

WHITE PAPER

The Care and Feeding of the Leader's Brain

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Introduction

Let's be honest. Your company didn't hire you for your brawn or your finely sculpted six pack. In business, brain power wins the day, not horsepower. Your ability to think, communicate, and exhibit emotional intelligence and creativity eclipses physical strength and stamina. Yet, if you were to design a lifestyle that is the antithesis of good cognitive function and long-term brain health, the life of an average executive would come pretty close.

Consider the human brain—our crown jewel. Scientists have learned more about the brain in the last 10 years than in all previous centuries combined. Yet it remains, for all intents and purposes, an unfathomable mystery. Weighing in at just three pounds, it consumes 15% of our total cardiac output, 20% of our total oxygen consumption and 25% of our total glucose use. When the brain is fully working, it uses more energy per unit of tissue weight than fully exercising quadriceps.¹

The brain is the seat of intelligence, emotion, and memory, and it initiates movements and behaviors. How it helps us lift a fork to our mouth or navigate a busy interstate at 70 miles per hour—relatively mindless acts we perform daily—is something we barely understand. There is not a computer in the world that can match its capacity. But we are prone to treating our brains like pieces of junk.

Lack of sleep, poor dietary habits, stress, lack of regular exercise, and smoking can all contribute to worsened cognitive performance and brain health. In fact, the same factors that elevate our risk for heart attacks—elevated cholesterol levels, high fat diets, low levels of fitness, diabetes, high blood pressure, obesity—have also been shown to increase risk for dementia, mild cognitive impairment and Alzheimer's disease (AD).^{2,3} [Note: Alzheimer's is a type of dementia, $\frac{3}{4}$ of dementia is Alzheimer's]

Alzheimer's, like heart disease, is years in the making. Both are diseases of accumulation. Researchers estimate it can take 20 to 30 years for cognitive impairment to fully develop.⁴ Mild impairment starts to occur in one's 50s and could be the early warning signal. It has been estimated that 80% of those who experience mild cognitive impairment will eventually have dementia and/or Alzheimer's later in life.⁵ Numerous recent papers looking at the link between lifestyle factors and Alzheimer's recommend healthy interventions early in life to prevent this disease.⁶

Deaths from Alzheimer's disease have seen a steady increase during the last few decades, and it is now the sixth-leading cause of death in the United States. Recent [predictions](#) are that the numbers of people afflicted with Alzheimer's worldwide will double every 20 years to 42 million by 2020 and 81 million by 2040. Equally disturbing is that those age 60 and older who have Alzheimer's, will experience 11.2% of years living with disability. This is more than for stroke (9.5%), musculoskeletal disorders (8.9%), cardiovascular disease (5%), and cancer (2.4%).⁷

However, rates of Alzheimer's have not had universally similar distributions. Age-adjusted rates tend to be [significantly lower](#) for Africans living in Nigeria, than for African Americans living in Indianapolis (1.4% versus 6.24%).⁸ It is also lower for [Japanese living in Japan](#) than those living in the United States or Hawaii.⁹ This suggests that environmental rather than genetic factors are the underlying cause of this disease.

Actually, I should say “were” lower in Japan as this country has also seen rapid increases in rates of Alzheimer's disease in recent years. This increase has been [attributed](#) to a shift away from more traditional diets based on rice, vegetables, and fish to higher intakes of meat and other animal-derived foods.¹⁰ Similar associations have been noted for China.¹¹



Food for the Brain

Does the type of food we eat impact our ability to think and the long-term health of our brain? More and more science is showing that yes, food can and does have profound effects on the brain. As one paper put it, “just like other organs in the body, the brain is acutely sensitive to what we eat or drink.”¹²

Executives also report that diet has an impact on performance and their brain function. When CCL asked whether diet impacted their performance, 75% of executives said it clearly impacted how they felt and performed. When asked how diet impacted them, most reported that when they didn’t eat well, they felt sluggish, lethargic, and less alert. Conversely, they said a healthy diet helps with sleep, energy and thinking, and feeling better. As one executive put it,

“I find diet to have the most direct impact on how I feel during the day, both physically and mentally.”

But diet is a bit trickier to study than exercise. Most studies focus on long-term brain health—cognitive decline in the elderly and/or Alzheimer’s disease. Fewer studies have looked at the acute impact of diet. Yet I think we all can agree that eating a heavy, high-fat meal does not enhance brain performance. One study found that when rats consumed a high-fat diet, there was an immediate and dramatic decline in cognitive function and working memory, *regardless of whether they had exercised or not*.¹³ Other studies show impaired blood flow to the brain following a single meal high in saturated fat. Fat—in particular saturated fat and cholesterol—hurt the brain.^{14,15,16} Which foods top the list when it comes to saturated fat and cholesterol? Animal foods, such as chicken, fish, cheese, meat, dairy, and eggs, contain cholesterol and saturated fat. Of the plant foods, coconut oil is highest in saturated fat.

