

# The Care and Feeding of the Leader's Fitness





# Fit Top Dog, ~~Fat~~ Cat



“Life is motion,” said Aristotle. “To restore life to your life, to defeat aging, to regain the youth you still possess, get your body in motion.”

~Dr. Sheehan

## Exercise, Leadership and Exercise Habits of Executives

Data that we have collected from CCL’s Leadership at the Peak program (aimed at C-suite executives) has shown that regular physical activity is associated with higher ratings of leadership effectiveness. When we compared how executives were rated on 360 assessments of leadership, those who exercised on a regular basis received consistently higher ratings by their peers, bosses and direct reports.<sup>6</sup>

Yet, only 42% and 48% of the female and male executives, respectively, (n=3500) reported being in the maintenance stage of exercise behavior (defined as doing some exercise for six months or longer). On average, this group exercised 4-4.3 hours per week. Compared to the non- or sporadic exercisers, they were leaner, had better lipid profiles and lower glucose levels.

For those who didn’t exercise, or only exercised sporadically the biggest challenges were: a) finding time b) work conflicts, and c) making it a priority.

The intent of this paper is to a) make a case for why regular physical activity is so important for leaders, b) provide guidelines on how to make it a regular and consistent habit, given limited time, c) provide an understanding of the “physiology” of exercise, what it means to be fit and the value of different types of fitness modalities and d) dietary factors that can help with exercise performance.

My changes have been at a very holistic level - combining increased scrutiny of diet with a rigorous exercise program... this has made a huge difference... better composure, better clarity and thought”

- a senior executive and LAP alumni

## Exercise Delivers Enormous Health and Mood Benefits

Exercising to get and stay fit comes with enormous health benefits. As discussed in my other papers it helps reduce risk of heart attack, improves endothelial and brain function and can even boost immune function. There is also irrefutable evidence that it can protect against diabetes, hypertension, osteoporosis, depression, premature aging and death and certain types of cancer.<sup>1</sup>

Exercise has also been shown to regulate emotions. In one recent study, researchers played a tearjerker of a movie (it was the final scene of the 1979 movie *The Champ*). Before watching the clip, they had half the group jog for 30 minutes and the other half did some stretching. They then showed both groups the clip and assessed how bummed out they felt. What they found was that those who ran were less negatively affected and were better able to recover from the emotional gut-punch than those who had stretched. And, those who initially felt worse seemed to benefit even more from the run.<sup>2</sup>

But I don't think we need to make a case for why exercise is helpful and good for you. If you've been around more than half a century, you already know that it is (although few people realize the full extent of just how enormously beneficial it is). Combine regular exercise with a good diet and a good night's sleep, you might live forever. OK, maybe not forever, but this powerful combination will add years to your life and life to your years.

The diet and exercise combo has been shown to have a synergistic effect, i.e. the two together are greater than the sum of their parts.<sup>4</sup> For example, people who exercise are better able to absorb antioxidants.<sup>5</sup> How cool is that? The same holds true for sleep and exercise. Exercise helps with better sleep and sleep enables us to exercise better.



## Some Important Questions

But before we get too far, here are some questions to reflect on related to your exercise experience.

1. Is exercise a “should” or a “want to”?
2. Does it feel like another chore that you need to accomplish, or do you see it as gift to yourself?
3. Do you approach it with dread or anticipation (or neither)?
4. What have you done in the past that felt good to you (and worked for you)?
5. If you don't currently exercise, is it because you feel like you really and truly have no time to exercise? Is it a time problem or a priority problem (or both)?
6. How do you feel after you exercise?
7. What is your why? If you don't exercise, why do you think you should? If you do exercise, why do you?

If you feel like exercise is more of a chore, a “should do” or is something you dread, then you might want to reconsider your definition of exercise. Most people think of exercise as “doing a workout”, e.g. going for a run or walk, going to a gym and using stationary equipment, or joining an exercise class. These options are great for many people (myself included), but not for everybody. If the idea of doing “a workout” leaves you cold, then you might want to find another, more creative way to incorporate “exercise” or, to put it differently, regular physical activity into your daily life. There are activities you can engage in that you might not have thought to count as exercise. If it involves moving and not sitting, then it counts.

For more on this I would recommend you read the book “No Sweat” by Michelle Segar. She does a wonderful job of helping those who have never had a good relationship with exercise to get moving in non-traditional ways that are enjoyable and motivating.

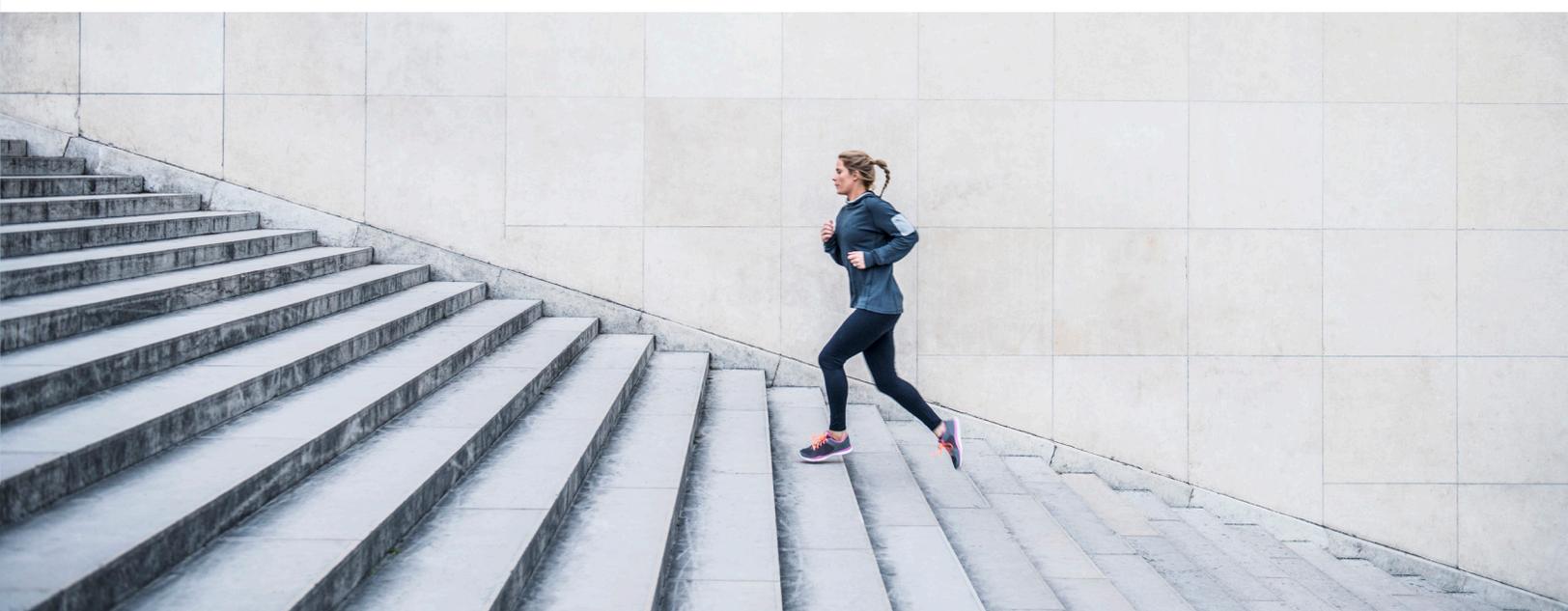
## If You Don't Have Time - Do Multiple, Short, Intense Bits

For those that don't have a lot of time to devote to exercise, remember exercise can be done in small bits of time over the course of a day, even in 2-5 minute increments. Take 5 flights of stairs, 5 times a day; that counts as exercise. Walking around while talking on the phone, doing walking or standing meetings, getting out of your seat for 3-5 minutes every hour to stand, move, stretch or walk, counts. There is even data to suggest that moving consistently throughout the day brings similar reductions in risk as doing a 30-minute brisk walk in the morning and then sitting the rest of the day. (People who do this are called “active couch potatoes”, although the worst thing you can be is an inactive couch potato).<sup>7</sup>

One recent study had sedentary women do vigorous stair climbing (3x20 seconds all out followed by 2 minutes of recovery) 3x per week for six weeks. After the six weeks, they found that they had significantly improved their cardiorespiratory fitness.<sup>8</sup>

This study was based on results of other studies which compare sprint interval training (SIT) or high intensity interval training (HIIT), where the total volume of the training is quite low but the intensity is high, to longer periods of exercise at lower intensities.<sup>9</sup>

Consistently it has been shown that one can achieve substantial health (like increased insulin sensitivity) and fitness benefits (increased aerobic capacity) from less time spent exercising, if the activity is quite intense. One study showed that 12 weeks of HIIT improved fitness and insulin sensitivity to the same extent as moderate exercise that took 5x more time.<sup>10</sup>



As it turns out, doing some high intensity exercise becomes also important as we age. A 2017 study published in Cell Metabolism compared genetic changes in a group of younger (under 30 years of age) to older exercisers (>64 years of age) using different types of exercise routines; an HIIT routine (4 min at >90% repeated 4 times) and moderate exercise for 30 minutes a few times a week combined with some resistance training. The HIIT training resulted in beneficial changes in 274 genes in the younger group and almost 400 genes in the older group. Thus, the decline in the cellular health of muscles associated with aging was “corrected” in the more intense exercise and responded more robustly in the cells of the older group than the younger group.”

You can download a 12 week HIIT training plan that takes 15 min, 3x per week from my website: [www.sharonlarsen.org](http://www.sharonlarsen.org). There is also a 30 minute HITT training plan if you have more time.

Now, will moving more, sitting less and taking stairs, etc. help with significant weight loss or get you in shape to run a marathon? Most likely not. (If you read the Weight paper, you already know that diet has a bigger impact on weight loss.) Remember the goal is to experience the numerous health and performance benefits that come with being physically active. Mental cognition, energy levels, and sleep will all benefit. What might surprise you is that the threshold level of activity needed to achieve benefits is not that high. What it does require, however, is consistency over time.

Movement needs to be a daily practice.



# Ideal vs. Recommended Levels of Physical Activities



“Devote 1 to 2 hours per day to physical activity as exercise for one’s health should not be sacrificed at the expense of business or learning pursuits.”

~Thomas Jefferson

In a 2008 report by the US Department of Health and Human Services the recommendation was made to get at least 150 minutes of moderate exercise (like walking or gardening) per week. This averages out to around 21 minutes per day. The Surgeon General and the American College of Sports Medicine recommend about 30 minutes per day of moderate exercise. I think most of us have heard these recommendations. However, are these recommendations ideal?

While it is true that 150 minutes per week will reduce overall mortality by around 7% compared to those who are sedentary, it turns out that 300 minutes per week (or about 42 minutes a day) will double the reduction in risk to 14%. What about 60 minutes a day? Well, that reduces risk even more, 24%. Thus, there is a dose response in terms of benefit. Increase the intensity, however, the benefits really start to accrue with less time spent exercising.

