce your risk of diabetes.

Another study, the first of its kind, used a very similar intervention – two minutes of light activity every 20 minutes – to examine the effects of sitting on gene expression in muscles. Celine Latouche and her colleagues at the Baker IDI Heart and Diabetes Institute in Australia found that "breaking up sedentary time with short activity bouts is associated with changes in the expression of skeletal muscle genes involved in cellular development, growth and proliferation, and lipid and carbohydrate metabolism," all of these beneficial. They also "observed similarities between genes regulated by breaks and by continuous acute exercise bouts of 30–90 minutes."

So, at least in terms of genetic expression, regular routine movement may offer benefits similar to those gained by vigorous exercise. By the way, I think the people in this study should be honored in some way, since the research included taking from each of them multiple biopsies, each biopsy entailing being cut open with a scalpel and then having a big needle passed through the opening to retrieve muscle tissue for analysis. Ouch!

One of the most common interventions proposed to break up our sitting days is the **standing desk**. An inordinate number of studies on standing desks have looked specifically at their effects on productivity. This meshes with anecdotal evidence that I have gathered in an amazing number of conversations that go like this: "Oh my God! If I stand up I'll quit thinking," or "I have to sit to think and get my best work done." Is standing to work really as disruptive as trying to rub your belly and pat your head at the same time? The evidence does not support this fear.

A 2009 study by Britta Husemann and her colleagues in Germany found that "a sit-stand workstation paradigm reduces musculoskeletal complaints without considerably affecting data entry efficiency." A 2011 study by Christina Ohlinger and her colleagues at Miami University found evidence that you can indeed think and stand at the same time, demonstrating that standing workstations can "increase physical activity in the workplace without compromising cognitive capabilities." Also at Miami University, Ronald Cox and his colleagues looked at people's ability to speak while sitting, standing, and walking at one mile per hour on a treadmill and found no difference in their ability to speak clearly and grammatically, concluding that "the significant elevation of metabolic rate in the absence of any deterioration in speech quality or RPE [rating of perceived exertion] support the utility of using active workstations to increase physical activity in the work environment." So it looks like you can safely stand upright, think, and even talk while using a standing desk.

Moving beyond concerns about productivity while standing, more recent research is testing whether people office workers will actually use standing desks and what the metabolic effects would be if they did. The first study to look specifically at this was a team lead by Nicholas Gilson at the University of Queensland in Australia. In 2012 they reported that when standing desks were made available most people in the office used them and replaced

most of their sitting time with standing time. The only notable change in the biomarkers they examined was a significant increase in HDL (the "good" cholesterol) levels. A 2013 study at Curtin University in Australia replicated the finding that when standing desks were made available, office workers stood more (Straker 2013). Also in 2013, another Australian team of researchers found that sitting time was reduced from 85% of the workday to 60% with the introduction of sit-stand desks in a government office in Sydney (Grunseit 2013). Standing desks may not be for everyone, but it looks like a lot of people will use them if they're available.

The other commonly proposed sitting intervention is, of course, the **treadmill desk**, a combined standing work station and low-speed treadmill that permit you to walk while you work. Several studies have looked specifically at treadmill desks in office settings. As expected, they provide evidence that walking at work burns more calories. A 2008 study in the *British Journal of Sports Medicine*, for example, reported that treadmill desk users burned an extra 200 calories per day (Thompson 2008). The big hope, of course, is that walking on a treadmill all day will help you get healthier and maybe even look better. The evidence supports that hope. Researchers at the University of Massachusetts found that walking while working "favorably influenced waist and hip circumferences and lipid and metabolic profiles in overweight and obese office-workers" (John 2011).

As is the case with standing desks, treadmill desks cause concern that productivity might decline. Indeed there is some evidence of this. Researchers at Miami University and at the University of Tennessee found that some fine motor skills (using a mouse, for example) were impaired while working at a treadmill desk (a 6-11% reduction in accuracy) and that math skills were somewhat diminished (John 2009). However, these studies found no negative effects on the participants' ability to think, to focus, and to comprehend written works. Another study that looked at radiologists who evaluated CT scans and found that their analyses of those crucial images were just as good when they evaluated them while walking at a treadmill workstation (Fidler 2008).

Many researchers note that because their studies are conducted over relatively short time spans, some of the productivity declines they observe might be mitigated with more training and experience. Researchers at the Mayo Clinic, for example, gave transcriptionists

four hours of training before comparing their seated work with treadmill transcriptions. They conclude that "more than 4 hours of training will be necessary to prevent a significant drop in employee productivity" (Thompson 2011).

