

**Sit Better: A doctor explains how ‘ergonomic’ chairs
undermine posture and health, causing back pain
and shortened lives**

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Disclaimer: Although I am an academic researcher, because I too suffered from back pain for quite some years, I am hardly a disinterested researcher. I went so far as to invent a mechanism to allow sitting to be active, and I am the CEO of a company (QOR360) created to popularize and sell chairs that encourage people to move while sitting. This conflict-of-interest disquiets me (Richard Feynman observed: “The first principle is that you must not fool yourself —and you are the easiest to fool”), but seems unavoidable.

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INTRODUCTION

THE PROBLEM

Plus an emergency hack
for your “ergonomic” office chair.

YOU ARE PROBABLY SITTING AS YOU READ THIS.

This was an easy guess because most of us spend most of our time sitting, over eight hours every day on average. Most of us sit more than we sleep.

Why so much sitting? Perhaps it is simply that sitting has become the default posture for most of our activities: reading, writing, emailing, driving, watching television, eating, eliminating, and the list goes on. Simply put, most of our work, our play, our amusements, even our vital functions, are done while sitting. Yes, we seem to be doing many different things, but as far as our bodies and our actual anatomy and physiology are concerned, well, we are just sitting.

None of this seems remarkable, of course, because chairs are so much a part of our built environment that they have become invisible to us, hiding in plain sight. We spend most of our lives in intimate contact with chairs, our bodies silently shaped by their malign design.

What is remarkable is that as a species we are not designed to sit. We spent the last three million years as hunter-gatherers, hunting and gathering, walking considerable distances, five or ten miles, every day. This long history shaped our bodies, and our biochemistry, in such a way that we now require daily doses of activity to stay healthy and vital. Interestingly, our requirement for daily exercise sets us apart from our primate cousins who, although biochemically very similar to us in most ways, require almost no exercise for health and longevity.¹

It is really only in the last one hundred years that we humans left behind days filled with physical activity and began slumping inertly in chairs for most of our waking lives. We might almost think of humans suddenly sitting so much as an immense science fair experiment. Unfortunately, it has not gone well for us subjects.

*As a species we're
not designed
to sit.*

As a species we are not designed to sit. Our addiction to passive sitting has been identified as the source of the twin epidemics of back pain and “sitting disease” (a constellation of obesity, diabetes,

heart disease, and cancer). These problems have not gone unnoticed by the office furniture design world, but despite decades of “innovation,” 80 percent of Americans still suffer from back pain

Despite decades of “innovation” in ergonomics, 80% of Americans still suffer from back pain.

severe enough to require help from a healthcare provider. More alarming, passive sitting is believed to shorten our lives on average by as much as two years.²

THE WORK-AROUND

Remarkably, the key to sitting well in an “ergonomic” office chair is to ignore or defeat most of the chair’s design features. This seems counterintuitive: after all, someone paid good money to design and manufacture all those features, doodads, and adjustments. But your body actually has its own perfectly evolved internal ergonomics: your skeleton. Unfortunately, the various “supports” provided by ergonomic chairs (back rest, foot rest, head rest, arm rests, and the coup de grace: lumbar support) serve only to distort one’s naturally perfect, internally generated, posture. So, what is required is a full-on hack of your chair that will allow you go get back to a more normal, organic, balanced, posture.

HOW TO SIT ON AN ERGONOMIC CHAIR

1. Standing in front of your chair, raise the sitting surface until it is a little higher than the top edge of your patella (kneecap). This will ensure that when you sit down your knees will be lower than your hips, allowing your lower back to express its natural curve (“lordosis”). This is simply a consequence of the mechanical connection of the lower back to the femur by the psoas muscle as illustrated in the middle frame of this helpful diagram from Galin Crazz’s book, *The Chair* (2013).



2. Sit on the front edge of your chair, with your sitting bones just 3 or 4 inches from the front edge of your chair.
3. Keep your feet flat on the floor, shoulder width apart.
4. Crucially, ignore the back rest, head rest, arm rests and lumbar support of your chair.
5. If possible, adjust your desk height to be slightly lower than your elbows with your elbows comfortable at your sides.

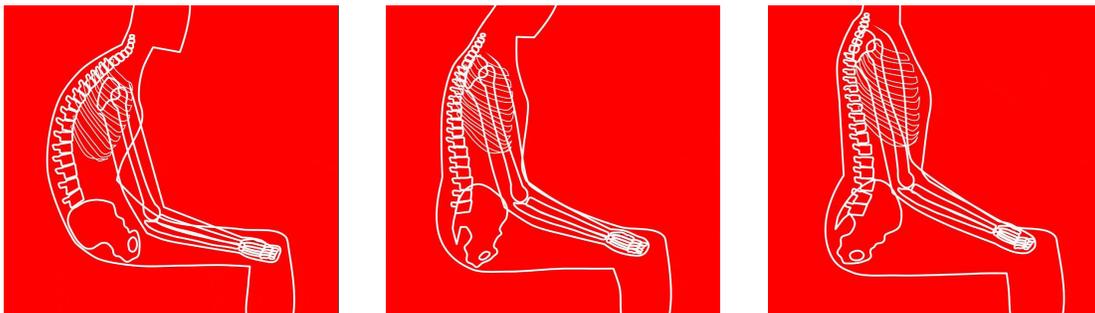


Raise the height of the seat so your knees drop below your hips, and then perch with your hips on the front edge of the seat. Crucially, ignore the back and arm rests.

Once situated you should have the feeling of “perching” on your chair, rather than collapsing into it. Your head should float on the top of your neck. If you feel the need to extend your head or allow it to slump forward, adjust your monitor to be higher or closer, or both. Your arms should hang comfortably from your shoulders. There is no need to prop them up on armrests.