Yes 60 minutes a day sounds like a lot, but I do think this a worthy goal. I do think 60 minutes of moderate exercise can easily be achieved by doing 20-30 minutes of more intentional exercise (like going for a walk) combined with getting up and moving/walking more throughout the day. (This can be where using a device that measures daily movement and offers reminders to get moving after a period of sitting can be helpful). Throw in a couple days of more intense exercise like running or intervals and you are well on your way to optimizing the benefits.

These guidelines are for moderate levels of exercise; so doing 20-30 minutes of more intense exercise 2 to 3 days a week is more achievable and comes with different benefits than 60 minutes of moderate exercise.

But remember, something is always better than nothing. Don’t fall into the trap of thinking, “If I don’t have an hour a day, then I can’t exercise.”

# For Those Who Struggle to Stay Motivated and Consistent



“Exercise is so difficult when you have to and so easy when you want to.”

~Falicity Luckey

“Physical fitness can neither be achieved by wishful thinking nor outright purchase.”

~Joseph Pilates

## The Motivational Triad

When I ask executives why they exercise, I almost always hear things like, “it makes me feel better”, “it helps me sleep”, “it gives me energy”, “it helps me deal with stress”. I almost never hear someone say they exercise because they are afraid of getting a heart attack or cancer. Invariably they engage in exercise because it provides an immediate and tangible benefit.

Why is this? Enter the motivational triad.<sup>12</sup>

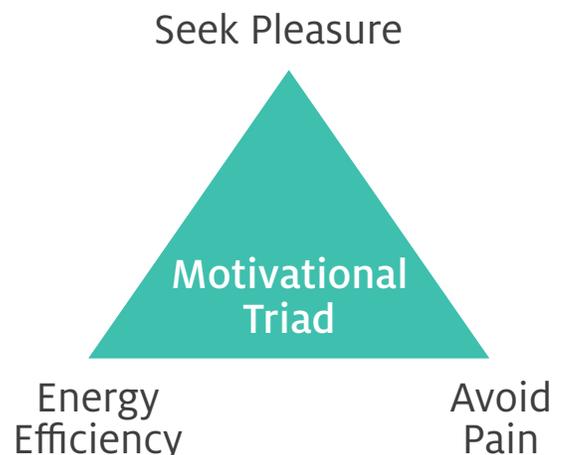
On a very basic level, the motivational triad helps to explain what drives some of our behaviors. It is also what has allowed us to survive as a species.

### The motivational triad is this:

- 1) We seek **pleasure/enjoyment** and are more likely to repeat activities that bring pleasure and enjoyment;
- 2) We are **pain avoidant** and thus don't tend to repeat activities that are painful (with some exceptions);
- 3) We are **energy efficient**, i.e. we tend to take the path of least resistance, or the one that expends the fewest calories (think elevators instead of stairs) to get the job done.

Historically, we can quickly see how this has helped us survive as a species. **Pleasure:** Two pleasurable activities food and sex, both important for survival, result in the secretion of dopamine, the pleasure hormone. **Pain:** We don't put our hand in the fire twice. **Energy efficiency:** There was a survival advantage in expending fewer calories to meet one's needs, especially when calories are in short supply.

In today's world, however, we can see how this can work against us.



Here are some examples of how these primal drivers of behavior can work against us:



**Pleasure:** We have created very calorie-dense, hyper-palatable foods by processing food and removing its fiber, water and nutrients. We are in a very real sense “addicted” to these foods. The more calorie dense foods are, the more dopamine is released, and the higher the pleasure response. This is why foods like ice cream and chips are so hard to resist. In a very real sense we sacrifice long-term health for short-term pleasure. Drugs, smoking and alcohol work much the same way. This is what Drs. Lisle and Goldhammer call the “Pleasure Trap”, and is nicely laid out in a book by the same name.<sup>12</sup>



**Pain:** Hunger is painful. Hence the need to have food readily available all the time. Given that we now live in a food abundant environment, we have food available 24/7. Exercise can also be painful. It can be boring, make our muscles burn, make us short of breath and result in sore muscles. So right there, for some people, is motivation to not exercise.



**Energy efficiency:** Given the side-by-side choice of taking stairs vs an escalator, most people will take the escalator. This explains why we take elevators, use the moving sidewalks in airports, and go for the closest parking spot. We do this almost without conscious thought. Indeed, this drive for efficiency is what drives industry. Much of our innovation has been to find ways for machines to do more work and for us to do less, expending fewer calories in the process.

There are obvious and wonderful benefits to the mechanization of our environment. An unintended consequence though is that we don’t expend very many calories during the course of a day. It is also why, if we want to get fit, we now need to carve out extra time in the day to “do a workout”. It can be hard to justify this time, because walking on a treadmill or lifting weights feels unproductive.

So, what can we do to offset these powerful drivers when it comes to increasing our daily levels of physical activity?

1

**Find ways to intentionally be less energy efficient.**

Park further away, take the stairs, sit less, stand and walk more. Being aware of this can help us fight this drive.

But, for most executives, doing this likely won’t be sufficient to achieve ideal levels of physical activity. Intentional forms of exercise should also be included.

2

**For exercise to be regular and consistent, it must bring a certain level of enjoyment and pleasure.**

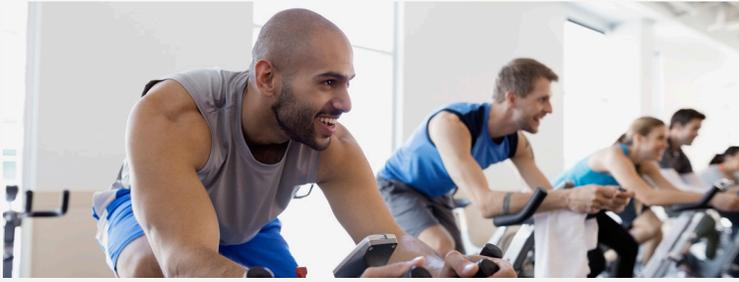
The pros must outweigh the cons. This doesn’t mean that every time we exercise it is an over the moon, runners-high type of experience. But rather, it is something that is enjoyable and makes us feel better (at least after we are done, if not during as well).

3

**The benefits must outweigh the pain and time input.**

Getting into shape can sometimes be painful; yet, as we start to experience the benefits of being in better shape, it gets less painful, more enjoyable.

# Using Pleasure Seeking to Exercise More



“You are only one workout away from a good mood.”

The motivational triad says that we tend to repeat behaviors that provide pleasure and enjoyment. If you are continually trying to engage in exercise that is dull and unenjoyable, it won't last. Willpower is a wonderful thing, but it can only take us so far. **Remember, willpower depletes with use, so use it sparingly.**



1. Find activities to do that are enjoyable or even just somewhat enjoyable. Don't try to make yourself do activities that are onerous to you (at least not all the time). There are some situations where you might hate it until you love it (starting to run comes to mind).

Think about activities you enjoy doing. Dancing, gardening, woodworking, hiking, walking, running, biking, playing a sport? Make a list. How do these activities make you feel? Energized? High? Satisfied? Are they absorbing? Find a way to incorporate more of these activities into your life, even if it is once a week or once a month. The rest of the time, you can endure less absorbing or less enjoyable exercise to get and stay fit for those more enjoyable activities.



2. Find a group/friend, social support system.

Studies show that when you exercise with other people, it enhances the dopamine release, i.e. it is more pleasurable. For example, one study found that rowing with a team heightened the endorphin response (and pain threshold) compared to the same rowing workout performed alone.<sup>13</sup>

Yet we know from the data we have collected over the years that executives who exercise consistently, for the most part, do it alone; it is just more practical and time efficient. Even so, if you can find groups/partners to exercise with at least 1x per week that can be helpful, motivating and create accountability.

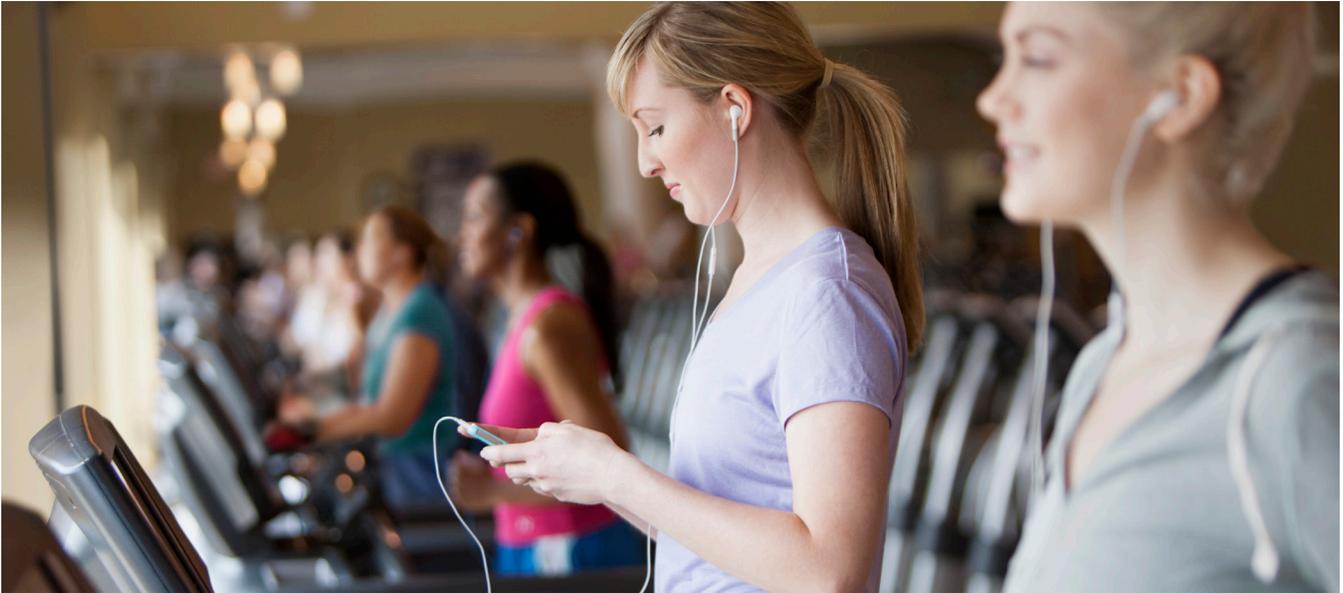


3. Get outside.

Walk, run, bike outside as much is possible. Even if it is cold and dark and snowy, it still beats the indoor machine. There is something about conquering the elements that is quite satisfying. Figuring out how to dress and getting

the right equipment is something that needs to be learned. Using a reflective vest and headlamp for when it is dark and micro-spikes on your shoes for when it is icy are examples that come to mind.