The Deadly Foes—Oxidative Stress and Inflammation

It is said that what is good for the heart is good for the brain. After all, the brain is a blood-hungry organ, so it stands to reason that anything that affects blood flow affects brain function. Atherosclerosis, or “hardening of the arteries” doesn’t just occur in the heart. It is in fact, as one paper put it, “an omnipresent pathology that involves virtually the entire human organism,” including our brains.¹⁷

One study that followed over 400 patients for four years found that those with more severe intracranial arterial stenosis (i.e., due to more plaque in the cranial arteries) had a faster decline in cognition and function compared to those with less stenosis. This was after adjusting for factors such as age, education, and vascular risk factors.¹⁸ The good news is that eating a low-fat, whole plant-foods diet has been shown to prevent and even reverse arterial plaque.¹⁹

But the brain also is highly susceptible to the effects of oxidative stress.²⁰ Oxidative stress occurs when free radicals are formed during metabolic processes—or the aerobic conversion of food into energy. These free radicals are atoms that pick up an extra electron and are, as the name suggests, highly reactive. Not only can they damage DNA, proteins, and fats, they also can produce changes in gene expression. The process of aging has been attributed, in part, to the accumulated effect of oxidative stress.^{21,22} To quote one [research paper](#) “. . . evidence indicates that a long ‘dormant period’ of gradual oxidative damage accumulation precedes and actually leads to the seemingly sudden appearance of clinical and pathological AD [Alzheimer’s] symptoms, including amyloid- β (Ab) deposition, neurofibrillary tangle (NFT) formation, metabolic dysfunction, and cognitive decline.”²³

Incidentally, those age spots on the backs of your hands are oxidized fat.

In addition to metabolism, oxidative stress is increased in response to stress, excess alcohol intake, eating fried foods, airplane travel, lack of sleep, breathing polluted air, and smoking cigarettes. With the exception of smoking (very few executives smoke), these factors are endemic to the executive lifestyle.

While things like smoking and excess alcohol consumption are avoidable, others are less so. The biggest contributor to oxidative stress is metabolism or the conversion of food to energy. The best way to mitigate and neutralize oxidative stress is to eat foods that are rich in antioxidants. One study which illustrates this quite nicely was where researchers fed sugar water to subjects found that markers of oxidative stress (free radicals) increased post ingestion. However, when they were fed orange juice (with a similar amount of sugar), there was no increase in oxidative stress.²⁴ Thus, it is imperative to eat antioxidant-rich foods with every meal.²⁵

Our brain is a fatty organ, so it is particularly susceptible to the damaging ravages of these free radicals. Certain metals like iron and copper, essential to human life, if taken in excess, can promote oxidative stress.^{26,27}

Finally, the brain and arteries are susceptible to inflammation—another aspect that is profoundly impacted by diet. As the author of one review paper put it, oxidative and inflammatory stressors are “the two major villains of aging.”²⁸

The Antidote: Antioxidant-Rich Foods

So what foods should we eat more of or less of to help combat oxidative stress and inflammation? For starters, the best foods are plant foods. All plants, including fruits, nuts, beans, spices, and leafy greens, make a vast array of chemical compounds that serve to enhance a plant's survivability. This includes combating oxidative stress and inflammation. Some of the plant foods studied most for their effect on brain function are blueberries, strawberries, grapes, blackberries, walnuts, green leafy vegetables, green tea, and the spices turmeric and saffron. All have been shown to have beneficial effects, such as improving working memory, staving off or reversing cognitive decline, neurogenesis, and the ability to manage complex learning tasks, to name a few of the reported benefits.^{29,30,31,32}

A 2010 paper that was eight years in the making reported the antioxidant content of 3,100 foods. What was interesting was the stark difference in antioxidant content between plant and animal foods. Animal foods, which also tend to be high in saturated fat and cholesterol, are dismally low in antioxidants. Iceberg lettuce, one of the most antioxidant poor vegetables, has more antioxidant units than the same amount of milk, eggs, salmon, and chicken or beef—all foods eaten to excess in Western countries. When the researchers averaged the antioxidant content of plant versus animal foods, the plants won hands down. In fact, it was no contest. Plants averaged 1,157 antioxidant units per 10 grams, while animal foods averaged 18.³³

Why? Simply put, plants are nutrient producers and animals are nutrient consumers.

Two antioxidants that have been shown to protect our brain cells are vitamins E and C. One [study](#) that followed 800 elders for four years found that vitamin E in food lowered risk of Alzheimer's by 67%.³⁴ Another [study](#) concluded that "various tocopherol forms rather than alpha-tocopherol alone may be important in the vitamin E-protective association with Alzheimer's disease."³⁵

You will notice a couple of important points here. The first study refers to vitamin E from foods and the second to "various tocopherol forms." This is important. Vitamin E is a family of tocopherols, including the alpha, beta, gamma, and delta forms. These in turn also consist of different isomers. The synthetic form of vitamin E found in most supplements is alpha-tocopherol and only contains one of the eight isomers found in the natural alpha-tocopherol. Thus, most vitamin E supplements bear little or no resemblance to the vitamin E found in whole plant foods. The best vitamin E pills are sunflower seeds, walnuts, and almonds! Animal foods (including fatty fish) are almost completely devoid of vitamin E. Nuts, seeds, and avocados are among the best choices. Vitamin C works synergistically with vitamin E in protecting our neurons. It serves to regenerate vitamin E. Again, animal foods are devoid of this antioxidant. Fruits and vegetables are your best source of vitamin C.¹³¹



Three antioxidants that we produce internally also defend against free radicals. These are superoxide dismutase (SD), glutathione peroxidase (GP), and coenzyme Q10 (CoQ10).