This sequence of images gives the idea of getting your sitting bones back under your pelvis, where they can support you, rather than out in front of your pelvis, where they will encourage you to collapse into a slumped posture from which there is no return. Note that when the sitting bones are pulled back under the pelvis, the space between the ribs increases, providing for easier breathing. This is still another reason to prefer sitting with good internal posture.

This “sitting bones back under your pelvis” has been described as the “puppy tail up” posture in a very insightful six-minute Goats and Soda article by Michaelen Doucleff of NPR: “To Fix That Pain in Your Back, You Might Have to Change the Way You Sit.”



Progression from a slouched position to “puppy tail up”, with the sitting bones under the pelvis.

You will likely find this “perching” posture more demanding than the slumped posture encouraged by your office chair’s various features and adjustments. Because for many of us our cores have become muscularly deconditioned through years or decades of passive sitting, sitting actively will likely require some effort at first. This is an almost universal experience, so allow yourself to gradually adapt to sitting using internal strength rather than external support. Perhaps you will need to get up periodically and walk around a bit. This is an added benefit of active sitting, actually. You may even need to return to your slumped posture periodically to rest up a bit, but within a few days or weeks, almost everyone can sit actively all day long. It is our birthright, born of millions of years as peripatetic hunter-gatherers, to be able to support ourselves, generating our posture from within rather than relying on a posture imposed from without.

THE DEFINITIVE SOLUTION

Of course, a work-around is just that: doing the best you can with what you have until you can arrange a better solution. But it need not be all work-arounds. Several companies now make chairs that specifically support and encourage active sitting. CoreChair, Fully, QOR360, Swopper, Salli, and a few other companies make chairs that, although they all approach the problem differently, all encourage movement while sitting. Perhaps sensing opportunity, even strait-laced Steelcase now has an entry in the active sitting arena. More recently, Knoll, one of the largest office furniture makers in the world, purchased Fully and took out a Superbowl ad in hope of catching the wave in active sitting.



If you are working from home, the time for you to upgrade your home office may finally have come. Several companies (e.g., Google) have recognized that better sitting options are in the interests of not only their employees' well-being but their company's bottom line, and as a result are offering stipends for employees' home office upgrades. It is worth asking human resources.



"Find your work flow" commercial from Fully.

One final thought, the hardest thing about good health habits is that most require daily commitment: running, going to the gym, skipping dessert, taking the stairs instead of the elevator, all require 365 decisions each year. But your built environment is different: you only need to make a single decision, "I'll think I'll switch to an active chair," to reap a lifetime of health benefits.

*You only need to make one single decision,
"I think I'll switch to an active chair,"
to reap a lifetime of health benefits.*

ONE

WHY CHAIRS?

WHY CHAIRS?

Perhaps too obviously, chairs allow us to sit. Of course, one can sit without a chair, on the ground, on the floor, anywhere really, but in the Western world sitting almost always involves a chair.

And we love our chairs, perhaps too well. It has been estimated that we Americans each host as many as seventy chairs. How is this possible? Count first the chairs around your home, your office, then add in schools, theaters, restaurants, hotels, waiting rooms, buses, trains, libraries, park benches, and restrooms. And then add in the silent army of chairs stored, waiting for the next wedding reception, school play, or funeral. It all adds up to a lot of chairs. We are so well supplied with chairs that *The Onion* reported in 2014 that we have no need to make more chairs. And yet, chairs keep coming.

Why do we love our chairs so? Perhaps because they allow us to take a restful posture at a height that makes many of our tasks and amusements more convenient. Indeed, chairs are required for most of what we do every day: eating, screen time, traveling, eliminating, all involve a seated posture, and so, inevitably, a chair. Chairs are by now designed into our lives, and even into our architecture. One cannot look out a window if seated on the floor. The window expects you to be seated in a chair.

Just as fish do not see the water they swim in, we no longer see chairs we sit upon. Chairs are simply how we live, and we can imagine no other life. Chairs are also objects of art, taking on new forms and using new materials in every age, generating an ever-changing panoply of sitting options. Whole museums are devoted to chairs, and new coffee table books of chair collections are published every year. The urge to innovate defines designers, and we consumers have an insatiable appetite for the new, so “new” chairs appear every year. We seem not to tire of making, and buying, new, if not very different, chairs, perhaps hoping that this next chair will succeed for us where all previous chairs have failed us. Simply put: chairs are the default perches for most of our modern life, and we cannot seem to get enough of them.

Oddly though, before there were any chairs we effortlessly did without them. For most of our three-million-year history we humans were hunter-gatherers, and our built environment was simply the tools and clothes that we could carry with us. Furniture had to wait for our transition from hunting and gathering to the more settled life of farming. The first chairs appeared only five thousand years ago, but for thousands more years, chairs were reserved for the royal and the wealthy. Anthropological evidence shows that Europeans squatted, rather than sat, until well into the Middle Ages, when stools and benches became common. Chairs were available for the most important people, of course, a throne for the king, a chair for the chairman of the board or the head of the household. Individual chairs had to wait until chairs could be cheaply produced, something made possible by the advent of designs that could be mass produced on the assembly lines that came to define the twentieth century. The explosive growth of chairs came with the switch from farm and factory work to office work, a revolution in work posture and activity that happened almost overnight. Predictably, not everyone was onboard with the sudden adoption of chair lounging as our default posture. Dr. Aveling counseled caution in his 1879 textbook *Posture in Gynec and Obstetric Practice*: “Of all the machines which civilization has invented for the torture of mankind... there are few which perform their work more pertinaciously, widely, or cruelly than the chair.”