If you do need to use indoor equipment, figure out ways to make it more enjoyable.



I take our vacation photographs and put them to my favorite music. I then play that while riding the indoor bike or running on the treadmill. This has the triple benefit of good music, seeing photos that bring back good memories and looking at beautiful, nature filled photos (not quite as good as actually being outside, but the next best thing). My husband, on the other hand, plays football on the X-box. Don't ask me how, but that works for him. He has run 20 miles on the treadmill doing that. Quite frankly, that just leaves me cold.

For others, it can be a time to catch up on the news or review problems at work or plan for your day. A colleague of mine uses his exercise time to catch up on important podcasts. Others I know listen to books on tape. It can also be "alone" time or thinking time, just you and your thoughts. As one executive put it, "I do my best thinking when I exercise."

Exercising in a natural environment can also help to improve the enjoyment factor, but it can improve **brain function**. One study found that brain performance was enhanced by walking in a natural environment compared to a more urban, busy environment<sup>14</sup>. Save the indoor workouts for when it is just too miserable or unsafe to be outside. The indoor machines should be the plan B, not plan A. However, the pros of using an indoor machine are that it can be less hassle and more time efficient, so there is a balance.

Doing intervals can also help the time go by, which brings me to point #4.



#### 4. Occasionally do some intervals or high intensity intermittent exercise.

Studies show that you get an endorphin high more quickly and easily with intense exercise than with less intense exercise, i.e. you can get high in 20 minutes versus an hour.<sup>16</sup> (In Colorado we have choices on how to get high; I happen to choose intense exercise and altitude). Yes, intense exercise can be painful, but sometimes the pleasure response can be worth it. It can also help the time go by.



#### 5. Exercise for a cause.

A few years ago, I listened to an interview with Fauja Singh. Fauja is a long-distance runner who holds numerous age group records, specifically in the 100+ plus age group. Yes, you read that correctly, he holds the record for being the oldest human to finish a marathon (I believe he was 101 at the time.) During the interview, they asked him what motivates him to do marathons at his age (he is out there about twice the time that most people are). I thought he would say something like “I do it to inspire older adults to get out and exercise”. Instead he said he does it for charity. During the long hours he is out there, he thinks about the people that he is raising money for. To date he has raised over 120,000 pounds for various charities.<sup>17</sup>

There are lots of charity events out there. Whether it is one that you raise money for or just help by paying an entry fee, you can feel good about participating. Which leads me to point #6.



#### 6. Exercise to prepare for an event (especially an audacious event).

A few years ago, the wife of a mountain biker I was coaching came to me and asked me to coach her. At the time, she was not used to doing anything physical and had no athletic history. Basically, she just wanted to lose some weight, feel better and get in shape. As I was used to working with athletes, I wasn't keen to help a non-athlete. But she persisted in her request. Finally I agreed, but on two conditions: The first was that she “train” for an event; the second was that she had to do everything I prescribed. She readily agreed. The event I suggested she train for was the Pikes Peak Ascent, a 13-mile foot race starting at 7,000 feet in Manitou Springs and ending at over 14,000 feet at the summit of Pikes Peak. At that point, she looked at me like I had two heads and said, “There is no way I can do that”. I told her, “if you do what I say, I can get you to the top of that mountain.”

She started training by walking a few blocks; then it progressed to running a few blocks. Eventually she ran a mile, then more miles, then a 10km. She started doing trail runs. Then longer, 3-to 4-hour trail runs. She followed the training plan to a T. To make a long story short, about a year after she started training she ran the Pikes Peak

Ascent (and made it look easy). Afterwards, she was on such a high. What an accomplishment for someone who had never been a runner or done anything athletic. She confided to me that now she felt like she could take on anything. This was from a woman who was too self-conscious to even join a gym. She went on to run the race a few more times as well as participate in other athletic endeavors.

Is there an event or a challenge that you would love to take on? Bike 100 miles, run or walk a marathon, climb a mountain, do a bicycle touring trip? Is there a sport you've always wanted to learn how to do? Or maybe you've always dreamed of being able to dance the tango? Signing up for an event or taking lessons to learn something new can be very motivating (not to mention it is good for the brain). It will get you out the door when it is cold and dark and you are tired. This brings me to the final point.



## 7. Hire a coach, trainer or instructor.

It's been said, "Treasure your health; if it is good, preserve it; if it not good, improve it; if it is beyond what you can do to improve, get help". Hiring a coach, instructor or a trainer can be energy and time efficient and create accountability. (Note: A coach can be a long-distance relationship; they provide you with workouts, you report back what you did. A trainer is more hands-on, i.e. they come to your house or meet you at the gym.) It is energy efficient in that you don't have to think about what to do. Also, having that appointment, and the fact you are paying for it, makes you less likely to miss it. This option doesn't work for everyone, however.

## Best Time of Day to Exercise? Win the Morning, Win the Day

I often get asked if there is a better time to exercise during the day. The answer, of course, is whatever time works best for you and whatever time allows you to be the most consistent. But, for the most part, those who exercise first thing in the morning are more likely to stick with it and be consistent. There are likely reasons why this is the case. Put it off for later in the day and the chances of other things coming up to take over that time are strong.

**Our data on senior executives shows that the consistent exercisers tend to exercise in the morning.** What is interesting, however, is that when we compared extraverts to introverts we found that most introverts exercised in the morning while slightly more extraverts exercised in the evening. As to the significance of these data, I am not sure, but it could be that after extroverting all day, introverts are so drained of energy that at the end of the day, they have nothing left to give for exercise. Extraverts on the other hand, might be feeling somewhat more energized and can then use the time to review and think over the day and wind down (for extraverts, this could be a helpful thing, trust me.)





## 8. Win the Morning

Start the day right by getting some exercise and eating a healthy, nutrient-packed breakfast. When done first thing in the morning, it lends an importance and a priority to that exercise time. It can also energize and can set the tone for the day. Given the mood-elevating benefits of exercise, your colleagues and direct reports might also appreciate it.

For those whose work day starts early, trying to fit in time for exercise would encroach on getting a good night's sleep; so doing something in the middle of the day (or during the day) can be a good choice. It can certainly help to provide a welcome break during busy and intense days. You might want to schedule time on your calendar to create space for this to happen.

I once had a 4-Star Admiral in my program who told me how he made it a point to exercise during the day. He would intentionally and visibly head to the gym with his gym bag (he worked at the Pentagon) during the day. Not only did this help him through grueling days, but he also wanted to set a good example and make the point that no matter your status or level of busyness, making time to exercise daily is important.

The important thing is to plan, make it a priority and schedule the time, for when it works best for you, be it morning, noon or evening.

### In Summary

To summarize, here are ideas on how to create conditions for exercise success:

1. The exercise (or activity) should be somewhat enjoyable/pleasurable. Finding a partner, getting outside, engaging in an absorbing activity are good ways to do this.
2. It must be repeatable and consistent.
3. It helps if it is cross-functional (i.e. serve multiple purposes, meet multiple needs).
4. Something is always better than nothing. Even short efforts can bring benefit. Don't get stuck into thinking that if you don't have an hour to exercise it is not worth doing. But if you have an hour, then that is even better.
5. If you don't have an hour, aim for 20-30 minutes of intentional, uninterrupted physical activity and combine that with more walking throughout the day.
6. If you have less time, crank up the intensity, i.e. do HIIT.
7. If need be, hire a coach or trainer.
8. Win the morning.

# For Those Who Want to Cover All the Bases



“Loss of flexibility says we are old even when we feel young inside. That’s why yoga and range-of-motion exercises should become our best friends.”

~Dr. Sheehan

## Understanding Exercise: Fitness Defined

There are different components of physical fitness. Each of these influences some aspect of health.<sup>18</sup>

1



**Cardiorespiratory fitness (CRF).** This is what is often referred to as “cardio” exercise. It involves the repeated use of large muscle groups (and preferably the same muscle groups). This type of fitness has been the most intensely studied regarding its health benefits. There are two types of CRF: aerobic endurance, the ability to go long; and aerobic capacity, the ability to go at a higher intensity. Both are important.

2



**Muscular fitness.** This also has two components: muscular strength or the ability to lift more weight; and muscular endurance, the ability to lift a certain amount of weight repeatedly. There are numerous health benefits associated with enhancing muscular fitness. These include improvements in body composition, increased insulin sensitivity, improvements in blood pressure, and helping to prevent metabolic syndrome. Most importantly, however, it can increase bone mass and decrease the risk of functional limitations. It can also reduce the pain and disability associated with osteoarthritis and general aging.

3



**Flexibility (or range of motion – ROM).** ROM tends to decrease with age but can be improved with regular stretching. ROM exercise may enhance postural stability and balance, particularly when combined with strength training. However, contrary to popular belief, no consistent link has been shown between flexibility and a reduction of musculotendinous injuries, the prevention of lower back pain or delayed onset muscle soreness (DOMS). Nevertheless, as Dr. Sheehan says, “Loss of flexibility says we are old even when we feel young inside.” This is more about doing some stretching and less about getting flexible.

4



**Neuromotor fitness (NMF).** This is sometimes called functional fitness training and incorporates motor skills such as balance, coordination, gait, agility and proprioceptive training. Activities such as tai chi, qigong, and yoga involve varying combinations of neuromotor exercise, strength and flexibility exercise. This type of training is particularly helpful for older persons, as it improves balance, agility, and can reduce the risk of falls. Few studies, however, have looked at the benefits of NMF training in younger adults. Some data suggests that NMF exercise can reduce the risk of certain injuries.

# Helpful Stuff to Understand About Exercise and Training



“Fitness is like marriage, you can’t cheat on it and expect it to work”

~Bonnie Pfister

## Understanding Exercise: Principles of Exercise Training

### Principles of Training

Below are some basic principles of exercise, which may seem obvious on the surface, but are worth reviewing.

1. Specificity
2. Progressive Overload
3. Individuality
4. Reversibility
5. Variation
6. Long-term Training
7. Recovery



**Specificity:** What you stress is what adapts. If you want to be a better runner, then running is what you need to do. But how you stress something is also important. Running slow or fast will stress different systems and result in different adaptations. If you go to the gym and lift weights very slowly, you will see strength gains at slow speeds of lifting but you won’t see much improvement at lifting weights at higher speeds. It is quite amazing how the body works.

**Progressive Overload:** To improve (i.e. get stronger and/or fitter) you need to continue to apply both a variety of stressors and to increase the load over time. The degree of improvement and overload required is going to depend on your starting point. If you are a 2:20 marathoner, it will take an enormous amount of time spent training to become a 2:15 marathoner. If you have just rolled off the coach, any exercise you do will result in rapid improvements.