CoQ10 is found in such foods as soybeans, peanuts, pistachio nuts, and olives, but mostly, you should be making it internally. Oral administration of CoQ10 has been shown to reduce the burden of the plaque in mice models. Statin drugs interfere with its production, which could be why their use is associated with cognitive decline. [Studies](#) suggest that supplementation with coenzyme Q10 might be useful therapy for Alzheimer's for some people.³⁶

SD is found in the mitochondria. Mitochondria are where oxidative metabolism occurs, thus they play a crucial role in neutralizing oxidative stress. Antioxidants from our diet can't really penetrate into the mitochondria (although they can protect the rest of the cell, like the DNA), so increasing our ability to make SD is important. There are two ways to do this—exercise and eating more vegetables.

A recent study looked at the effect of diet on gene expression of SD and found that those eating more plants, i.e., vegetarians, had three times the genetic expression of SD.³⁷ Thus, even though antioxidants from our diet can't get into the mitochondria, eating more antioxidant-rich foods can help us to produce more SD and therefore increase our free radical quenching power.

GP is also produced in the mitochondria. Again, there is some evidence that eating more plant foods can increase its production. In one study on athletes, those who drank 75 ml of tomato juice post training had about double the concentration of GP than the control group.³⁸ Incidentally, those athletes drinking the juice also improved their running performance.

But can eating antioxidant-rich foods improve our brain power?

Dogs are useful models. Like humans, they have cognitive decline with age and accumulate oxidative damage. One study using older beagles found that an antioxidant-rich diet using spinach flakes, tomato pomace, grape pomace, carrot granules, and citrus pulp—the human equivalent of raising fruit and vegetable servings from three servings to five or six servings a day—led to cognitive learning improvements in just two weeks. Over time, the dogs showed reduced oxidative damage and maintained their learning ability, while untreated animals showed marked progressive declines.³⁹



photo by Przykuta and Research Hound

In human studies, there is substantial evidence that adherence to a predominantly plant-based diet, one that is rich in fruits, vegetables, whole grains, and legumes can significantly lower risk for Alzheimer's disease, while diets rich in meat and dairy substantially increased risk.^{40,41} A recent meta-analysis found that those who had a greater adherence to a Mediterranean style diet (characterized by low intakes of meat and dairy and high intakes of fruits, legumes, and other plant foods) had a 33% lower risk of both cognitive impairment or Alzheimer's disease.³⁶

In one lifestyle and age-matched prospective [study](#), subjects who ate meat (including poultry and fish) were more than twice as likely to become demented than their vegetarian counterparts (relative risk 2.18), and the longer people ate meat the discrepancy was further widened to three times the risk (relative risk 2.99).⁴²

Japanese studies have found a similar relationship. Individuals with low vegetable and high meat consumption were the ones most likely to develop Alzheimer's.¹⁰ One point worth mentioning is the importance of considering the diet as a whole rather than looking at the effect of single nutrients. There is substantial evidence of food synergy. As one paper pointed out, foods such as berries have benefits beyond just their antioxidant capacities.⁴³

While much of the focus has been on the aging brain and cognitive decline, what can a healthy diet do for you in the short term? Well for starters, it may improve memory, cognitive performance, mood, and even learning. In one study where the diets of older adults were supplemented with blueberry juice, memory function was improved compared to those fed a placebo.³⁰ The researchers speculate the anthocyanins in blueberries, which have antioxidant and anti-inflammatory effects, may have accounted for this. Additionally, anthocyanins increase neuronal signaling in brain centers, mediating memory function, and improving glucose disposal.

A study from Norway looking at fruit and vegetable consumption and cognitive performance in healthy older adults found a "diet rich in plant foods is associated with better performance in several cognitive abilities in a *dose-dependent manner*." That means the benefits increased as consumption of these foods went up. The effect was most notable in fruits, vegetables (in particular cruciferous vegetables), high-fiber bread, and mushrooms. It was less notable in potatoes, while white bread had a negative effect. After consumption reached about a pound, the benefits started to level off.⁴⁴ Recent recommendations are to eat eight to 12 servings of fruits and vegetables per day to maximize their health benefits.



photo by David Monniaux



Another study compared mood states between vegetarians and meat eaters. Vegetarians had significantly less negative emotion than meat eaters, despite having lower intakes of long-chain omega-3 fatty acids found in fish. The vegetarians, however, had higher intakes of the short-chain omega-3 fatty acid, alpha-linoleic acid (ALA), found in nuts, seeds, and vegetables. Vegetarians also had lower intake of arachidonic acid, which is highly pro-inflammatory.⁴⁵

A different study compared the academic performance of fifth graders who ate a healthy diet high in fruits and vegetables and low in fat to those who ate a poor diet. Researchers found a dose-dependent association. Those eating a better diet showed significantly better academic performance than those eating a poor-quality diet after accounting for other factors.⁴⁶ So while it is difficult to determine if these results are applicable across all age groups (i.e., will blueberries help those of us who are not elderly? Or do the benefits of a healthy diet extend beyond school kids?), they do underscore the point that diet plays a role in brain function.