A couple of studies have looked at **under-desk stepping and pedaling machines**. The most detailed of these, a 2012 study by Lucas Carr and his colleagues at the Centers for Behavioral and Preventive Medicine in Rhode Island, gave full-time office workers under-desk pedaling machines and tracked their usage over four weeks. They found that, without any prompting other than the presence of the gadget, the experiment's participants used it about a half hour every day and reported that it was comfortable and enjoyable and a good indoor exercise for rainy days. The study measured only time spent using the machines, not any of the biomarkers associated with sitting and exercise, and gathered just a little qualitative feedback from the participants, so much more research is needed on these machines. One concern that I have with these gadgets is that they are used sitting down and that they have so far been used only episodically, making them more like an exercise intervention than a sedentariness-reduction intervention. It will be interesting to see whether and how future research untangles the independent threads of sitting versus exercise with this kind of intervention.

One other intervention on the horizon deserves comment: the "metabolic polypill." Pharmaceutical companies are developing a medication that combines aspirin, statins (for managing cholesterol levels), and blood pressure-lowering agents. This pill is designed for patients at high risk for cardiovascular disease, but it has already been proposed as a remedy for "sitting disease." Not surprisingly, many exercise-physiology researchers disagree with this idea. In a paper entitled "Exercise Is the Real Polypill," Carmen Fiuza-Luces and her colleagues note that "regular exercise, a drug-free intervention, is available at low cost and relatively free of adverse effects" and that compared to exercise "no drug intervention has proven efficient to maintain muscle fitness, a key factor to ensure independent living throughout all stages of life." A medication like the polypill might address some of the symptoms of your sitting condition, but it can't help you stay strong and vigorous into your later years, as exercise can.

As you can see, sitting causes plenty of problems, and this section has described a sample of the nascent understanding of what to do about it. As David Dunstan, the oft-cited Australian researcher points out, "Even in physically active adults, concurrent reductions in the amount of time spent sitting is likely to confer health benefits." The rest of this book aims to help you to develop habits that have you routinely move more during your workday or, at the very least, to sit less.

In other words, it's time to get up off your derriere and get moving at work. Are you standing up yet?

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The research shows that moving more at work will almost certainly prevent disease and add quality to each year of your longer life. But office work presents other problems. In addition to being sedentary, office work is also stationary, repetitive, and stressful. Let's look at some of the implications of those characteristics.

Both Sedentariness and Stationariness Are Problems

The difference between being sedentary and being stationary might seem like an overly pedantic distinction, but the distinction matters in the context of office fitness. The word sedentary comes from the Latin *sedentarius*, which literally means "sitting." The word stationary comes from the Latin *stationarius*, which referred to soldiers standing at a post or station. In this book, I use the term sedentary mostly to talk about sitting and stationary to talk about the about more general problem of not moving.

Like sedentariness, being stationary is unkind to your body. We are designed to move. Putting yourself into any one posture or position for hours on end is unnatural and can unnecessarily challenge your body, leading to orthopedic injuries and contributing to other pathological conditions. This, of course, applies to sitting at a desk all day, but it can also apply to the more physiologically engaged but nevertheless stationary posture of standing.

The tissues in our bodies constantly adapt to the stresses placed upon them. Early in life the changes can be dramatic. Take a moment to feel the bony knobs at either side of the base of your skull just behind your ears. In infancy those were just tiny buds of bone (anatomically known as the mastoid processes of the temporal bone). When you began to crawl, and lifted your head the muscles attached to that little knob tugged at the buds and gradually pulled them out into their larger shape. Your body created new bone tissue to fill the bigger space. Changes become less dramatic as we age, but they are happening throughout our lives. Our bodies constantly adapt to the outside forces (gravity, furniture, clothing, etc.) and to our movements – or lack thereof. Think about the positive effect that regular exercise has on the way you look and feel. In a cruel and pathological sense, being stationary has the opposite effect.

Effects on the Body

Think about your body's organs and systems and how your sitting or standing still for most of the day could affect your skin (the biggest organ in your body); your circulatory, nervous, and digestive systems; and your muscles and bones.

Skin. Your skin is pulled tautly over your muscles and bones, as if you were wearing a snug unitard covering your entire body. This crucial organ protects you from pathogens and other environmental hazards, senses heat and cold and pain, and performs a variety of other vital functions, many of which can be disrupted when you sit down for prolonged periods. For example, your skin plays an important role in your body's heat regulation, but it needs access your environment to do this. This is why chairs with mesh fabrics feel more comfortable than squishy, close-knit fabrics that closely conform to your body.

Circulatory system. Prolonged sitting or standing can put you at risk for impaired local blood circulation in addition to the circulation problems mentioned in the research summary earlier in this chapter. For example, a common consequence of working at a computer for long stretches is a "dead" feeling in the arms and hands. That sensation is almost always caused by postural changes in the shoulders and thorax that impede blood flow into the arms. Much less common, though still a legitimate concern for office

workers, is deep vein thrombosis, a serious circulatory condition that can be caused by prolonged sitting.