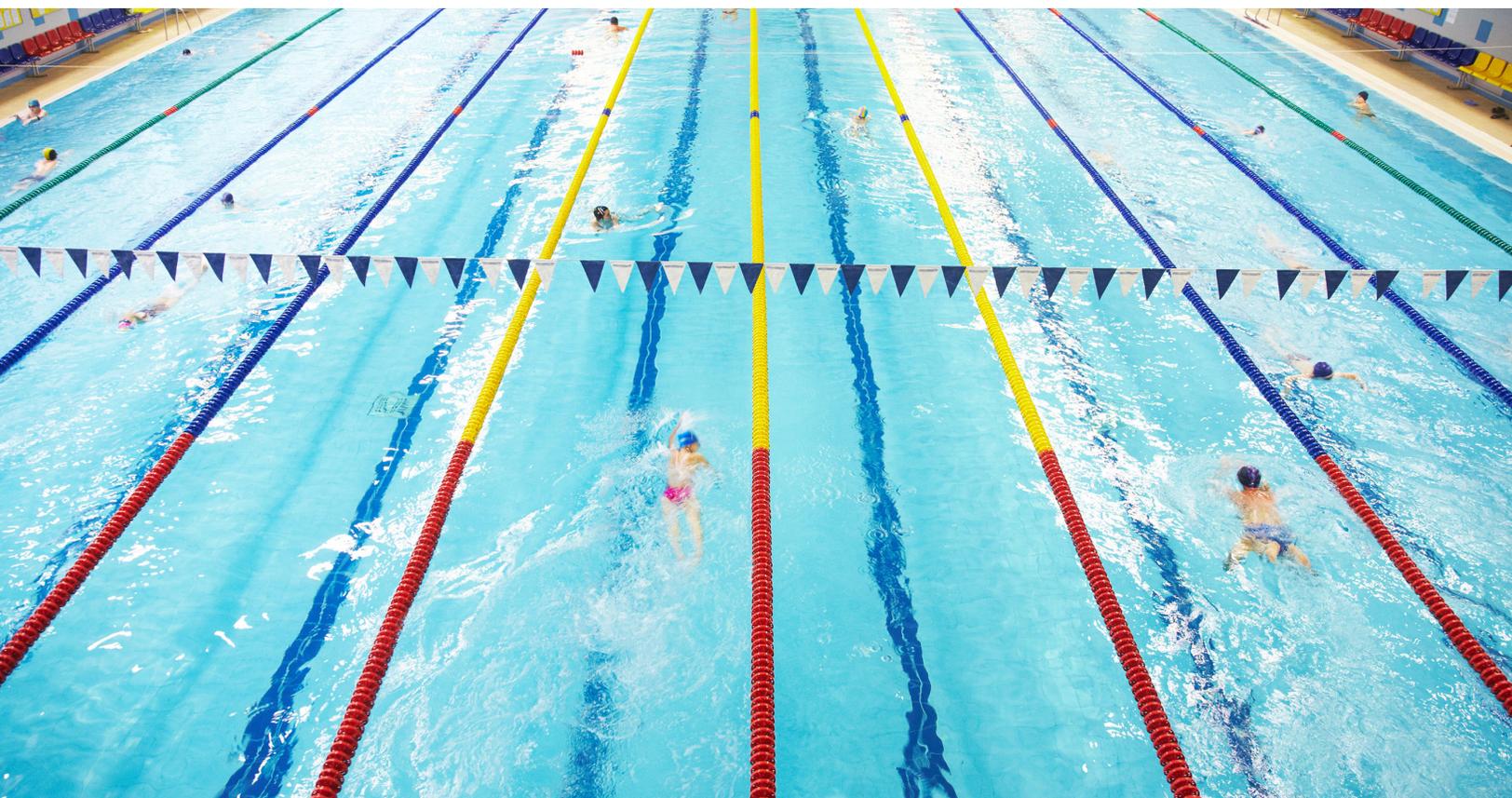
**Individuality:** People have different starting points, but they also have different rates of adaptations to exercise. Studies where different people are put on the exact same training program show that improvement in aerobic capacity (one measure of fitness) can range from 0-43%. That is quite a wide range of responses. This is what keeps coaches scratching their heads sometimes when they coach a wide variety of people.

**Reversibility** is something we have all experienced. If you don't use it, you lose it. The rates of loss will depend on a) how inactive you are (i.e. bedridden vs. still doing something vs. being active but not exercising), b) how fit you were before you stopped, and c) how old you are. Your rates of loss will be slower the fitter you are, i.e. you will hang onto stuff a bit longer. The less fit you are, well you can easily lose any gains you have made within a few weeks of stopping exercise. For example, one of the benefits of exercise is increased production of brain-derived neurotrophic-factor or BDNF, a factor that is incredibly important for cognitive function. Exercise for two weeks and levels of BDNF go up. Stop exercising for one week and it drops back down to pre-exercise levels<sup>19</sup>. Having a consistent mindset is so important; because if you do miss a week or two due to an illness, a heavier workload or injury, you won't lose as much if you have been doing something consistently prior to taking the week off.

**Variation** is important physiologically and psychologically. If you went to work each day and did the same thing every single day, you would a) never get better, b) probably die of boredom and c) you wouldn't last very long. The same is true for exercise. Additionally, having the option to exercise in a variety of places and environments, like outdoors, on stationary equipment and with different people, can also help.

**Long-term principle:** The greatest benefits of exercise occur when it is done consistently. This is a lifelong endeavor. Who doesn't want to be fit and healthy for life? For those aspiring athletes, out there, it takes about 8-10 years of focused training to fully achieve your peak. For the rest, consistent exercise over time is what you want to strive for. Yes, exercise is something you need to engage in for the rest of your life (or least until close to the end of your life).

**Recovery:** We don't get fitter during the exercise bout (in fact we are tearing things down). The adaptations occur during the recovery period. Therefore, doing easier days or a different mode on a different day (like doing yoga one day and running the next) is not only helpful, but also a good idea. Not to mention it will help prevent injury and burnout. Again, variety is key. The amount of recovery needed, however, will depend on how intensely you exercise. If your routine involves walking at a moderate pace, then that is likely something you can do most, if not every day. If you are doing more intense workouts, then those need to be interjected with easier days. This is one reason why it is recommended that at least 48 hours should separate hard resistance training sessions.



# For the Science Geeks

If you are not interested in the physiological side of exercise, skip this section. Knowing this stuff won't necessarily help you exercise better, but it will provide some of the underlying rationale for why variety in exercise intensities can be important.

## Understanding Exercise: Energy Systems and Pathways

### *How we get and use energy for muscular work*

#### ATP - The Energy Currency

The energy currency of the body is a molecule called ATP or adenosine triphosphate. Regardless of whether we use fat or sugar as substrates (these are the primary substrates used, protein is a last-ditch effort when it comes to providing energy), the end game is ATP production. ATP is required for all our energy needs; without it no work can be done and many chemical reactions would not occur. Indeed, it is essential for life itself.

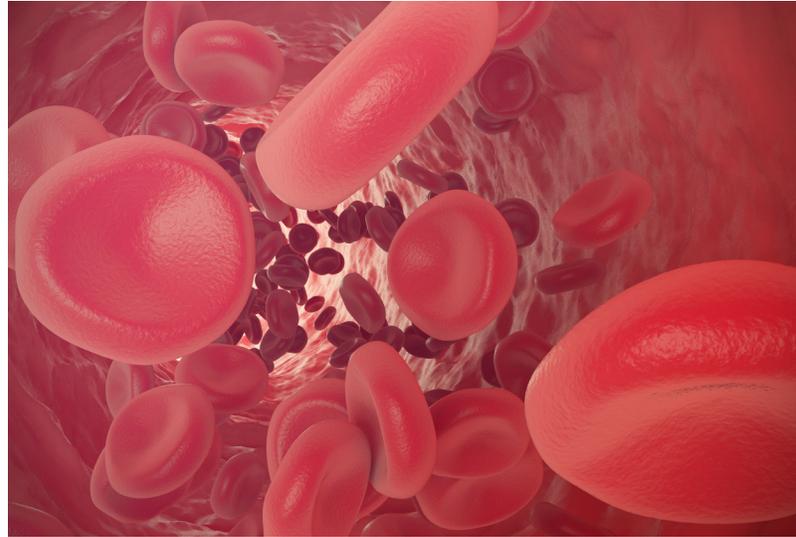
There are four primary pathways by which we generate energy for exercise. During exercise the demand for energy increases considerably and these energy-producing pathways (or systems) are called upon to meet the increased demand. The predominant pathway that is used will depend on a combination of both the intensity (**rate of demand**) and the duration (**total demand**) of the activity. Thus, during exercise, any variation in the intensity and/or duration of exercise can be met via different relative contributions of these energy pathways or systems.

Training or stressing a system will result in improvements in that system to create energy, either via increased **rate** of energy delivery and/or via enhanced **capacity**.

Buried within every cell are tiny structures known as mitochondria. These are the “aerobic energy factories” as it were, and are the final destination for the oxygen that has been transported from the lungs by the red blood cells to the muscle cells. Contained within the mitochondria are specialized proteins, or enzymes, which, like workers on an assembly line, process fat and glucose molecules. It is here, in the final events, that oxygen makes its appearance. Approximately 90% of all ATP are formed by aerobic means; the other 10% are formed outside of the mitochondria and are generated without oxygen (otherwise known as anaerobic).

#### 1. Energy from Fat (Beta-oxidation)

In humans, fat has the potential to provide an abundance of energy. Theoretically it can provide an almost endless supply. A 75-kilogram male with 5% of his weight as fat translates to 3.75 kilograms of fat. This contains about 29,000 calories worth of energy. Most of the fat we burn during exercise, however, comes from fat stored in the muscles and only a small proportion comes from subcutaneous fat. Even so, the total capacity of energy from



fat is quite high. The downside of using fat as fuel is that it is slow and its rate of energy production is low, i.e. it is rate limiting. Thus, it is too slow (5-10 kcal/min) to be of much help during very intense exercise. It is the preferred substrate during exercise performed at lower intensities and for longer durations (>45 min). This limitation is one reason why we can't run marathons at the same pace as running a flat-out mile.

The good news is that, up to a point, we can train this system to increase its rate of energy delivery. Doing longer duration workouts at relatively lower intensities will stress this system and cause it to adapt (especially if you limit your glucose intake during the workout).

#### A Fat-Burning Zone?

Unfortunately, an incomplete understanding of this system has led to the idea that to burn fat and, by extension, lose weight, we must exercise in the "fat burning" zone, which is a low intensity effort. This is only half true. Yes, it is true that at lower intensities a higher percentage of the energy will come from fat (if you go long enough). But, if you read the weight paper, exercise, while an important part of the weight loss equation, is not the most important part. Changing one's diet is. If we want exercise to assist in the weight loss process, it is more about optimizing caloric expenditure. This means sustaining a high heart rate for an extended period, i.e. it is more about time under intensity.