Naysayers aside, chairs swiftly became the basis for Western life, and there has been little reconsideration of this change in our lives. And as we ease into the twenty-first century, screen time has become almost synonymous with waking time. We now find ourselves sitting eight or ten or even twelve hours each day. In just an evolutionary blink of the eye we have come from our chairless peripatetic hunter-gatherer lives to lives almost entirely defined by sitting.

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Of course, not every culture adopted chair sitting. Chairs were available in classical China and Japan, but most people sat on the floor by choice. And the few remaining hunter-gatherer peoples have not yet discovered chair sitting, and so have continued to placidly squat rather than sit right through to the present day. So, maybe chairs are not inevitable.

Recent history makes it seem that chairs will be the common fate of humanity, however. Chair sitting is displacing floor sitting among the young in China and Japan, and even the Hadza, a hunter-gatherer folk still found in Tanzania, when introduced to Western chairs are drawn to them “like moths to a porch light” (PNAS, Rauchlin). It turns out that hunter-gatherers are not immune to the seductive pleasures of passively slouching on a chair. Far from it. Rather they simply had not discovered the bliss of passively sinking into a camp chair. Although late to the party, the Hadza, like the rest of us, seem to now be all in on chairs.

So, chairs are inexorably taking over as our resting posture. Indeed, they have become our default posture. And we seem to love our chairs very much. The problem is, our chairs do not love us back.

TWO

WHY NOT CHAIRS?

SO, WE LOVE SITTING.

We love sitting so much that most of us sit eight to twelve hours of each day, and our sitting time continues to increase.³ We love sitting so much that we have arranged to have an abundance of chairs wherever we go, just to be sure we will always be able to take a seat, anywhere, anytime. We crave the reassurance of being surrounded by chairs. By some estimates there are seventy chairs for every person in America. That is a lot of chairs.

We love our chairs so much that we are able to see there is a problem in this relationship. And, unfortunately, it is a big problem. Because here is the thing: we are not designed for sitting.

And, because we are not designed for sitting, sitting still turns out to be bad for us. Passive sitting is bad for our posture, bad for our core strength, bad for our backs, and especially bad for our overall health. There is not anything about sitting that improves us. We might almost think of sitting as postural candy: it feels good in the moment, but it does not nourish us. In addition, in the longer run, large doses of sitting can produce illness, and even shorten our lives. Indeed, it is estimated that those of us who sit a lot lose on average two life years to sitting.⁴

How, exactly, sitting causes so much mischief is complicated, because sitting passively affects so many systems: our posture, our muscular activity, and even the biochemistry of our blood. But there are three lines of evidence that shed light on the harms done by passive sitting: epidemiological, anthropological, and physiological.

EPIDEMIOLOGIC EVIDENCE

Epidemiologists have long linked passive sitting to a host of bad outcomes. Perhaps most concerning is the observed association of sitting with early death. A recent paper in the *Annals of Internal Medicine* found that mortality was increased by 20 percent in folks who sat the most. Of critical

importance, this association was independent of overall physical activity levels.⁵ So, going to the gym cannot undo the harm of passive sitting. This is especially bad news, because as a nation we are sitting more and becoming less active each and every year.

Several mechanisms seem to be involved in shortening our lives. More time spent sitting is associated with an increased risk for diabetes and heart disease, and these effects are large: the risk of diabetes was increased by 13 percent and that of heart disease is increased by 30 percent.⁶ Perhaps more surprising, some types of cancer (colorectal, prostate, and lung cancer) are also increased in those who sit a lot.⁷

Tellingly, it is not just adults who need to move more. It turns out that even babies who move more are better off as measured by having less body fat. In an ingenious experiment, Hopkins researcher Benjamin-Neelon and coworkers (Bediatric Obesity, 2020) fit babies with tiny accelerometers, and they found that babies who moved less were fatter, an important observation because overweight children often go on to be overweight adults, heir to the health and longevity consequences that come with obesity.

*In people who sit more, studies show:
20% increase in mortality,
13% increased risk of diabetes,
13% increased risk of heart disease,
increase in colorectal, prostate,
and lung cancers.*

*And these numbers are independent of
overall physical activity levels,
meaning the harm of sitting
cannot be undone
by going to the gym.*

ANTHROPOLOGICAL EVIDENCE

It turns out that humans may be unique in their need for activity. Recent research shows that all of our nearest relatives, chimps, bonobos, and gorillas, have surprisingly low activity levels in the wild. A typical day in the life of a chimp involves ten hours/day of resting and grooming before knocking off for ten hours of sleep each night. In their four “active” hours, chimps walk about a mile and climb about one hundred meters (equal to another mile of walking). Orangutans lead lives that are about as active, and gorillas do far less. In zoos, great apes are even less active but somehow stay lean (10 percent body fat for chimps) and healthy. By contrast, humans seem to need ten thousand steps (five miles) of walking every day to stay healthy.

But we are very similar to our cousins the great apes (97 percent of our DNA is identical after all), so it is surprising that we humans require so much more activity. How did this happen? Really, it seems to have been an accident, an unintended consequence of the single huge and fateful step humans took when they abandoned the sedentary gatherer lifestyle of our ancestors in the jungle and strode out onto the savannah to become hunter-gatherers. This new lifestyle required an obvious upgrade to our anatomy: upright posture, efficient walking, more slow-twitch fibers in our leg muscles, and greatly increased sweat cooling to run down game without overheating.

But our physiology also had to evolve now that we were walking five to ten miles/day (eighteen thousand steps). This was in effect an invisible, biochemical, upgrade. As new hunter-gatherers we did much more walking, and our bodies simply came to rely on walking to keep us healthy. Active muscles release hundreds of signaling molecules (myokines) that inform and fine-tune our internal biochemistry: increasing insulin sensitivity, improving immune function, greater clearing fat from the blood, and a host of other tweaks that are required if we are to stay healthy. It is not too much to say that every organ system depends upon adequate levels of activity, right down to the cellular level.