Nervous system. That "dead" sensation in your arms after long bouts of computing is usually not solely a circulatory issue. The blood vessels that go into your arms are bundled with the nerves that serve your arms and hands, and those nerves can also be impinged by computer-use posture. In some cases, impingement of those neurovascular bundles leads to a condition known as thoracic outlet syndrome. Similarly, the nerves that go into your legs, in particular the sciatic nerve, can be impinged in the low back and/or hips, leading to sciatica: tingling and pain in your hips and legs.

Digestive system and other internal organs. Just as desk posture can constrict your blood vessels and nerves, sedentary behavior can compromise your internal organs and movement can help them. Researchers have shown, for example, that taking a walk after a meal improves digestion. Picture also your lungs and other internal organs being compressed when you slouch in your desk chair and your rib cage settles onto them.

Musculature. Depending on how you count, the human body has around 800 or 900 muscles. As the source of our movement, these tissues are arguably the most disheartened structures in a sedentary or stationary body. When we sit, not only are the muscles not moving, they can be contorted into unnatural positions which, over time, can lead to postural distortions and cause pain.

Even when not in use, muscles are poised for action, ready to serve us at a moment's notice. In settings less abnormal than office spaces, our bodies rest in relaxed, neutral positions from which we can immediately spring into muscular action. Sedentary and stationary computer postures throw a monkey wrench into this arrangement, shortening some muscle sets and stretching others. Then neither set of muscles can work properly. A muscle already in a shortened position has little space in which to contract much further. A muscle already in a lengthened position has to "take up the slack" before it can fully engage to do its job. Over time, muscles in either situation become resigned to their fate and permanently adopt their shortened or lengthened position.

After days, hours, weeks, months, and years of peering into your computer monitor, pairs of opposing muscles in your shoulders and neck and at the base of your skull can end up shortened and lengthened, leaving you with chronic headaches as

well as neck and shoulder pain. Had you been up walking around, picking berries, and chasing rabbits across meadows, this wouldn't have happened.

Skeletal system. Even your bones are affected by a sedentary and stationary work style. Although we think of bones as permanently fixed structures, bones are more flexible and resilient than commonly thought. In fact, recent research shows that bones consist largely of a gooey substance lying between the nano-scale crystals that make up the hard part of bone tissue. Even before this discovery, though, doctors knew that sedentary behavior was a strong risk factor for conditions like osteoporosis.

You can see that whether you're sitting down, standing still, or otherwise staying in one position for long periods, failure to move regularly is unkind to your body.

Office Work Is Repetitive

The little movement that we can manage in a modern office is just that — little. Big, natural movements like walking, running, and climbing propel us through space, using long chains of muscle and connective tissue. They get our heart pumping with movements we've been doing for millennia. Small, unnatural movements like typing and using a computer mouse keep cursors moving and words and numbers and code flowing, but that's about it. Worst of all, we make the same motions over and over and over again.

Repeating these small movements all day long can have a surprisingly big effect on your body. From full-blown carpal tunnel syndrome to achy wrists at the end of a long workday, repetitive strain injuries (RSIs) are a bane of the modern office. They cause outsized amounts of pain and impede office productivity.

Perhaps the most unhealthy thing about these small movements is their repetitive nature. Just as repeatedly bending a wire coat hanger back and forth will eventually snap it in two, repeatedly sliding tendons across bones and other structures can fray them and make them more susceptible to injury. Rotating your palm face down and then repeatedly extending your fingers to make keystrokes sets up exactly this kind of situation. Reaching out for your mouse, even if it's just a couple of inches, and then bending your wrist over and over to operate it, does too.

Using just one part of the body in isolation is what makes those movements unhealthy. The big, natural movements that we have used throughout our history involve long connected chains of muscles and bones and other tissues that support one another. A repeated tiny motion by one part of your body breaks the chains and removes their support.

This, by the way, points to one of the many ways that maintaining a good level of overall fitness can bolster your office fitness. A good level of overall physical robustness can lend support to your body as it struggles to execute tiny, awkward office tasks. In fact, in their analysis of a large Canadian community health survey, Charles Ratzlaff and his colleagues (2007) found that "being physically active during leisure time is associated with a decreased risk of upper-body occupational RSI." (Remember, though, that your leisure-time exercise can't undo the toxic effects of prolonged sedentariness.)

In addition to the general robustness developed by regular exercise, good ergonomics practices and better posture at work can mitigate the damage caused by repetitive motions. Each of these topics gets its own chapter later in this book.