At higher intensities, the relative contribution of fat will be lower but the absolute contribution could be higher (in addition to the fact that the total energy expended will be higher as well). This is especially important to understand if exercise time is limited. If all you have is 30 minutes, then crank up the intensity. Going at a very low intensity for 30 minutes won't help you burn that many calories. Second, the amount of fat used during exercise is also dependent on the duration. It takes time to crank up and stoke the fat burning system. If you are exercising for >1 hour, this is where it starts to kick in, and needs to kick in, to sustain the energy output. So, go at a lower intensity if you have more time (i.e. > 1 hour).



## How to Train:

Workout examples: Increasing weekend runs/hikes/walks/ bike rides/swims to an hour of consistent effort at about 50-70% of your max. Depending on your goals, you can gradually increase the length to two hours and maybe even three (swimming is the exception, however, unless you are training to swim the English Channel). As you get fitter and this system adapts, you can then go a bit harder for that 1-3 hours.



## 2. Energy from Sugars (or glycogen)

Carbohydrates come from plant sources like fruit, starchy vegetables, and grains. Through the process of digestion, these are broken down into their basic elements, simple sugars, and then absorbed into the blood stream. Once in the blood stream, these simple sugars (i.e. glucose) are carried to various cells throughout the body. Our brains, for example, rely almost exclusively on glucose for energy (consuming about 20-25% of our total glucose). Protein can be converted to glucose--via a process called gluconeogenesis-- but this is a rather inefficient process. Fats cannot be converted to glucose, so fats are not a good source of fuel for the brain or more intense exercise.

### Glucose: A Universal Fuel Source

Glucose is in fact a universal energy source. It can be used by all human cells. Some cells, like red blood cells, most parts of the brain and kidney cells, can only use glucose for energy.

Excess glucose is stored in the liver and in the muscle as glycogen. Glycogen is basically strings of glucose molecules with water attached to them. Therefore, severely depleting glycogen stores (achieved by eating a very low carb diet) can result in significant loss of water weight. These glycogen stores are the body's pep pills and provide a high-octane fuel that is readily available for muscular work.

Approximately one-third of our glycogen stores are stored in the liver and the rest is stored in our muscles.<sup>20</sup> Liver stores are used to maintain our blood glucose levels. The liver has enough glycogen to pump out blood glucose for about 12 hours. Muscles tend to be stingier with their glycogen and won't share with the rest of the body, i.e. once in the muscle it is used exclusively to power muscular work.

### Glucose to Fat: De novo lipogenesis

Once the storage capacity for glycogen is reached, any excess can be converted to fat. Converting glucose into fat is known as de novo lipogenesis, or new fat production. This is an expensive process. Twenty-three percent of the ingested energy is expended just to complete the process, only 3 out of 4 carb calories gets converted to and stored as fat (once glycogen stores have been filled). Compare this to dietary fat, which is quickly and efficiently converted to fat stores, i.e. it takes only 3% of our calories to convert dietary fat into stored fat. One study in which women were overfed about 500 calories per day from sugar found that, while de novo lipogenesis did occur, the amount converted to fat was rather small. The women produced less than 4 grams of fat per day from the extra sugars<sup>21</sup>. (For more on this, see the Weight paper.)

Glycogen is important for fat metabolism to occur. Without glycogen, fat cannot be burned via normal processes. It's been said (and is true) that fat burns in the flame of carbohydrate.

When glycogen stores run low, protein is sacrificed (often from muscle) to maintain blood glucose levels. The body is amazingly adaptable. During times of starvation or low carbohydrate intake, a process called gluconeogenesis gets cranked up, i.e. the conversion of protein to glucose starts to kick in.

## Ketogenic diets: Good or bad?

Fat cannot be converted to glucose, so, at very low carbohydrate intakes ketones can also be formed from fat, which provides an alternate source of energy. There are three types of ketone acids--acetacetic acid, B-hydroxybutyric acid and acetone--and they can be used as an emergency fuel. Parts of the brain, but not all, can use this as an emergency fuel source. But again, the preferred fuel of the brain is glucose, not ketones.

Ketosis was never meant to be a long-term proposition. During starvation or long-term illness, the loss of appetite which accompanies ketosis comes in handy as it is nature's kind way of staving off the hunger pains. So, going into ketosis can be an adaptive survival mechanism. Is it normal and natural? Yes, just as periodic fasting and death are normal and natural. Is it ideal and healthy? While occasional fasting can have some health benefits, eating a high-fat or high-protein, very low carbohydrate diet is not ideal, nor is it healthy.

Full-blown ketosis (which is achieved by eating a very low carbohydrate diet or by a sustained period of fasting) is associated with loss of appetite, nausea and fatigue. There is also massive diuresis, or water loss. This can result in rapid initial weight loss. Under normal conditions, being in ketosis for sustained periods of time is not healthy for several reasons (it can be hard on the kidneys and bones, for example). Mineral deficiencies can be created as the body's buffering systems become depleted and the body strives to neutralize this very acidic environment (ketones are very acidic).<sup>22</sup> Other problems that occur following long-term adherence to a ketogenic diet include: hyperlipidemia, constipation, diarrhea, dehydration, suppressed immune function, bone loss, vitamin and mineral deficiencies, and cardiomyopathy, to name a few.<sup>23</sup>

The biochemical name for the breakdown of glycogen or glucose into energy is glycolysis, and whether the reactions ultimately use oxygen or not designates whether the pathway provides energy via aerobic glycolysis or anaerobic glycolysis.

## Aerobic Glycolysis

If you remember your high school biology course, you might remember something called the Krebs cycle. It is via this cycle that most of our ATP from glucose is produced. The primary advantage of using glucose or glycogen for energy is that the rate of energy yield is much higher than it is from the breakdown of fat (10-15 kcal per min compared to 5-10 for fat). It can thus be used to fuel exercise performed at higher intensity. The right training, however, can help to increase this rate of energy delivery. In fact, one of the adaptations to more intensive and extensive endurance training is to increase the size and number of the mitochondria within the muscles being used, which in turn increases the rate of ATP production via this pathway (as well as the rate of fat oxidation).

Unlike fat with its relatively unlimited capacity for energy production, the total available energy from glycogen is only around 900-1500 calories, enough for approximately one to two hours of somewhat intense exercise. Thus, there is more than enough for most bouts of exercise. However, repeated days of intense exercise without adequate replenishment can quickly diminish muscular stores resulting in fatigue. The good news is that training can improve storage capacity (i.e. we can store more glycogen in the muscle) and increase our ability to quickly replenish glycogen stores, or the rate of glycogen replenishment. However, for short, very intense exercise, such as running an all-out 200-400 meters on the track, or sprinting to catch that flight, we need a faster method for generating ATP. Enter anaerobic glycolysis.



## How to Train:

Workouts which help to train aerobic glycolysis involve doing efforts that are "somewhat hard" for 5-15 minutes. For example, you can do 4x6 minutes at this effort with relatively short rest (1-2 minutes). Then as you get fit, you can do 3x8-10 min with 2-5 minutes of easy exercise in between. The secret to doing these is to not start out too hard so that you can maintain the pace throughout the interval and for each subsequent interval. It is a fine balance between going too hard or too easy. In terms of your percent of max, these can be 70-85% of your max heart rate (the fitter you are the higher the percentage; elite runners can sustain up to 90%, for example).

## Anaerobic Glycolysis

Anaerobic glycolysis is a more powerful system as it can generate ATP at a much higher rate than fat or aerobic glycolysis, 15-20 kcal per minute. Its capacity is quite limited, however, because lactic acid is produced as a byproduct. As lactic acid starts to accumulate within the muscles, the environment of the muscle becomes very acidic. This interferes with the ability of the muscle to contract, which causes a decrease in force production and loss of coordination. Lactic acid can also activate pain receptors and a burning sensation can sometimes signal its presence. If the duration of the exercise bout is short (albeit all-out) but less than 20 seconds, the individual does not have to deal with the consequences of high lactate levels. However, once the duration gets much past 20-30 seconds, the consequences of its accumulation will be felt. All-out efforts of 15-40 seconds rely heavily on this system.



### How to Train:

Workouts to train this system: 6-10x15-30 seconds hard with lots of rest or easy exercise in between (3-4 minutes). As you get fit, you can do 30-45 seconds hard with lots of recovery in between each effort.

## ATP-Creatine Phosphate System

The final system is known as the alactic or nonaerobic pathway. This is where we use ATP and creatine phosphate (CP) that is already present in the muscles. This is the most powerful system as the rate of energy yield is very high; 20-25 kcal/min. However, its capacity is very low, i.e. it is only good for very short, 5-10 seconds, of all-out effort. The reason that it is so powerful is that within each muscle lies a ready source of ATP and CP. CP is quickly converted to ATP and thus both can be used at a moment's notice. This system is unaffected by the presence of oxygen. Activities such as lifting weights or running the 100-meter dash rely heavily on this system. Such intense efforts can only be sustained for short periods of time as the muscle is quickly depleted and other slower rates of energy delivery must be called upon once the effort goes beyond 10 seconds. This system is quickly replenished, however, once the effort is stopped. So, you can repeatedly do hard efforts if you allow a short rest interval in between efforts. This system can be trained to increase its capacity, but only up to a point.<sup>24</sup>



### How to Train:

Workouts that stress this system: lifting weights, short all-out sprints 5-10 sec in length with 1-2 minutes of recovery time in between efforts.

It should be noted that any type of exercise relies on multiple energy systems. However, it is easy to see how the duration and intensity of the exercise will determine which is the predominant pathway used. Thus, by varying the duration and intensity of exercise, different pathways will be stressed. Depending on which pathway is stressed will then determine which pathway will adapt.

Ok, so that was a lot of physiology to digest. Now how to put this to practical use.



# Understanding Exercise: Exercise Design and Plans



“No matter how slow you go, you are still lapping everybody on the couch”

## A. Cardiorespiratory Exercise

As mentioned, this type of exercise has been the most intensely studied as to its health benefits. Consistently engaging in this type of exercise is where you will derive the most health and performance benefits. Thus, this should be where the bulk of your exercise time should be spent. If given the choice between working to improve muscular fitness or cardiorespiratory fitness, I would pick cardiorespiratory fitness any day (the exception being if you are much over 55, then muscular fitness takes on greater importance).

Available from my website are two options for some HIIT aerobic workouts: There is a 15 minute series (for those that are really short on time) and a 30 minute series (for those with more time or a good follow up to the 15 minute series). You can apply these workouts to just about any activity that involves the repeated use of large muscle groups, i.e. cycling, running, walking, elliptical, stair stepper, etc. You can adapt them for indoors on stationary machines or outdoors on roads or trails. You don't have to follow these perfectly, and there is some trial and error to figure out the prescribed intensities.