*Exercise is not optional; it's required.
This is why your body rewards you
with a "runner's high"
when you work out.*

So it turns out that exercise is not optional. It is required. Your body knows this, of course, and rewards you with endocannabinoids when you work out (that "runner's high" you get). Unfortunately, it is harder for your body to signal that modest amounts of movement also provide critical benefits to overall health and longevity.

PHYSIOLOGICAL EVIDENCE

It is long been known that staying active was essential to staying healthy: Hypocrites observed that "walking is man's best medicine," and physicians emphasize to their patients that exercise is an essential component of staying healthy. But the exact mechanism underlying this connection is only now coming into focus. Perhaps surprising to some, not only is exercise good for us, but an entirely separate mechanism is also at work: inactivity is itself a risk factor for disease and a shortened life span. We have known for some time now that even modest levels of activity reduce systemic inflammation, so it is not surprising that decreased activity promote inflammation.⁸ In a harrowing experiment Danish researchers paid young healthy men to sit all day and walk less than one mile a day for six weeks.⁹ Before and after MRI scans showed that these men increased their "organ" body fat by 7 percent, triggering signs of chronic inflammation in their blood stream: subjects showed increased bad cholesterol (LDL), decreased good cholesterol (HDL), and increased serum insulin, changes that, in general, promote diabetes and heart disease ultimately taking years off our lives. Fortunately, it turns out that even modest activity can avoid the harmful effects of inactivity. Homer and coworkers showed in a 2017 study that simply taking "movement snacks" (just two minutes of walking every thirty minutes) improved postprandial plasma triglyceride, nonesterified fatty acid, and insulin responses.¹⁰

*"Walking is man's
best medicine."*

- Hypocrites

So breaking up long periods of inactivity with even very brief bouts of activity is the key. Unfortunately, in practice arranging to reliably interrupt ourselves is not easy: timers on our computers seem intrusive and apps on our phones can be ignored. What is needed is a way to make sitting intrinsically active. Rather than interrupting our sitting to move, we can make our sitting inherently active, no interruptions required.

**THE SOLUTION: MAKE SITTING ACTIVE,
RATHER THAN PASSIVE**

The real answer to our sitting addiction is to change the very way in which we sit. We must find a way to incorporate movement into sitting. This will require a fundamental rethinking of what chairs are, and will result in designs that not long ago would not be recognizable as chairs. But if sitting can be made active, we will be able to continue our romance with sitting without the untoward consequences of passive sitting.

What would such redesigned chairs look like? We'll save this for the last chapter.

*Improve health outcomes
with “Movement Snacks”:
2 minutes of walking
every 30 minutes.
Or, make sitting active,
rather than passive-
no interruptions required.*

THREE

WHAT MAKES A GOOD CHAIR?

WHAT MAKES A GOOD CHAIR?

It depends upon whom you ask. But at root the answer depends upon what you think a chair is for. And, because chairs are used in different contexts, it follows that the question “What makes a good chair?” can have more than one answer.

One view is that chairs are objects of art, a part of our everyday world that can surprise and delight. And, because designers, the artists of the chair world, are endlessly inventive, the array of chairs we have is dizzying. Almost every material, color, shape, and idea seem to have been explored, and yet the perfusion of available chairs continues to expand, with armies of designers, young and old, working away, and new designs winning awards every year. In part these new designs are inspired by new materials and manufacturing techniques, but mostly they seem to come from our insatiable desire for the novel. This has stretched the definition of “chair” so that it now includes royal thrones and beanbag chairs, and everything in between.

Indeed, there is a lot of room in this “in between.” For example, consider just two chairs, from over the last fifty years: the “Images of a Cloud” chair and the “Globe Garden” chairs. If one tries to imagine how one might actually sit down on one of these chairs, the practical aspects of chair design begin to assert themselves: in order to sit down, does this chair require a stepladder, or a crane or what?

Unfortunately, chairs designed to delight the eye may not actually be very good for sitting on or getting anything done. Indeed, chair designers rarely come from the world of human anatomy and

Chair designs are often rooted in art, not anatomy.



*Left: Images of Cloud, Shota Urasaki, 2020
Right: Globe Garden, Peter Opsvik, 1986*

physiology. Most commonly they begin with a bachelor's or master's degree in furniture design or industrial design, or simple emigrate to chair design from the world of art. Designing an original chair is a common final class project. As a result, chair designs often are more rooted in the world of art than in the world of anatomy.

A competing view is that a chair is a machine for sitting rather than an objet d'art. In this view, a good chair is one that helps us to sit well. But this begs the question, what does it mean to sit well?

One approach to "sitting well" would be to maximize comfort, perhaps by reducing physical effort to a minimum. This idea leads to a new sort of "chair," one that resembles what most of us would recognize as a bed or perhaps a dental chair.

It turns out that such "chairs" are now available to anyone with \$7,000 to spend. But, for most of us, this sort of chair probably is not actually the solution we are looking for: too expensive, too intrusive, and just a little too weird.

While the "chair as bed" approach may seem silly, it can serve as a valuable thought experiment. Is it really the case that the purpose of a chair is to extinguish all muscular effort? If so, well, chairs with footrests, armrests, backrests, headrests, and so on, seem like the obvious solution: the more rests, the more restful. And this approach may make sense when one is just looking to take a bit of a rest. But chairs are now our default posture, with most of us sitting more than eight hours a day. So, it is important to ask if there are unintended consequences for turning off almost all muscular activity for most of our waking lives. To no one's surprise, there are profound consequences for our muscular strength, our posture, and our health. More about this shortly.