Glucose is the brain's only source of energy. Thus the brain thrives on a starch-based diet, albeit complex starches in which glycemic and insulin loads are low and in which distribution in the body is slow but regular. Interestingly, a child's brain consumes twice the glucose per unit of weight as that of an adult, which might explain why poorer performances at school are seen when breakfast is insufficient.¹

In young adults, poor regulation of blood glucose leads to poor memorization. This is reversed after ingestion of glucose. In fact, the most absorbing tasks, those that require extended focus over a long period, benefit most from glucoregulation.¹

Fruits, vegetables, whole grains, sweet potatoes, and legumes are great sources of energy for the brain, while also contributing nutrients, antioxidants, and fiber. At rest the brain consumes more than 50% of dietary carbohydrates, approximately 80% of which are used only for energy. Better regulation of glycemia provided by these foods has been shown to improve the quality and duration of intellectual performance.⁴⁵ One study found the presence of fiber in the diet is associated with higher alertness ratings and less perceived stress.⁴⁷ Fiber serves to regulate glucose uptake and slow its absorption, which results in better insulin regulation. This is important because excess insulin is bad for cognitive function. High-fat diets, in particular those high in saturated fat, fried foods, and meat, are associated with higher risk of insulin resistance.^{48,49}

When it comes to insulin regulation, the type of protein is also important. Dietary protein triggers release of both insulin and glucagon. The beta cells (where insulin is produced) do not detect protein per se, but rather the post-meal increase in circulating amino acids. In other words, when we eat protein it gets broken down in the gut to individual amino acids and then absorbed. As a general rule, essential amino acids (as found in animal protein) are more effective at promoting release of insulin, whereas nonessential amino acids (as found in plant protein) promote glucagon release.⁵⁰

Plant proteins contain a higher amount of nonessential amino acids, while animal proteins are higher in the essential amino acids. In one study by Descovich et. al., patients were fed a low-fat meat protein diet for one month followed by a low-fat plant protein diet for one month, where the animal protein was replaced with textured soy protein (everything else stayed constant).⁵¹

During the no-meat trial, fasting glucagon levels rose by an average of 19% while insulin declined by 17%—a greater than 40% increase in the glucagon/insulin ratio.⁵¹ This ratio change is good from a number of perspectives. It decreases fat storage, reduces synthesis and circulation of LDL cholesterol, and reduces triglyceride and insulin-like growth factor synthesis—all factors that are good for the brain.

While Alzheimer's is certainly complicated and multifaceted, the associations to meat consumption are quite strong. What are some other possible mechanisms that could explain this?



Advanced Glycation End Products (AGEs)

Not only are animal foods devoid of free radical fighting nutrients, they also contain substances that are [harmful](#) to brain health. As previously mentioned, saturated fat (mostly sourced from meat and dairy) and cholesterol (only found in meat and dairy) consumption have been [shown](#) to double one's risk of Alzheimer's disease.⁵² Elevated serum cholesterol in midlife was [found](#) to triple one's risk later in life.¹³³ This is similar to the risk posed by cigarette smoking. In a [review paper](#), total fat (mostly from animal sources) was most strongly associated with increased risk for Alzheimer's while cereal or whole grain intake was inversely associated with risk.⁵³ But when it comes to animal foods, their fat and cholesterol content, while troublesome, is really the least of your worries. AGEs likely pose a bigger threat to brain health.

Advanced glycation end products (AGEs) are cross-linked proteins that damage neurons and increase oxidative stress and inflammation within the brain. They are also aptly called AGEs as they [promote aging](#). In fact, scientists refer to them as [gerontoxins](#), or aging toxins.⁵⁴ Skin wrinkling is in part caused by AGEs that have built up in the collagen tissue. They possibly play a role in [damage](#) to kidneys, eyes, joints, bones, and arteries.⁵⁵

AGEs can enter our bodies when we eat [foods that contain](#) them. They are formed when meats are cooked at high temperatures, such as frying, roasting, searing, broiling, or grilling. Cooking foods in water or cooking foods with a high water content limits their formation. Fresh plant foods, for example, contain very low amounts (if any). Boiling meat has been shown to limit their formation, whereas broiling meat promotes their formation.⁵⁶

When it comes to AGE content, foods that top [the list](#) are roasted chicken, bacon, fried steak, and hamburgers—all foods that loom large in Western diets. Just by way of comparison, a burger has almost 5,000 units, a Boca veggie burger has 20. Foods that contain carbohydrates, such as beans, fruits, and vegetables, have very low AGE concentrations. Dairy products are also low unless you age the milk into cheese. Thus, cheeses can contain significant amounts as well.⁵⁷

AGEs have been shown to be [two to three times higher](#) in the brains of Alzheimer's patients compared to normal patients.⁵⁸ They were found specifically in the amyloid plaques and the tau tangles. AGEs wreak their havoc by increasing [free radical damage and inflammation](#) and have been implicated as being one of the [causative factors in Alzheimer's](#).^{59,60}

For a variety of reasons it is best to limit your consumption of AGEs.

The Spices That Are Right

Curcuminoids found in the curry spice turmeric have also shown potent anti-inflammatory and anti-cancer qualities.^{61,62} The low rates of Alzheimer's disease in India have been attributed, in part, to the high consumption of curry (and in part to eating a meat and egg-free diet).⁶³ Indeed, India has among the lowest incidence of Alzheimer's in the world.

In one study those who consumed curry occasionally or very often performed significantly better on tests of cognitive function than those who never or rarely ate curry.⁶⁴ Additionally, those eating curry had half the risk of cognitive impairment than those who rarely ate curry. In a case report, three patients with Alzheimer's disease showed remarkable improvements in behavioral symptoms and mental performance after taking the turmeric for 12 weeks. After a year their behavioral and psychological symptoms of dementia did not worsen.⁶⁵ While these results are preliminary, this study along with others does show promise. As with most foods, it is important to take turmeric as a whole spice rather than a curcuminoid supplement.