## B. Muscular Fitness (strength training)

I am going to be honest here. Strength or resistance training is not my favorite form of exercise. Some people love it. If that is you, then more power to you. But I don't. Most days I would rather go to the dentist than go to a gym to lift weights. But as an older, slightly built female, I know this is important to do. So, I have tried to figure out ways to make it work for me. This means using a variety of modalities, like using dynabands (in my office), doing bicep curls when I carry in my grocery bags (bet you didn't know that was a thing) or doing air squats while waiting for the copy machine. But at the end of the day, I get the best results when I go to a gym and do a routine that I don't have to put a lot of thought into and that doesn't take a lot of time (15-20 minutes at most). You can get a lot done in 15-20 minutes if you do it right.

The same principles that apply to aerobic training also apply to resistance training: Variety, consistency, overload, and specificity. The good news is that you can get benefits and results from relatively short sessions.

Before we get into specifics, here are some reasons why it is a good idea to include some resistance training in your weekly routine. BTW anything that gets you pulling, pushing or picking up relatively heavy objects counts as resistance training. So, yard work and house maintenance can count, even if you only do it once a week.

## Reasons to Do Resistance Training

If you are a strong, muscular male or female, you can skip the weight training and just focus on your cardio work. But if you are older (sorry, that means anyone above 50), prone to injuries, have poor posture, have trouble opening the pickle jar or lifting your luggage into the overhead compartment then you likely need to do this.

**1. Functionality:** Resistance training is not about getting cut, growing bigger muscles or looking better in your speedo (hopefully you are beyond that). It is about functionality and staying functional as you age. Yes, I want to be able to lift myself up from the toilet seat without help when I am 90.

**2. Strong bones:** Weak muscles are a risk factor for weak bones. The only way to get strong bones is to stress them. The only way to stress a bone is to stress the muscle attached to it. Drinking cow's milk is not going to do it for you (even if you do lift weights). See side bar on bone health and exercise.

**3. Injury prevention:** Consistent resistance training can come in handy when you do something out of the ordinary like throwing your grandson up into the air or shoveling snow during that once-a-year snow storm. There are no guarantees, but it might make the difference between being slightly sore or throwing your back out of whack.

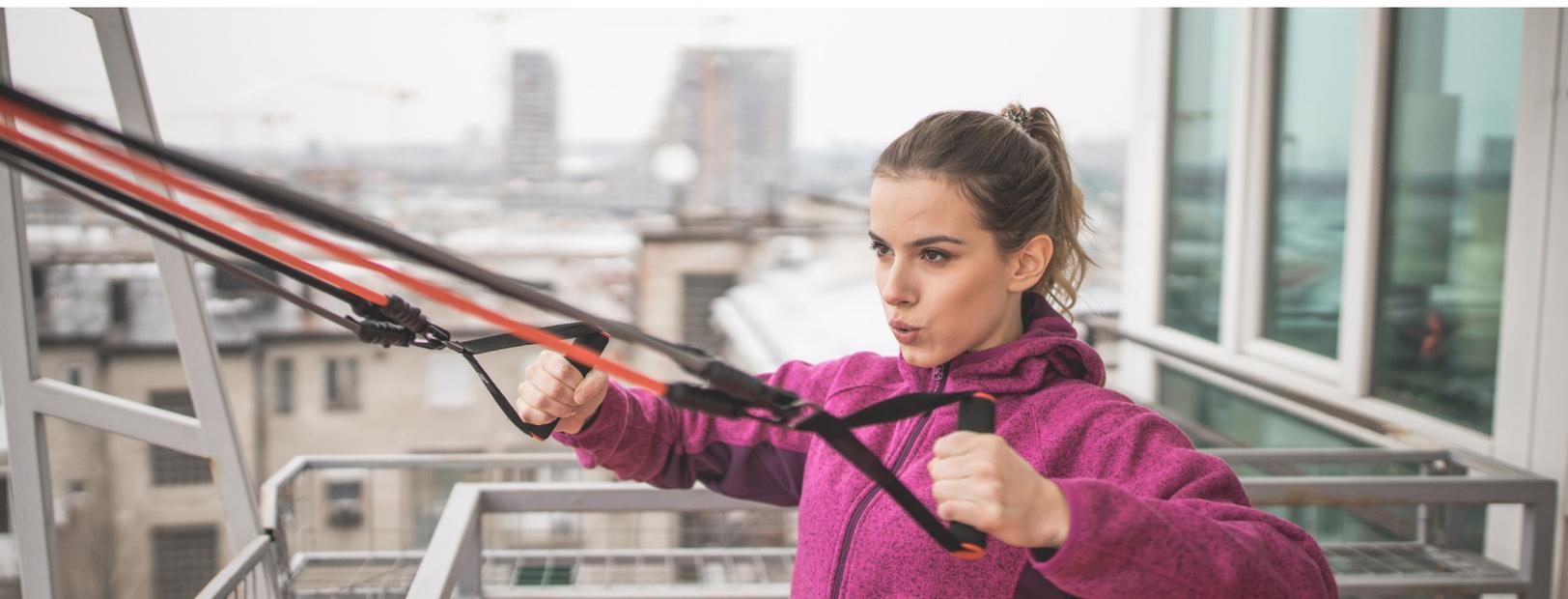
“The effects of resistance training for prevention of weight gain are largely unknown owing to lack of available literature. Resistance training does not seem to be an effective means for weight loss but is associated with numerous other health benefits....”

~ American College of Sports Medicine Position Stand on Physical Activity for Weight Loss and Prevention of Weight Gain<sup>52</sup>.



## Weight training myths:

1. I will get bulky. True, a small percentage of the population easily gains muscle mass when they do weight training. For most people, however, the only way you can build lots of muscle is to quit your job and spend hours in the gym.
2. It will help me lose weight. There are two lines of thought on this; a) Basal Metabolic Rate (BMR) will go up following the workout (more so than following a cardio workout) and b) BMR will go up because of gaining muscle mass. First, the most important reasons for doing resistance training are listed above. Losing weight is not one of them. (Remember changing your diet is the most important thing.) This is not to say it can't help. But I do believe



that the benefits in this regard are overstated. For example, for every 1kg (or 2.2 pounds) of muscle gain (which is about the most that people will likely gain), your BMR will go up by about 25 calories. This is the equivalent of eating 2-3 potato chips a day. Like I said, the benefits are often overstated. As for increasing your BMR post weight training, this has been shown to be truer for men than for women. But here again the total calories burned is relatively small. The best way to increase BMR post workout is to have a high metabolic flux. This means you expend a lot of calories and you eat a lot of calories (i.e. run 20 miles then eat a lot). Unless you are an IRONMAN triathlete, this is probably not going to be you.

Bone mass decreases by about 0.5% per year or more after the age of 40, regardless of sex or ethnicity. The benefits of exercise in older adults may be an attenuation of bone loss rather than an increase in bone mass. Estrogen withdrawal at menopause results in rapid bone loss; however, high levels of physical activity may prevent fractures even if it does not attenuate bone loss. Walking programs of up to a year have yielded only modest effects, if any, on the preservation of bone mass. Higher loading forces such as progressive weight lifting programs, tennis, jogging (at least intermittently during walking), or activities that involve jumping (basketball, volleyball) are recommended for preservation of bone mass. It is recommended that weight-bearing endurance activities be performed 3-5 times per week and resistance exercises 2-3 times per week. ~American College of Sports Medicine Position Stand on Physical Activity and Bone Health.<sup>53</sup>

## Keeping it Simple

There are a lot of different approaches, plans and philosophies around implementing a good resistance training program. Personal trainers can be endlessly creative when it comes to the variety of exercises that can be done. Crossfit and P90X involve doing a lot of super intense exercises in a specific rotation. If that gets you moving and sounds like fun, then I am all for it.

However, at the end of the day, what you do needs to be: A) effective, B) repeatable, and C) time-efficient.

- A. Effective:** For the most part, I think the goal of resistance training is to get stronger in a balanced way. Doing super intense efforts with lots of reps and in a way that gets your heart rate elevated is not the most effective way to get stronger. Not that I have anything against these types of workouts, but it is a bit like doing something of everything and nothing of anything. Yes, you will gain some cardiovascular benefits and you will likely gain some strength. But as discussed above, the best cardiovascular benefits come from repeated use of large muscle groups. Doing some sort of circuit weight training, even if it does get your HR up, just doesn't provide the same cardiorespiratory benefits.
- B. Repeatable:** The best way to stay consistent is to create a routine that you can do anywhere (i.e. at home, hotel gyms or even hotel rooms) and is adaptable. It should also be one that you don't have to think a lot about. When you ask most people who exercise consistently, they will often say, "I just do it"; it is as routine and habitual as brushing their teeth. The same is true for resistance training. Create a routine that focuses on the major muscle groups, doesn't take a lot of time, involves little to no equipment, and is easy to remember.
- C. Time-efficient:** The routine should work within your time constraints. Again, shorter sessions performed consistently will be more beneficial in the long run than doing longer sessions sporadically.

## Foods shown to help alleviate muscle soreness: Cherries and Watermelon

A 2006 study published in the British Journal of Sports Medicine looked at supplementation with tart cherry juice and delayed onset muscle soreness (DOMS), and subsequent ability to produce force. What the researchers did was induce muscle soreness by having subjects repeatedly do eccentric contractions (where you lengthen the muscle but contract it at the same time, similar to what occurs with downhill running). They then measured strength loss, pain perceptions, muscle tenderness and loss of ROM (range of motion). Subjects drank fresh tart cherry juice (a 12 oz. bottle in the morning and evening) or a placebo 4 days prior to and following the pain inducing exercise test. Strength loss while on the placebo was 22% but only 4% on the juice over the subsequent 4 days. Pain values were also significantly less in the cherry group<sup>54</sup>. Numerous antioxidant and anti-inflammatory agents have been identified in tart cherries, which could help explain this. For example, consumption of 45 Bing cherries a day has been shown to reduce circulating levels of inflammatory markers in healthy men and women.<sup>55</sup>

Researchers in Spain had athletes pre-load with watermelon juice (500 ml) prior to a strenuous bout of exercise and compared this to a group of athletes who drank a taste-alike placebo prior to the same bout of exercise. Those drinking the watermelon juice reported having significantly lower levels of delayed onset muscle soreness or DOMS<sup>56</sup>. Why pick watermelon? Watermelon is an excellent source of L-Citrulline. Citrulline is an amino acid that can be metabolized to arginine. Arginine is used in the synthesis of nitric oxide. Nitric oxide plays an essential role in cardiovascular and immune function and is a potent vasodilator. Watermelon consumption has been shown to increase plasma arginine<sup>57</sup>. Pretty cool. Thus, the benefits to athletes might be via increased blood flow to muscles enhancing recovery. Or, it could also be via the antioxidant, anti-inflammatory action of the many phytochemicals found in watermelon (like lycopene). And here I thought watermelon was, well, mostly water.