And even if the goal is a chair that relieves us of all muscular activity, the seductively simple idea of "putting the body at rest in an upright position" is not an easy lift. In practice many different mechanical supports will be required, and because people come in many shapes and sizes, adjusting all these supports will be a substantial project, likely beyond the ken of many people who just want to sit down and get to work. Indeed, when it has been studied, most people do not adjust any of the available knobs and levers. This has created an entire industry for ergonomists to come to



Chair? Or bed?

the desks of workers in an attempt to get their chairs adjusted "just right." But what if the ergonomist does not know either?

It turns out that the advice of certified ergonomists about how to sit well is really

What are the unintended consequences for turning off almost all muscular activity for most of our waking lives?

is based on very little scientific research. Many ergonomists are still advocating for the “90-90-90” posture, that is, 90-degree angles at the ankles, knees, and hips. This “ideal” posture was first promulgated in the 1800s, more as a way to demonstrate moral rectitude than as a way to sit productively.¹¹ Unfortunately, little progress has been made. We know this because, despite fifty years of ergonomic science and advice, 80 percent of Americans still have back pain at some time in their lives, so severe that they seek the help of a medical professional. If “ergonomic” chairs are the solution, why has the problem persisted?

Where can we turn for good advice? Likely we are best advised to simply sit in ways that comport with our hunter-gatherer body’s natural design and inclinations. That is, we should find ways to sit that allow our natural “internal ergonomics,” our skeletons, to support us from within, rather than rely on being propped up by “ergonomic” supports: backrests, armrests, headrests, lumbar supports, and the like. As a species, we were comfortable without these “ergonomic” intrusions on our posture for three million years. It is odd that we should suddenly require such props just in the last one hundred years. The twenty-first century may require us to sit, but it does not require us to sit badly.

*As a species, we were comfortable
without “ergonomic” intrusions
on our posture for
three million years.*

*If ergonomics are the solution,
then why to 80% of Americans
still suffer from back pain?*

FOUR

KIDS SIT, TOO.

IN THE TWENTY-FIRST CENTURY, OUR WESTERN CULTURE REQUIRES THAT CHILDREN SIT NO LESS THAN GROW-UPS.

Breakfast, lunch, dinner, at school, homework, video games, television, it all adds up to an immense amount of passive sitting. We introduce kids to the environment that we have created for them, and it turns out that sitting is a big part of it.

Kids know instinctively that they would rather be moving than sitting. One need only watch first graders wiggling on their tiny chairs to see this. But sitting is required, and kids adapt. Because, really, what choice do they have? With baby strollers and baby car seats, children are programmed within the first few months of life to fit into the world they are presented with, and soon come to think of sitting as the default posture for their lives. Confined in highchairs for their safety, in chairs for meals, in the sofa for television and video games, in chairs for school: sitting, sitting, sitting, every day. Indeed, most days sitting dominates most of the day. So children eventually give up and accept that chairs are their destiny.

But this reliance on the seated posture comes with detrimental consequences. For example, children come into the world as natural-born squatters. Often a child learning to toddle who loses her balance will slip gracefully into an elegant squat to catch herself and avoid a fall, and then rebalance and continue on. Children are quite comfortable squatting for the length of eating a peanut butter sandwich or playing a game of go-fish or longer. But unlike the children of cultures without chairs, children in our chair-centric culture soon lose their ability to squat, an ability that is difficult to regain. Just watch any adult try to squat at all, let alone squat to enjoy an entire peanut butter sandwich.

Posture is important, and sitting well has long been understood to be a part of posture generally. As a result, an approach to “proper” sitting for children has often been culturally prescribed. Because children are growing and developing, however, the posture that furniture imposes is of particular significance. As early as 1743 the French orthopedic physician Dr. Nicolas Andry de Bois-Regard

understood that school furniture would impose a lifelong imprint upon children: “place the children upon these little chairs, by which means their bodies begin to grow deformed, little by little, in their tender years.” Despite the importance of chair designs for children, the designs for chairs used in schools have typically been based on tradition rather than research. An exception has been in Scandinavian countries. In the mid-twentieth century, Dr. A. C. Mandal in Denmark introduced posture-appropriate chairs into schools,¹² and innovative designs have continued to appear in Scandinavian schools, for example, the much more contemporary Rodeo Chair.¹³



Rodeo Chairs

In the United States, however, self-appointed groups have arisen to fill the perceived need for standards. The group that currently sets standards for educational furniture is the American National Standards Institute/Business and Institutional Furniture Manufacturer’s Association (ANSI/BIFMA). This group is surprisingly candid in their most recent report in their assessment of the current state of the art of school furniture.¹⁴ They admit that current furniture design is limited by the “lack of ergonomics design guidelines for educational furniture,” and further that a “one size fits all” approach under which schools typically purchase chairs of one size for convenience, well knowing that their students actually come in very different sizes. Perhaps most shockingly, the ANSI/BIFMA acknowledge that school seating is “Designed for custodial staff: In many cases, the design of seating is based on stacking and cleaning requirements.”

In the US, school seating is designed for custodial staff, based on stacking and cleaning requirements.

Shouldn't we expect more for our kids?

Amazingly, despite acknowledging “the lack of ergonomic guidelines” the ANSI/BIFMA provides hundreds of pages of “standards.” These are proprietary and although sold for \$188, provide only unsupported pronouncements from a self-appointed group drawn largely from the chair furniture industry.