Although I tend to demonize computers and other modern gadgets, repetitive strain injuries have no doubt been around since the first cobbler started cranking out multiple pairs of shoes and the first assembly worker started attaching the same gadget to each car that came down the line. Now, instead of a few thousand people in a few specific fields getting RSIs, tens of millions of office workers are vulnerable because they repeat the same motions over and over again.

Office Work Is Stressful

The modern office is a uniquely stressful place. Ever-rising performance expectations and a relentless flood of information leave you feeling perpetually behind; 24/7 wireless connectivity that lets your work follow you wherever you go, and ever-evolving technology can sap the stress-management resources of even the toughest desk jockey.

The study of psychological stress is a vast, complex undertaking. Allen Elkin, a stress management expert with over 50 years of experience in the field, once wrote that "trying to define

stress scientifically is like trying to nail a hunk of jelly to a tree." Nevertheless, I'll attempt a quick overview.

Stress is a normal human response to events and stimuli in the world around us. Good stress (called "eustress" by Hans Selye, a pioneering stress researcher) can be beneficial – motivating, challenging, and energizing us. Think about athletic competition, the imminent launch of your favorite new project, or mustering the courage to attempt a first kiss.

When the demands placed on your mind and body exceed your coping resources – when you are cornered by a hungry tiger, for example – you experience bad stress, or "distress." In distress, your body automatically and rapidly releases a series of hormones that put you in the well-known "fight or flight" mode. Throughout most of human history, the hormonal avalanche unleashed under acute stress was episodic and short-lived. You escaped the tiger and got on with your life. Nowadays, as you may have noticed, our stressors hang around longer.

Your body's immediate responses when you face stress make sense physiologically. Functions irrelevant when a hungry tiger is bearing down on you – like digestion, immunity, and procreation – are put on hold. Functions absolutely necessary in a crisis – like increased alertness, quicker reaction times, more energy, reduced pain perception, and better blood flow – are engaged at full throttle. The end result is a body on high alert, ready for any physical challenge. Your vision narrows, focusing on the threat. Your palms sweat. Your pulse races. Your stomach tightens. Your jaw clenches. Your muscles become engaged and taut. For the time being, you are stronger, have faster reaction times, are extremely focused, are poised to fight or flee.

That is exactly what you need when a tiger is coming after you, but it is rarely a helpful response in the modern office. The stress response mechanism is a short-term tactic, designed to get you away from that tiger or to slay it with your trusty spear. Nowadays, instead of the occasional tiger attack, we face an endless stream of stressors. Faced with long-term stressors, our bodies react as they always have, with those vestigial responses designed to deal with a short-term problem. We end up in bodies that are constantly bathed in hormones that trigger knee-jerk reactions, tunnel vision, high blood pressure, increased heart rate, suppressed immunity, tight

muscles, and poor digestion. Not exactly the ingredients for a productive, positive workday.

An effective self-care strategy for dealing with stress in your work life and personal life can obviously not begin and end with this book. I will point out, however, that exercise and movement practices like those I advocate here are generally included in a comprehensive stress-management plan. Exercise practices that specifically include a mind-body component, like yoga and tai chi, can be particularly useful in helping you manage your stress.

In any case, with exercise appearing near the top of the list in almost every stress-management program, the routine movement and exercises suggested later in this book may help you manage your stress. At the very least you will be taking action, not cowering behind a tree, waiting for the tiger to leave.

What to Do about These Hazards

I've hinted at some solutions while discussing these challenges of office work. If you're sedentary and stationary at work, you need to sit less and move more. If you're doing repetitive motions all day, you need to do them correctly. If your work set-up contorts you into positions that created pain and discomfort, you need to improve your posture.

That's what the rest of this book is about. Chapter 3 shows you how to incorporate routine movement into your workday, to reduce your risk of "sitting disease." Chapter 4 shows you how to take charge of your ergonomic set-up, to mitigate the hazards of doing repetitive micro-movements all day. Chapter 5 shows you how to cultivate "body awareness" and improve your posture, to reduce the strain on your body that leads to pain and injury. Chapter 6 shows you exercises that you can do at work, at home, and at the gym both to counteract the effects of your sedentary, repetitive, stressful job and to support your new, improved posture.

But first, Chapter 2 shows you how to create better office fitness habits. After all, these behaviors that are giving us so much trouble are all habits, bad habits that we have unintentionally adopted over the years. Understanding how habits work and how to develop better ones is the master key to office fitness.

Suggested Reading

Sitting Kills, Moving Heals: How Everyday Movement Will Prevent Pain, Illness, and Early Death -- and Exercise Alone Won't, Joan Vernikos

Get Up!: Why Your Chair Is Killing You and What You Can Do About It, James Levine

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This is a partial list of sources consulted as I wrote this chapter, including only items mentioned or referred to above. For a full list of everything I read as I prepared this chapter, please visit sitless.com/chapter1