## Frequency

Most of your strength gains can be achieved by doing resistance training two days a week, especially in untrained individuals. Three days a week is slightly better, especially if you have been strength training for some time. But if all you can do is two days a week and, if two days a week means being more consistent, then shoot for two days. If there are occasional weeks where you can't fit it in, studies show that you can hang onto your gains even with significantly reduced training. For example, when men and women resistance trained for 10 or 18 weeks and then spent an additional 12 weeks either not training or at reduced training, they found that those who stopped training retained 68% of their gains. Those who reduced their training from three days a week to two or even one day a week did not lose any strength at all.<sup>25</sup>

## Pain and Discomfort

If you haven't lifted weights in a while, start conservatively. I would recommend starting with just one set of each lift and not going to exhaustion. For the first few weeks, learn the lifts and apply some resistance, but moderate how hard you work. This will minimize muscle soreness. The other school of thought is to go all out, i.e. get sore, and then it is over and done with. This is fine if you are 20 something, but not so good if you are 50 something. The other factor is that it takes longer for tendons and ligaments to get stronger (these are where muscle attaches to bone and in our joints) than it does for muscles. Strain a tendon or ligament by going too hard too soon and this can set you back a few months. Being a bit sore after the first few workouts is fine and normal. But you don't want to be so sore that it takes you weeks to recover. Know the difference between pain and discomfort.

## Single set versus multiple sets?

In untrained individuals, the data around single-set vs. multiple-set routines are mixed regarding which is most effective at achieving strength. Several studies have reported similar gains between single- and multiple-set programs, whereas others have reported multiple-set programs to be superior.<sup>26</sup> At the end of the day, if all you have time for is one set of each exercise, then do one set. However, if you are already quite strong and have been resistance training for some time, multiple-set programs have been shown to be superior for continued strength gains. Again, if you have time, do two sets; if you don't, then do one.

## Exercise Order

Studies show that multiple-joint exercises (like a bench press) or large lifts that involve large muscle groups (like squats) should be performed earlier in the workout. Those exercises that isolate muscle groups (like doing leg extensions on a machine) or that use smaller muscles should be performed later in the workout.

## Speed or Velocity

Very slow rates of lifting (which came into vogue a few years ago) are not the way to go. Going at a higher velocity (assuming of course that good technique is maintained throughout) has been shown to be more effective for increased strength gains. It appears that the intent to maximally accelerate the weight during training is critical in maximizing strength gains versus super slow or slow training. However, for those who are novice lifters, performing the exercise at slower to moderate speeds is recommended. Once you are more proficient, you can work on increasing the speed or velocity at which you perform the lift. But here again, variety, i.e. doing some workouts slower and others a bit faster, can be good.

# The Major Muscle Groups

## Upper Body: Shoulders, shoulder girdle and arms

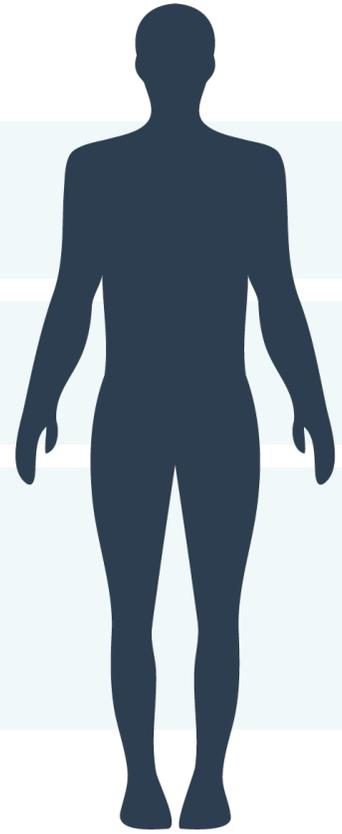
Examples: Bench press, military press, seated row, bent row, pushups, pull ups, pull downs, bicep curls, tricep extensions, dips (pick 2-4)

## Core: Abs and back and sides

Examples: back extensions, side planks, planks, crunches, Russian twist (pick 2-4)

## Lower body: hips and legs

Examples: squats, single-legged squats, lunges, heel raises, side leg lifts, clamshells, side lunges (pick 2 to 4).



The goal is to do 6-10 different exercises that target all the major muscle groups.

## Some basic principles

1. Alternate between the upper, core and lower body. This minimizes the time you need to rest between exercises. The recommended rest between lifts, BTW, is 2-3 minutes, but who has time for that?
2. Vary the resistance and speed at which you perform the exercises, i.e. one day go a bit slower and add more resistance and do fewer reps. On another day, do a bit lighter, but with more reps and a bit faster.
3. Ultimately you do want to try to go to momentary fatigue, i.e. do enough reps and enough weight to the point where it is hard to do another rep. But don't sacrifice technique.
4. If you work the front side of the body, balance that with an exercise to work the back side of the body (i.e. if you do bicep curls, also do tricep extensions).
5. Strength gains tend to occur by doing 1-12 RM (repetition maximum) of an exercise with longer rest periods in between lifts. Muscular endurance gains are seen with 15-20 reps with less rest. Variation is good.
6. Pick exercises that involve the least amount of equipment. Pick exercises that you can do with a dynaband, body weight or dumbbells (machines are the last resort). This way you can adapt your routine to whatever you have on hand regardless of where your travels may take you.

## Range of Motion (ROM) and Agility

To round out your fitness routine, include some ROM (i.e. stretching) and balance exercises. Doing yoga or Tai Chi 1-3x per week is, of course, good for this. In fact, yoga (or any other martial art for that matter) kills three birds with one stone as there are strength, flexibility and agility elements to it. Again, this doesn't have to take a long time; even 15 minutes will suffice. But if yoga or Tai Chi isn't your thing, here are some ideas:

1. Do some ROM exercise after your cardiorespiratory workout. Flexibility exercises are most effective when the muscle temperature is elevated. Stretch the major muscle groups, holding each stretch for 10-30 seconds (going longer doesn't increase the benefit). For greater benefit, do each stretch twice. A hamstring stretch, hip flexor stretch, quad and lower back stretches would be good ones to do.
2. Stretch and between lifts during strength training sessions.
3. Stand up and stretch during the workday. Ones that open the chest are particularly important as we tend to sit hunched over a desk most of the day. Stretching the hip flexors, neck, shoulders and hamstrings are also good as these get tight from sitting.
4. Start or finish your day with some yoga stretches like doing 3-4 sun salutations, some cat/cows and child's pose.
5. Balance on one foot while brushing your teeth or waiting for the copy machine. Close your eyes and balance on one foot. This challenges proprioception.
6. During travel, try to do some stretching while sitting in your airline seat. Yes, this can be done.
7. During travel, after you check into your hotel and unpacked your bag, do some stretches. This need only take a few minutes (3-5 minutes), but the payoff will be huge.
8. Have a mini Bosu type ball in your office at work. Take off your shoes and practice balancing on one foot, (alternating of course). If you have a standing desk you can do this periodically while working at the computer.

Go to [www.sharonlarsen.org](http://www.sharonlarsen.org) for some yoga/flexibility/movement breaks and resistance training examples.

# Nutrition Before, During and Post Exercise



“You can’t exercise your way out of a bad diet”

There is a lot of lore and misinformation about fueling for exercise performance. Here are some of my pet peeves about advice that is often given.

1. Athletes are experts in nutrition. In popular health and fitness magazines, athletes are often asked about what they eat (the implication being that because they are elite athletes, they know must know how to eat a health-promoting diet and, that they way they eat helps them excel in their sport). Trust me, these athletes are not spending their days doing extensive reviews of nutrition research. Truth be told, given the right amount of talent, enough training, and enough calories, athletes will do well. They can even win gold medals and world championships. Not that diet isn’t important for performance, but most athletes do well in spite of what they eat, not because of it.
2. Athletes who have changed their diets, and then do well, will often swear by said diet. I have seen athletes testify to the power of high-fat ketogenic diets, high protein/low carb, paleo, or fruitarian diet. Name a diet and you will find an athlete that swears by it. This is what is called anecdotal evidence. It is the lowest, least rigorous form of evidence out there! Questions that come to mind when I hear these testimonials is what were they eating before they changed their diet? How do they know they didn’t get better because they trained more or differently? Is there a biologically plausible reason as to why said diet improved performance? Plus, anytime someone changes their diet they are now paying attention to what they eat. Often the diet is somewhat healthier as a result and they experience some benefit. In fact, just about any diet is healthier than the standard American diet, which is kinda scary if you think about it.
3. Reductionism. This is when isolated nutrients are studied relative to exercise needs and performance outcomes. As an example, we hear a lot of discussion about how many carbs or how much protein we need to consume pre, post and during exercise. This is not without some value, but I think it is time to start looking at the whole package; to study the types of foods eaten and their impact rather than just talking in macro nutrient terms. Another outcome of this reductionist approach is the plethora of supplements that are sold which claim to help recovery and/or performance. Trust me, ingesting isolated nutrients is not the path to improved exercise performance; the type of food you eat on the other hand, is.



## The Bottom Line: Eat a Health-Promoting Diet

Diet and exercise work synergistically. Eat a health-promoting diet and you will have more energy to exercise, not to mention better recovery and improved exercise outcomes.

A health-promoting diet is one that is nutrient rich and calorie dilute. It is high in foods that contain fiber, water and nutrients (i.e. fruits, vegetables, cooked whole grains, mushrooms, beans, nuts and seeds). Don't become overly focused on high or low carb diets, getting enough protein or how much fat you eat. If you eat enough calories from nutrient rich unprocessed plant foods, your macronutrient needs will be covered.

Here are some reasons why eating this way will help take your exercise to a new level:

**Maintaining a healthy cardiovascular system is an important way to improve exercise performance and aid recovery.** Improved blood flow to the joints, heart, brain and muscles improves oxygen and nutrient delivery and helps waste removal. Arterial plaque and poor endothelial function, on the other hand, hinder blood flow. The best way to achieve improved blood flow is to eat a whole-foods-plant-based (WFPB) diet.<sup>27</sup> This way of eating does not promote plaque deposition (if anything it helps to reverse it) and it promotes endothelial health (which in turn promotes vasodilation of blood vessels and inhibition of plaque deposition).<sup>28</sup>

**Antioxidants promote improved joint health.** Whether you run, hike, ski or bike, keeping those knees (and other joints) in good working condition takes priority. Osteoarthritis, also known as degenerative joint disease, is found most commonly in the knee. The principle cause is progressive degradation of the articular cartilage. One proposed mechanism of this degradation is excessive oxidative stress (which also promotes inflammation) in both the joint cartilage and the synovial fluid.<sup>29</sup>

One study which examined patients with knee arthritis found abnormally low antioxidant status within the synovial fluid in the knee joint of these patients. They also found synovial viscosity was decreased and oxidative stress was increased compared to those in the control group.<sup>30</sup> In other words, low antioxidant levels kept the synovial fluid from being an effective lubricator of the joint.