Another spice that has shown promise is saffron. One study compared a placebo sugar pill to 30mg of saffron ingestion per day. For those on the placebo, cognitive decline continued unabated over the 18-week trial. However, those on saffron actually showed improved cognitive function.⁶⁶ Buyer beware, however, as too much saffron (>5 g/day) can be toxic.



The Key to Brain Health Is Arterial Health

Endothelial cells, or the endothelium as they are collectively known, are the key to arterial health. These cells line the walls of our arteries. There are so many of them that if placed side by side they would cover seven to eight tennis courts. These cells produce a gas called nitric oxide that plays a number of important roles in protecting us from plaque buildup. Most importantly, nitric oxide is a potent vasodilator, allowing arteries to expand when blood is pumped through the body. It also helps the blood to flow smoothly, i.e., it helps the arteries to act like Teflon rather than Velcro and keeps things from getting sticky. Damage these endothelial cells or limit their ability to produce nitric oxide and you create the perfect environment for arterial disease.⁶⁷

Again, diet can profoundly impact how well endothelial cells function. Eat processed oils (such as olive, soybean, and other oils), fast food, trans fats (found in processed foods, meat, and cheese), cholesterol-laden foods (from anything that has a liver) and you compromise the ability of these cells to produce nitric oxide.^{68,69,70,71} While this is an important lesson in heart health, what does it have to do with brain health?

Scientists at the Mayo Clinic have grown brain endothelial cells in a culture. As the cells increased in number, so did the production of nitric oxide. When scientists fed the cells a nitric oxide synthase inhibitor, nitric oxide production went down, but the production of a beta-site amyloid precursor protein cleaving enzyme (BASE for short) went up. As its name suggests, this bad boy cleaves to amyloid precursor proteins, resulting in the emergence of beta-amyloid—one of the suspected culprits in Alzheimer's disease and dementia.⁷²

What this study suggests is that damage to brain endothelial cells, via poor dietary choices, can boost production of beta-amyloid plaque and thereby increase the risk of Alzheimer's disease.

Caldwell Esselstyn has worked with hundreds of heart disease patients, many of whom were no longer eligible for stents or bypass procedures. When he had them switch to a whole-foods, plant-based diet—free of animal products and processed foods like oils, white flour, and sugar—most saw a dramatic regression of their plaque.⁷³ However, what was most interesting was that *all* saw dramatic improvements in blood flow to the heart after being on the diet for *only a couple of months*. Plaque reversal can take years, thus the increased blood flow was not due to plaque regression. What could account for the improvement? In a nutshell, when the offending foods were removed and the intake of unprocessed plant foods went up, the endothelial cells began to regenerate. Nitric oxide was produced and blood flow and vasodilation improved. This fact could have profound implications for long-term brain health as well.⁷³





photo by Kaptain

Iron, Copper, and Aluminum

Other culprits in this war on brain health are excess iron, copper, and aluminum. Both iron and copper are implicated in the formation of oxygen-free radicals and can damage tissue in the brain. In human prospective studies, there is a strong association between cognitive decline and a diet that is simultaneously high in saturated fat, copper, and iron.⁷⁴ Foods with the highest copper content include beef (the US is the only country that does not regulate copper content in beef), oysters, and mollusks. Other sources of copper are copper piping and supplements (such as your daily multivitamin).⁷⁵ Copper toxicity combined with a high-fat diet is strongly linked to rapid cognitive decline—over three times the normal rate (copper with a low-fat diet doesn't appear to be as harmful).⁷⁶ Avoid supplements that contain copper. Check copper levels in your water (copper pipes don't necessarily mean toxic amounts in the water). More importantly, reduce (even better eliminate) meat intake, as copper is absorbed more easily from meat compared to vegetables.

Meat, and in particular red meat, is also high in heme-iron. Like copper, iron is more readily absorbed from meat than from plants. The body absorbs iron from plants more selectively, i.e., if your stores are low you absorb more, and if your stores are high you absorb less. So plant sources of iron are safer.

Aluminum (Al) is a neurotoxin and can contribute to the creation of tau tangles in the brain, the formation of amyloid plaques, and other pathological changes associated with Alzheimer's disease.^{77,78} It can also accumulate in certain neurons known to aggravate the free-radical damage already initiated by iron.⁷⁴

Dietary sources of Al are numerous and varied. Al salts are added to commercial foods for a variety of reasons: for food coloring, anticaking agents, cheese-melting agents, a rising agent in cakes and other baked goods, pH adjusting agents, thickening agents, meat binders, emulsifiers, buffers, dough strengtheners, sweeteners, and curing agents.⁸⁰ Thus, reducing consumption of processed foods like commercial cakes, cookies, and pancakes from pancake mixes is a good idea. One of the leading culprits in the Western diet, however, is cheese.⁸¹ Aluminum is added to cheese to enhance slicing and melting properties. It also gives cheese a softer texture and prevents fat bleeding, since cheese would be far less appetizing if fat droplets were oozing out of it. Cheese is also high in fat (in particular saturated fat) and cholesterol, so eliminating cheese from your diet is good for a variety of reasons. Other avenues by which we absorb or ingest Al are through aluminum cookware, deodorants, antacids, some vaccines, some sunscreens, cigarettes, buffered aspirin, and other pharmaceuticals, and some bottled water.⁷⁸