Unfortunately, the dearth of data concerning good sitting design has not prevented some governments from creating standards, based upon long-held prejudices about “correct” seated posture. Indeed, some of these standards are written into law. As an example, until recently the EU standard (prEN 1729-1) required that the seat of all school chairs tip backward –5 to –10 degrees. This creates a slippery surface, which children must constantly fight against to get to their desk, until after months or years of effort, they finally succumb, and slide back against the backrest and then slouch forward to get to their desks. This is the root cause of the all too common “poor postural habits” that they keep for the remainder of their school careers, and usually for the rest of their lives. Note that this is a profoundly unnatural, and likely unintended, posture. Researchers have tried to correct this problem by providing children with foam wedges that convert the backward slope of their chairs to a forward tilt, and found a 58 percent decrease in back pain after a matter of weeks.¹⁵ Encouragingly,

a recent campaign to tip children's chair seats even further backward was overridden by a concerted campaign by the students and graduates of the Alexander Technique Training Course in Ireland.¹⁶

But should we not expect more of our school chairs than that they do no harm? Perhaps chairs could encourage better seated posture for students. For example, chairs with unstable seat surfaces encourage students to change their posture much more frequently than simple, static chairs.¹⁷ Although such chairs are not common, designs are freely available for active chairs that can be inexpensively constructed from plywood and easily assembled without tools, an option that may appeal to schools and parents interested in providing active sitting options to their children.¹⁸

*Could allowing students to
move their whole body,
rather than just their pencils
to doodle, be beneficial?
Turns out, yes.*

The avowed goal of school is not really about posture, however, but rather about learning. Could seating in schools contribute to improved learning? While this may sound unlikely, we now know that learning is not something that just happens to the brain within its bony box but rather is a coordinated enterprise involving both the mind and the body. To fix ideas, it is known, for example, that allowing students to doodle in class improves retention.¹⁹ It might be that allowing students to move their whole body, rather than just their pencils, to doodle, could improve learning and retention.

Interestingly, there is some early research suggesting this is the case. Researchers at Gutenberg University looked at the effect of a chair that allowed students to slightly tip in all directions while sitting. They found that manipulation of postural control affordances has an effect on mathematical reasoning performance in algebraic, geometric, and numerical reasoning tasks, and went on to hypothesize that “under dynamic postural control visuo-spatial mathematical processing is enhanced.”²⁰

We do not yet understand all the ways in which sitting affects children, and new associations continue to be discovered. For example, in a recent study, a host of physiologic markers (cholesterol, HDL cholesterol, total cholesterol/HDL ratio) were found to improve with reduced sitting time in adolescents. Cognitive function was also improved.²¹ Another study found that uninterrupted sitting decreased blood flow in the femoral artery of adolescent girls, but this was reversed by short, regular exercise breaks.²² In still another study, it was found that long periods of inactivity (sitting) were associated with increased rates of depression in children.²³ Doubtless, still other effects will be found to be associated with sitting. Further research will be required, however, because simple associations do not necessarily demonstrate causal relationships, and even when a relationship is causal, the direction of causality may not be obvious. So, for example, does prolonged sitting cause depression, or is it simply that depressed children are less active and sit more?

In light of our incomplete understanding of the effects of sitting on children, how are we to proceed? One simple recommendation is that children simply sit less. And, when sitting cannot be avoided,

allowing kids to sit for shorter periods of time seems an obvious caveat. Active rest postures, such as squatting, should also be encouraged when possible.²⁴

In addition, egregiously badly designed chairs, such as chairs with seat that slope backward, should not be forced on children by school systems. Where such errors are already enshrined in the furnishings of a school, foam wedges can be employed to rectify the backward tip of chair seats.

Finally, innovative types of chairs that encourage continuous movement and rebalancing may play a role. Chairs such as the ErgoErgo²⁵ stool, the ButtOn Chair,²⁶ the Wobble Chair,²⁷ and others, are now available, and more such chairs are certainly in the pipeline. It is unclear how much benefit this approach to sitting will provide for children. Likely some of these stools provide more benefits than others. Because there is almost no research upon which to base decisions, schools and parents, in consultation with their children, are left to make their own best decisions when selecting chairs.



ButtOn Chair

FIVE

ALTERNATIVES TO STANDARD CHAIRS

THE FAILURE OF CHAIRS to satisfy our need for a seated posture that allows us to get our work done has spawned a menagerie of different approaches to sitting. In part this is due to our insatiable need for the novel. But the number of alternatives to standard office chairs that are now on offer underscores the fundamental fact: we have not yet figured out a way to sit that lets us sit comfortably, and healthfully, for the eight to twelve hours a day that our twenty-first-century chair-centric culture requires.

The quick fix of turning to existent alternatives to office chairs such as simply standing all day or sitting on yoga balls has failed to rescue us, because these solutions were not carefully thought out, but simply adopted out of expediency. So, it should not surprise us that these approaches have failed to solve the basic problem of sitting.

*How do we sit comfortably-
and healthfully- for the
8 to 12 hours a day
that our current
chair centric culture
requires?*

YOGA BALLS

The yoga ball has been around since 1963 when an Italian plastics manufacture first figured out how to make a mold for a large, inflatable plastic ball. Small balls were initially used in the respiratory treatment of pneumonia in premature infants in hospitals, but larger balls soon caught on in Switzerland as a way to treat movement disorders in adults. Yoga balls are now ubiquitous and are used to allow motion in athletic training routines, yoga, and Pilates.

Because yoga balls are about the height of a chair and allow movement, and because sitting still is bad for us, it was natural to think that sitting on a yoga ball might be beneficial. Unfortunately, this has not turned out to be true. Even the seemingly obvious claim that yoga balls increase muscular activity seems not to be true when carefully studied.²⁸ As Wikipedia observes: “There is

no scientific evidence of those benefits occurring by just sitting on a yoga ball without additional exercises. . . , some warn against using a yoga ball as a chair because of ergonomic considerations or biomechanical reasons.”