Another study reported that higher intakes of vitamin C, beta-carotene and vitamin E helped reduce cartilage loss by 75%, 50% and 25%, respectively<sup>31</sup>. To quote one paper, "Therefore, treatment with antioxidants in the initial stages of the disease may be useful as secondary therapy to prevent the oxidative damage and deterioration of the musculoskeletal tissues in osteoarthritis."<sup>32</sup> Vitamin C is particularly important in the production of collagen.



**What are the best sources of these antioxidants?** Food, not supplements. What foods are best? Whole plant foods for starters. As the adage goes, plants are nutrient producers, animals are nutrient consumers. Animal foods contain few, if any, antioxidants. One paper which examined the ability of foods to quench oxidative stress reported that on average plant foods had 1,157 antioxidant units versus 18 for animal foods.<sup>33</sup>

Vitamin C is most abundant in fruits and vegetables. Parsley, peppers, potatoes, and citrus fruit are all rich sources. Beta-carotene is found in red, orange and green-colored foods: Carrots, yams, pumpkin, sweet potatoes, green leafy vegetables (spinach is especially high), to name a few (i.e. lots of fruit, vegetables and starchy vegetables). Good sources of vitamin E are sunflower seeds, almonds, some leafy greens and walnuts. Vitamin E, like beta-carotene, is a family of nutrients called tocopherols. Vitamin E supplements can do more harm than good as the supplements most often contain only one type of tocopherol. Berries, fruits, greens, beans, nuts and seeds are all good sources of antioxidants.



**Eating animal foods can promote inflammation and oxidative stress.** Not only are animal foods devoid of antioxidants, they also promote inflammation and oxidative stress. Some inflammation is good, as it can stimulate important adaptations. However, you want the inflammation to come from the stress of exercise, not from a chronic cycle of inflammation induced by the foods that you eat. Chronic inflammation is not good for joints, arteries or the brain. There are several mechanisms as to how animal foods promote inflammation:

- (a) **Bacterial endotoxins.** These are made from the cell walls of bacteria which are prevalent in meat and dairy (one hamburger, for example, has around 100 million bacteria). One UK study looked at extracts from 27 different foods and the capacity of each to induce inflammation. The worst foods were pork, poultry and dairy foods (like ice cream)<sup>34</sup>. Animal fat can also play a role as endotoxins have a strong affinity for the saturated fat transport system through the gut wall and into the blood stream.<sup>35</sup> Thus, the saturated fat found in these foods helps to boost endotoxin absorption.
- (b) **Preformed arachidonic acid (AA).** Foods like chicken, beef, eggs and fish have preformed AA which is “a key substrate for the synthesis of pro-inflammatory eicosanoids and downstream cytokines”.<sup>36</sup> AA intake is about nine times higher in non-vegetarians compared to those who don’t eat meat.<sup>37</sup> Patients with rheumatoid arthritis, for example, showed significant clinical improvement when they switched from a meat diet to a low AA, vegetarian diet.<sup>38</sup> Note, we need some inflammation and some AA to trigger the inflammatory cascade, but our bodies make all the AA that we need, so we don’t need any from the foods we eat.
- (c) **Advanced glycation end products (AGEs).** These are formed when high protein foods (i.e. animal foods) are cooked at high temperatures. They are also formed when blood glucose is not well managed, as in diabetics. AGEs are potent stimulators of oxidative stress and “amplifiers of inflammation”.<sup>39</sup> The cartilage of the knee may be particularly susceptible to the accumulation of AGEs. Receptors for AGEs have been found in the knee joint and activation by AGEs plays a role in mediating tissue injury in several chronic degenerative and inflammatory conditions (such as arthritis and inflammation of the synovial fluid).<sup>40</sup>

**Whole plant foods, on the other hand, have anti-inflammatory effects.**<sup>41</sup> Several dietary polyphenol compounds, including resveratrol, genistein, catechin, quercetin and indole-3-carbinol which are ubiquitous in plants have been used in Oriental medicine for thousands of years. In fact, many of the anti-inflammatory drugs on the market were derived from or based on these natural products. Epidemiological studies have shown that populations who consume foods rich in polyphenols have a lower incidence of chronic inflammatory diseases (such as rheumatoid arthritis, osteoarthritis, asthma and inflammatory bowel disease).<sup>42</sup> Foods such as onions, apples, grapes, berries, beans, soy, kale, broccoli, turmeric, and brussels sprouts are all rich in these polyphenols.



I believe that the biggest benefit of eating a health-promoting, plant-based diet is that it will allow you to continue to exercise well as you age. You will recover more quickly, have more energy to exercise and experience less joint pain, as well as reduce your risk for weight gain, and heart, brain and back problems.

### **Eating Before, During or After Exercise**

But what about eating right before, during or post exercise?

The answer to this is to experiment with what works for you. If you exercise first thing in the morning, you should have enough muscle glycogen to power your way through the workout without needing to

eat. But everyone is different. I usually like a cup of coffee, maybe some dry toast or a piece of fruit. But if it is a short workout (under an hour), I don't generally eat anything. I think the most important thing is to drink some water, as you are likely going to be somewhat dehydrated first thing in the morning. For longer bouts of exercise, I like to drink a smoothie or eat some oatmeal with fruit prior to the workout.

During the workout, you shouldn't really need to drink a sports drink or take in calories unless you are planning to exercise much longer than 45 minutes to an hour. Remember you have enough muscle glycogen for about 90-120 minutes of intense exercise. But studies do show that performance is improved if you can consume some carbohydrates during the exercise bout even if it is less than 90 minutes. Because most sports drinks are empty calories, I prefer to get any additional calories from foods. My favorite foods to eat during exercise are potatoes or fruit. If the exercise is intense, then a diluted sports drink might be the way to go. For longer endurance efforts (>2 hours), consuming a well formulated sports drink is a good idea, especially in the heat.

### **Strength Training and Protein**

For weight lifting, there is a big emphasis in getting more protein. This need for protein is really overstated, and people will often ingest all manner of protein shakes and powders as a result. Unless you are an NFL linebacker you really don't need to do this. Eat some food, or drink a smoothie that has a plant protein source like soy milk and spinach, and you will be fine. Whole food plant protein sources also come packaged with fiber and antioxidants. Protein powders are essentially processed and don't come with any real health benefits.



There is evidence that ingesting some protein and carbohydrate before a heavy weight lifting session will reduce the post workout catabolic response as compared to ingesting something post workout. But again, for the average person, I don't think the timing is that significant unless you are doing back-to-back workouts.

**Don't Focus on the Macronutrients** (hint: focus on the micronutrients and eating whole foods)

Most sports nutritionists focus on the macro nutrients, i.e. getting enough carbs or protein. But, pre- or post-exercise is where you want to really focus on getting sufficient nutrient and antioxidant-rich calories. Why?

**Exercise can increase oxidative stress** (mostly because metabolically we are churning through more oxygen). But herein lies the dilemma: Could exercise that is so good for us be inducing greater levels of oxidative stress?

As one paper put it, "Some authors have looked on the exercise-induced increase in free radical production [oxidative stress] as a paradox: an apparently healthy act leading to detrimental effects through damage to various molecules and tissues."<sup>43</sup>

The good news is that exercise training has been shown to enhance our own internal antioxidant defenses. Two defenses that increase with exercise are **superoxide dismutase** and **glutathione peroxidase**. Both are found in the mitochondria (where oxidative metabolism occurs). This is a good thing as many antioxidants from our food can't penetrate the mitochondria where they are needed (although they can protect the rest of the cell, like the DNA).

This increase in our internal antioxidant defense mechanisms is just one of the many adaptations to exercise.

However, eating antioxidant-rich foods can also help to boost these defenses and prevent some of the oxidative damage induced with exercise that is covered by these internal adaptations. For example, one study found that those who ate more plants, i.e. vegetarian, had 3x the genetic expression of **superoxide dismutase**.<sup>44</sup>

In another study, athletes who drank 75 ml of tomato juice for 60 days after their morning training session had about double the concentration of **glutathione peroxidase** than the control group. They also improved their performance on a 12-minute run test compared to the control group undergoing the same training.<sup>45</sup>

In another study, volunteers drank 320g of tomato juice one hour before they exercised for 30 minutes. During the exercise bout, they were monitored for their rate of perceived exertion, or how hard the exercise felt to them. Compared to the group that only drank mineral water, those that drank the tomato juice exercised longer with lower rates of perceived effort or fatigue.<sup>46</sup>

Distance runners have been shown to have DNA damage in 10% of their cells, both during and for up to two weeks after a long run, such as a marathon.<sup>47</sup> A recent study found that even short bouts of high intensity exercise (5 minutes) can cause an uptick in damage to the DNA.<sup>48</sup>

To see if antioxidant-rich foods could prevent this, researchers had subjects eat watercress (rich in antioxidants) two hours before a treadmill test. Without the watercress, free radicals (or oxidative stress) increased after the exercise. After eating the watercress there were significant reductions in free radical levels. In fact, levels were even lower than before the test. When it came to measures of DNA damage, those who ate no watercress had increased damage, while those eating daily servings of watercress had less DNA damage. (BTW, DNA damage is not good for athletic performance in that it can limit aerobic capacity).<sup>49</sup>

Other foods shown to reduce exercise-induced oxidative stress are legumes and other plant food like fruit. Flavonoids are potent inhibitors of Xanthine Oxidase (XO) activity. XO is the main contributor of free radicals during exercise. To quote one article, “vegetarians may have an enhanced antioxidant defense system to counter exercise-induced oxidative stress due to the increased quantities of fruit, vegetables, and whole grains they consume.”<sup>50</sup>

As it turns out, supplements or antioxidants that come in a pill form don’t show the same benefit. In fact, some supplements may worsen measures of oxidative stress or inhibit the body’s own defense systems.<sup>51</sup> No surprise really. We’ve seen this with Vitamin A and Vitamin E supplements. As usual, the best sources are whole foods. There is likely a synergistic effect of these nutrients that isn’t present when you take the nutrients out of their natural packaging and put them into pill form.



## In Conclusion

Exercise to get fit, stay fit, feel better and stay functional. Understand and articulate why exercise is important for you and why it is something you need to create time for. Focus on variety and consistency over time rather than volume. The basis and bulk of your exercise time should be cardiovascular focused, but strength and neuromotor training become more important as you age. Keep things simple and doable.

Finally, eat a health-promoting, whole foods plant-based diet. That will go a long way towards allowing you to exercise into your later years. This way of eating will protect arteries and joints, reduce inflammation, protect you from oxidative stress and, most importantly, keep your brain healthy.

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