Omega-3 and Omega-6 Fatty Acids: Achieving the Right Balance

Much of the fatty tissue in our nerves and brain is made up of fatty acids. Thus, some of the most focused research on nutrition and brain function has involved research on omega-3 fatty acids. There are three types of omega-3s: alpha-linoleic acid (ALA), eicosapentaenoic acid (EPA), and docosahexanoic acid or DHA. EPA and DHA are commonly referred to as fish oils. Of these three, only the ALA is an essential fatty acid, i.e., we need to get it from our diet. ALA is made by plants and is found in green leafy vegetables, soy, and walnuts and seeds, such as flax, chia, and perilla. We can convert ALA to EPA and DHA, so technically we don't need to eat fish to get our EPA and DHA. Pre-formed EPA and DHA are also found in algae and sea vegetables (like seaweed). Some fish can concentrate EPA from algae. Salmon, sardines, and mackerel are the three most common fish that contain large amounts of EPA.¹³⁴

Another essential fatty acid is linoleic acid (LA) which is an omega-6 fatty acid.

ALA and LA are converted to eicosanoid precursors, which are powerful signaling molecules that control inflammation and immunity. Those that are produced from ALA are anti-inflammatory and anticoagulant. Those produced from LA tend to be pro-inflammatory and procoagulant.¹³⁴

Changes to our diets during the last 100 years have resulted in a dramatic increase in the ratio of omega-6 to omega-3 in circulation and in our tissues. This shift may be responsible, in part, for the increased risk and incidence of numerous inflammatory diseases, including asthma, allergic rhinitis, and inflammatory joint diseases.¹³⁴ A recent study showed that a four-week change in diet that reduced the ratio of omega-6 to omega-3 decreased gene expression of pro-inflammatory cytokines. That means dietary factors can regulate gene expression and significantly alter inflammation.

Walnuts are well known for their high levels of ALA and have been well studied with regard to brain function. A recent study shows walnuts are similar to berries in their improvement of cognitive function in aged rodents. Walnuts also reduced microglial activity in the hippocampus (a good thing). In addition to having healthy fats, walnuts contain other bioactive compounds shown to influence brain function, including vitamin E, melatonin, and fiber. They also include the antioxidant polyphenols such as ellagic acid that act synergistically with ALA to increase dietary antioxidant absorption and uptake.^{29, 136} In short, adding walnuts to your leafy green salad is a good thing.

Omega-6 comes from vegetable oils such as olive, corn, sunflower and safflower oils, and is thus very prevalent in our diets. Ideally, we need to reduce omega-6 consumption and increase consumption of foods rich in omega-3 fats. As previously mentioned omega-3 fatty acids are more anti-inflammatory and might also play a role in preventing lipid peroxidation. They are also important in the expression of certain signaling processes. Inadequate intake of these fats also has been shown to promote dementia. In the aged brain, studies have shown a deficit of omega-3s in the hippocampus, cortex, and cerebellum—all areas involved in cognitive and motor function.

DHA also increases production of LR11, which is known to destroy the protein that forms the “plaques” associated with Alzheimer's disease. In mice, even short-term restriction of the omega-3s causes significant memory deficits.¹³⁷

Is It a Good Idea to Supplement with Fish Oils?

Supplementation with fish oils (EPA and DHA) has not consistently been shown to reduce the risk of dementia and Alzheimer's disease.^{82,138} There are a couple of reasons for this. Many of the studies were conducted on populations that eat fish, thus supplementation was not shown to have benefit. Additionally, fish and fish oils are contaminated with bio-accumulated toxic chemicals, such as polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (known as persistent organic pollutants), even if the claim on the label says otherwise. Distilling fish oils does remove some of the lighter organic compounds, but to quote one study which tested various distilled fish oil supplements:

The bioactivity of the organic contaminants in fish oil must be assessed to truly comprehend the trade-offs between the risks and the benefits of these supplements. This is especially important given the evidence presented here that current treatment processes are ineffective at removal of the heavier organic contaminants.⁸³

Yet, evidence suggests that DHA deficiencies can leave us vulnerable to neurodegenerative diseases such as Alzheimer's and Parkinson's. There are a number of compelling reasons for not choosing to eat fish (environmental reasons and the high levels of contamination—see next page). Eating more walnuts, seeds, and greens can provide most with adequate levels of ALA, which is then converted to DHA and EPA. However, for some, additional supplementation with EPA and DHA is a good idea.¹⁴⁰ As we age we get less effective at converting ALA to EPA and DHA. A small percentage of the population are actually very poor converters, especially older men. If you are unsure, then it is a good idea to get a blood test every couple of years to ensure that you

have adequate levels. It might also be prudent to take a yeast or algae-derived EPA and DHA (after all that is where fish get theirs) supplement.¹³⁹ But try to find one where hexane (a neurotoxic chemical) hasn't been used to extract the oils. Also DHA and EPA are delicate oils, and once extracted, are prone to oxidation and rancidity, especially when exposed to light.¹³⁵ Thus try to find a supplement that comes in a dark bottle. The best DHA/EPA supplement that I have found is from www.drfulhrman.com. (Go to supplements and then click on DHA Omega-3 fatty acids).