So while yoga balls seem like a cheap answer to the problems of sitting, they fail. And they fail for a couple of reasons. First, because they are squishy, one cannot feel one’s sitting bones (ischial tuberosities) when sitting on a yoga ball. Because the base for sitting is poorly defined, it is hard to align one’s spine on top of a yoga ball. Perhaps worse, when sitting on a yoga ball, there is a tendency to rock one’s pelvis backward, leading to a hunched lower back and, after a short while, lower back discomfort. Still another difficulty with yoga balls is that it is impossible to adjust their height. Indeed, it is hard to know what the height of a yoga ball is, because it changes as soon as one sits on it, and the degree of this change depends on one’s weight, as well as the (usually unknown) inflation pressure of the ball. Because the height of one’s chair is critical to sitting with good posture, this makes yoga balls a nonstarter for most people.

Still another problem with yoga balls is their propensity to fail unexpectedly. As yoga balls age, the plastic becomes brittle, and eventually all yoga balls will pop, dropping the sitter on the floor suddenly and unexpectedly. Such failures have caused serious injuries, so much so that many human resources departments have now banned the yoga ball.

Despite these shortcomings, we find yoga balls everywhere. I think this is because yoga balls seem like an obvious way to inject more movement into our days. And they are very cheap to make, and very, very, cheap to ship. But mostly, I think the rage for yoga balls seemed to be a ready to hand solution to the problem of sitting.

KNEELING CHAIRS (BALANS CHAIR)

Conceived almost forty years ago, kneeling chairs were the first piece of furniture conceived for use sitting in front of computers, and were originally called “computer chairs.” The basic design was the work of Hans Christian Mengshoel, but the design was adapted by Peter Opsvik and others. The hope was to allow people to sit all day, motionless, by dividing their weight between their shins and their sitting bones. The chair also enforced an open hip angle, thus encouraging a physiologic lumbar lordosis in the spine.



Balans Kneeling Chair

However, while kneeling chairs encourage better spinal posture, they extinguished most spontaneous movement. Indeed, the point of the kneeling chair is to enforce a single posture. As a result, kneeling chairs have not been widely adopted, seemingly one more blind alley in the search for a chair that would allow all day sitting.

STANDING DESKS

If sitting is the problem, it stands to reason that standing would be the solution, because standing seems to obviously be the opposite of sitting. This idea is so self-evident that entire companies devoted to making and promoting standing desks have sprung up. Indeed, standing desks have grown to a three-billion-dollar industry in the United States in just the last few years. This is remarkable, because no research has shown that standing desks offer any health advantages.

The confusion is understandable, however. Standing may be the linguistic opposite of sitting, but sitting and standing actually have a lot in common. Yes, when most people sit, they slouch forward or lean against the backrest and armrests, and their postural muscles turn off and go dark. But it turns out that most folks at a standing desk lock their knees and slide a hip forward to adopt a locked out posture that pretty much turns off most of their postural muscles, just like their seated co-workers. So, at the muscular level, sitting and standing are not that different. It is not surprising that the increase in metabolic rate when moving from sitting to standing is quite modest, in the range of 10 percent.²⁹

But there is one big difference between sitting and standing. It turns out that the risk of heart disease is twice as high for those who stand most of the day compared to those who sit. This surprising result published in the *American Journal of Epidemiology* in 2018 is based upon observing seventy-three hundred workers over twelve years.³⁰ It is a well-done study that adjusted for a variety of factors.

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How could standing be associated with more heart disease than sitting? Lead author Dr. Peter Smith explains that biological mechanisms largely explain why standing in a fixed place for hours at a time is actually worse for your health in the long term than sitting down. “The blood tends to pool in your legs, there is an increase in venous tension and oxidative stress, all of which increase the risk for cardiovascular disease,” he noted. “Combinations of standing and sitting and walking are probably where we need to be for all types of occupations.”

Does Dr. Smith think it is time to retire all those standing desks that human resources just bought? “There is a real absence of evidence that standing for short periods does anything to reduce your risk of cardiovascular disease. The best thing to do is to be more active during the day rather than think that just standing a few extra hours will make any difference.”

So the real culprit seems not to be sitting or standing, but inactivity. And it turns out that while sitting still is bad, standing still is even worse, about twice as bad in fact, at least for your heart. The real solution is to inject activity into your day wherever possible. Active standing (aka walking) is better than standing still, of course. But how could one walk at one’s desk? Enter the treadmill desk.

TREADMILL DESKS

Treadmills are at once one of the oldest and one of the newest technologies in the hunt for better sitting options. Treadmills were conceived three thousand years ago as a way to convert human or animal efforts into mechanical work that could be harnessed to pump water or grind grain. The association of treadmills with grinding labor resulted in treadmills being incorporated into English prisons of the nineteenth century as a form of punishment for inmates. However, it was not so much the physical punishment of labor that made treadmills such a formidable punishment as their Sisyphean specter. A contemporary observer, James Hardie, observed in his *The History of the Tread-Mill*: “[It was ennui, stemming from the treadmill’s] monotonous steadiness and not its severity, which constitutes its terror.”

Despite this unpromising beginning, treadmills continued to seep into our culture, first as tools to research cardiac physiology in the 1930s and later as high-tech exercise machines. An exercise treadmill even found its way onto the Space Station. By the 1960s smaller, less expensive treadmills became available for home exercise use, and today exercise treadmills have grown to a billion-dollar industry in the United States. A billion dollars? Well, it adds up when high-end home treadmills sell for five thousand dollars.