Ratios of Omega-6 to Omega-3 in Various Oils and Foods

English walnuts	4:1
Flax	2:1
Chia	1.2:1
Olive oil	15:1
Canola oil	2:1
Corn oil	79:1
Soy oil	7:1
Sunflower oil	15:1
Chicken	15:1
Eggs	16:1

Sources of Omega-3s*

1 oz. walnuts, 2.5–5.0 grams
1 oz. flax seed, 5.0–6.5 grams
1 oz. chia seeds, 5.0 grams
1 oz. wild salmon, 0.6 grams

**There is no daily recommended intake of Omega-3s, but the National Academy of Sciences has set what is considered to be an adequate intake over time: for women, 1.1 grams/day; for men, 1.6 grams/day.*

Fish: A Double-Edged Sword

Fish consumption is generally recognized to be heart and brain healthy.⁸⁴ Eating fish is generally better than eating chicken and beef. However, it is not the health food it is made out to be. Our oceans and waterways have become the sewers of the world, leading to widespread contamination. If the fish oils are contaminated, so are the fish. All fish now contain traces of mercury and other pollutants such as PCBs, dioxins, heavy metals, and DDT to a greater or lesser degree.^{85,86} But, while fish are a primary source they are not the only source. Consumption of food is the major source of non-occupational exposure to these pollutants, with foodstuffs from animal origin accounting for more than 90% of the human body burden.⁸⁷ Thus meat, dairy, and fish products are the primary culprits.

Scientists have also begun calling these contaminants “obesogens,” because they are known to interfere with normal metabolic processes and are thus implicated in the rise in obesity.⁸⁸

Mercury, which is widespread in fish, is highly toxic and will counterbalance the beneficial effects of DHA and EPA. Indeed, more recent studies show mixed results with regards to the benefits of fish consumption. Some have shown increased risk of death, diabetes, certain cancers (such as thyroid and breast), and heart disease. Other studies have shown decreased risk with eating more fish.^{89,90,91} A 2012 meta-analysis published in the *Journal of the American Medical Association* concluded that omega-3 supplementation was not associated with a lower risk of all-cause mortality, cardiac death, sudden death, myocardial infarction, or stroke.”⁸⁹ The recommendation to physicians was this: “Our job should be to stop highly marketed fish oil supplementation in all of our patients.” Another review article on the risks versus benefits of fish consumption noted “no clear benefit of omega-3 fats on health.”⁹³

Fish (as well as other animal foods) also have high levels of preformed arachidonic acid. Arachidonic acid is also formed from omega-6 fatty acids. This is why omega-6 fatty acids tend to be pro-inflammatory. However, consumption of preformed arachidonic acid (which is only found in animal foods) results in a heightened inflammatory response.⁹⁴ So this may also cancel out the benefits of fish consumption. Chicken is also very high in preformed arachidonic acid.

If you do choose to eat fish, it is best to do so rarely—one to two times per month and limit it to around 6 ounces. Women who ate fish more than two times per week were found to have seven times the mercury levels of those who ate fish rarely.⁹⁵ Choose fish that are low on the food chain i.e., eat fish that don’t eat other fish. High-mercury fish include shark, swordfish, king mackerel, tilefish, tuna, and sea bass. Low-mercury seafoods include shrimp, tilapia, haddock, trout, and haddock. High PCB fish include mackerel, salmon, sardines, herring, lobster, catfish, oysters, and crab.⁹⁶

Regardless of whether you choose to eat fish or not, as much as possible reduce your intake of omega-6 fatty acids and arachidonic acid and boost your intake of flax, soy, walnuts, and/or chia seeds. Adding one to two tablespoons of ground flax to your daily diet will help bring the ratio of omega-6 to omega-3 fatty acids closer to 3:1. As previously mentioned, taking an algae or yeast-derived supplement that has been cold pressed and hasn’t been sitting on the shelf for a long time, is also prudent.^{139,140}

While the effect of diet on brain function is still an emerging science, it is becoming apparent that the same diet that protects us against heart disease, cancer, and stroke is likely to optimize brain function and protect us against the ravages of brain aging, or at least slow it down. After all, wouldn’t it be a bit strange of nature if one diet was good for the heart but not good for the brain? There is clear evidence that most of our Western diseases can be prevented and in some cases reversed by eating a whole-foods, plant-based diet, one that is rich in leafy greens, cruciferous vegetables, berries, seeds, walnuts, mushrooms, cooked whole grains, fruits, and legumes. Additionally, it should be low in saturated fat and cholesterol (i.e., animal foods), advanced glycation end-products, and persistent organic pollutants.



Exercise: The Magic Bullet

“Physical activity is cognitive candy,” writes John Medina, a molecular biologist and author of the book *Brain Rules*. He goes on to say, “Research has consistently shown that exercisers outperform couch potatoes in tests that measure long-term memory, reasoning, attention, problem solving and fluid intelligence. When combined with the health benefits exercise offers, we have as close to a magic bullet as exists in modern medicine.”⁹⁷

In a 2014 review, 26 out of 27 studies found a significant association with increased physical activity and attenuated cognitive decline and disease. Various forms of exercise were studied, including aerobic, weight training, Tai Chi, and isometric.⁹⁵



How Much Exercise Do We Need?