By the 1980s concerns about the adverse health effects of protracted sitting led to standing desks being paired with treadmills in offices. While slipping a treadmill under one’s desk seems like a shortcut back to the healthful peripatetic lifestyle of our hunter-gatherer forebears, in practice there have been problems. The expense, noise, and inconvenience of bringing exercise equipment into corporate cubicles has been a barrier to adoption. In addition, careful testing has shown that the ability to type and use a mouse accurately degrades with walking speed. Perhaps of greater concern, a recent study in PLOS ONE found that treadmill desks were associated with significant decrements in learning and memory compared to simply sitting at a desk.³¹

It is not clear what the future of treadmill desks is. Steelcase, one of the largest office furniture makers in the world, was an earlier adopter and began producing the WalkStation in 2007. But, perhaps in a sign of things to come, Steelcase has since hopped off of the treadmill desk treadmill.

In sum, while it is likely that some enthusiasts for treadmill desks will keep the market alive, the first several decades suggest that treadmill desks will remain a niche product, held back by the practical difficulties of bringing complex exercise equipment into one’s office.

*“Combinations of sitting and standing
and walking are probably where
we need to be for all types of occupations...
The best thing to do is to be
more active during the day...”*

-Dr. Peter Smith

ACTIVE CHAIRS

The most recent addition to the list of alternatives to standard office chairs are “active chairs.” These chairs incorporate an element of instability in their design, which requires that one actively balance on the chair while sitting. This rebalancing is largely mediated by spinal reflexes, and so happens outside of conscious awareness.

Requiring people to actively engage with their chair provides at least two advantages. First, by requiring continuous muscular engagement active chairs increase metabolic rate by 20 percent to 40 percent, and thus provide prophylaxis against sitting disease.³² Because the level of muscular engagement is subtle, active sitting is unobtrusive. But because large muscle groups are constantly engaged, the overall metabolic consequences are considerable. Detailed study of the metabolic consequences of active sitting have yet to be published, but because even the minimal activity of fidgeting improves all cause mortality it seems likely that active sitting will bring similar benefits.³³

Perhaps as important, by requiring continuous small postural adjustments moment to moment, active chairs encourage people to unconsciously explore the space of possible seated postures, a process that allows a more balanced posture to naturally arise. In addition, because active chairs require a balanced posture, slouching and hunching against the various supports provided by “ergonomic” office chairs is almost impossible.

By requiring continuous muscular engagement, active chairs increase metabolic rate by 20 to 40%.

Because active chairs require the use of muscles, which in many chronic sitters are atrophic, it may be days or even weeks before someone new to active sitting can sit comfortably all day on an active chair. During this transition it is common for people to take sitting “breaks,” slouching for a bit in their “ergonomic” chair. But ultimately almost everyone is able to sit unsupported all day without noticing the absence of the various external props provided by “ergonomic” office chairs.

As the most recent addition to the list of alternatives to conventional office chairs, it is not yet clear if active chairs will be widely adopted. Certainly, the novelty of such a radical redesign of chairs will give those who manufacture and sell chairs pause. After a half century of insisting that lumbar support was essential, it will be difficult for the chair industry to walk back this storyline. And the modest effort required of people whose core muscles have been deconditioned by decades of passive sitting may discourage many people from adopting active sitting.

SIX

THE FUTURE OF SITTING

WE LOVE SITTING, BUT OUR CURRENT CHAIRS ENCOURAGE US TO SIT BADLY.

The result has been two sorts of mischief: poor posture and a weakened core leading to back pain; and a host of metabolic consequences that ultimately shorten our lives by as much as two years.

WHAT IS TO BE DONE?

It seems safe to say that sitting is not going away. Chairs are by now designed into our architecture, into our very lives. As much as we might come to dread them, chairs will be a part of our future.

However, perhaps chairs could be less a part of our future. Sitting less, and especially sitting for shorter periods, is the most obvious and inexpensive work around. And these small changes to our habitual way of sitting can bring big benefits. Getting up every thirty minutes and walking for as little as two minutes has been shown to avoid the unfortunate metabolic consequences of prolonged sitting.³⁴ And, if you are lucky enough to be a natural born fidgeter, just fidgeting may be enough activity to avoid most of the untoward consequences brought about by our chair addiction.³⁵

However, for many people a solution that is designed into their workspace will be the best solution. And there is no shortage of ideas as to what could replace our current chairs. Likely, many of the replacement possibilities I have discussed will play a role in our chair future.

I think that active chairs will be the best choice for many, perhaps most, people who wish to avoid the panoply of problems that our chair-centric culture has created. Of course, I would say that, wouldn't I? I am the CEO of a company that makes active chairs, after all. But the reason I am in the active chair game is because I genuinely believe our current relationship to sitting must change, and I want to be a part of that change. It is my conviction that providing better sitting options will allow people to make better decisions for themselves about their approach to sitting. These decisions are far too important to be left to the current practice of ergonomics, which is still evolving and seems not to be a science yet.

So while the twenty-first century may require us to sit, it does not require us to sit badly. And fortunately tools are now available that will allow us to develop better ways to sit, which will be both comfortable and healthful. But we must move quickly, because our current approach to sitting is extracting a daily toll in terms of back pain and the consequences of sitting disease: obesity, diabetes, heart disease, and shortened life spans. Awareness of the problem is the first step, but solving the problem will require a complete rethinking of our relationship with chairs and a radically different approach to chair design.

“I genuinely believe our current relationship to sitting must change, and I want to be a part of that change. It’s my conviction that providing better sitting options will allow people to make better decisions for themselves about their approach to sitting.”

-Dr. Turner Osler

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Dr. Turner Osler is the CEO and Founder of QOR360. Dr. Osler spent twenty-five years as an academic trauma surgeon and researcher and has over three hundred peer reviewed papers on his curriculum vitae. After receiving a master's degree in biostatistics and a grant from the National Institute of Health in 2005, he traded the operating room for full-time outcomes research. He became interested in the health problems created by our passive, chair-centric lifestyle, and has spent the last few years studying “sitting disease” and ways to combat it.

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