Not that much actually. Even walking a few times a week has benefit. Ten minutes of vigorous exercise has been shown to acutely improve mood and subsequent brain performance. However, it appears the greatest benefits occur when exercise sessions are greater than 30 minutes in duration. One study showed higher gray matter volume in late adulthood among those who walked more than six miles per week, but no benefit for those who walked less.⁹⁹ It is possible that, similar to heart disease, the benefits are dose-dependent (i.e., the more active one is the greater the benefit). One study found that as exercise levels increased, so did the brain benefits.¹⁰⁰ There may be a point of diminishing returns, however. Too much exercise too soon could lead to exhaustion and over-training.

The benefits also appear to be associated primarily with aerobic exercise. The results on resistance (or weight) training are mixed, and the benefits appear to be limited to more intensive resistance training programs. A recent review article, however, did suggest that aerobic training may be more effective for some individuals, while resistance training or a combination might benefit others more.¹⁰¹

What we are also unsure of is whether one needs to see actual improvements in fitness to accrue

brain benefits. Preliminary data suggests that improvements in cognitive function can occur without a concomitant increase in actual fitness level.¹⁰² (Note: Researchers define fitness level as aerobic capacity—a measure of the ability of the cardiovascular system to deliver oxygen to the muscles during a maximal effort.)

Declines in cognitive function is one of the unfortunate hallmarks of aging. This could be due, in part, to dysregulation of brain plasticity. Brain plasticity is important for learning and memory. Physical activity promotes positive neuroplasticity, increases cognitive reserve, and promotes neuronal connection density, resulting in improved cognitive function. By contrast, poor neuroplasticity results from physical inactivity, poor nutrition, substance abuse, and social isolation. In short, bad habits hurt learning, good habits improve it.¹⁰³

Exercise helps brain function in a multitude of ways: through cardiovascular adaptations (improved blood flow, arterial function, insulin sensitivity and oxygen-carrying capacity), as well as psychological benefits (improved sense of well-being, mood, or mental outlook). Yet even the psychological benefits have a physiological basis.^{102, 104, 105}

For overall good health, the American College of Sports Medicine recommends:

- 30 minutes or more of cardio exercise five or more times per week, or 20 minutes three times per week if the activity is vigorous.
- Resistance training two to three times per week
- Neuromotor exercise involving balance, agility, and coordination two to three times per week
- Range of motion exercise like stretching or yoga more than two times per week.
- Limit sedentary behaviors and intersperse them with short bouts of physical activity and standing, irrespective of exercise habits.

How Does Exercise Work Its Magic?

Animal studies have shown several key mechanisms by which aerobic training may enhance brain function. One is neurogenesis, or the generation of new neurons in the hippocampus.¹⁰⁴ This leads to improved hippocampal function, which is good for certain types of memory.

Another is angiogenesis, or the growth of new capillaries. Exercise has also been shown to induce angiogenesis in the cerebellum, hippocampus, and the motor cortex.¹⁰⁵ This is a big deal. Angiogenesis declines with age, thus exercise can prevent this decline. New blood vessels improve blood flow, which improves oxygen and nutrient delivery as well as better removal of waste. The hippocampus, which is essential for memory formation, is highly dependent on oxygen. This makes sense as the brain is an organ hungry for oxygen, glucose, and blood. Enhance its oxygen and food supply and it performs better.

Better blood flow has been linked to improved learning and memory. Increased blood flow velocity (as occurs during exercise) is significantly associated with less cognitive decline, whereas lower velocity is associated with Alzheimer's disease.¹⁰⁶

Aerobic exercise also has been shown to increase the production of neurochemicals that promote growth, differentiation, survival, and repair of brain cells. Some of these effects are more pronounced in younger rather than older animals, suggesting it is better to start regular exercise early in life and stick with it. The good news, however, is that in older, aerobically trained rodents, improvements in performance were seen even in the absence of neurogenesis or angiogenesis.^{107,108}

There are several neurochemicals that help to mediate the benefits of exercise on brain health, including brain-derived neurotrophic factor (BDNF). BDNF increases in response to both acute (a single bout) and chronic (regular) exercise.¹⁰⁹ Why is BDNF so important? It has been described as “fertilizer for the brain.”¹¹⁰ It keeps existing neurons young and healthy and encourages the formation of new cells in the brain—particularly in the hippocampus.¹¹¹ The importance of BDNF in preservation and enhancement of cognitive function in humans is evident by studies which show that decreasing levels of BDNF are associated with age-related decline in hippocampal volume.¹¹² Aerobic exercise, however, increases BDNF as well as hippocampal and temporal lobe volumes.¹¹³ In short, exercise nourishes the brain.

Aerobic exercise also enhances several neurotransmitters in the brain, including circulating dopamine, serotonin, norepinephrine, and acetylcholine. These neurotransmitters play a role in mental health and mood enhancement, among other things. This could be one reason why exercise is such a powerful antidote to depression.¹⁰²

Finally, long-term aerobic exercise has been shown to reduce oxidative stress (in rats at least) in the brain by the up-regulation of superoxide dismutase and glutathione peroxidase.¹¹⁴

Exercise Tips and Suggestions

1. Every minute counts. In addition to some form of structured exercise, look for ways to move more. Take frequent movement breaks during the day. Some CEOs have treadmills in their offices to do just that. Others have treadmill desks. (Yes, one can check e-mail and walk at the same time). But barring that, take a quick walk up and down stairs or hallways every hour or so.

2. Do something every day, but keep it varied. We are designed to move and move lots. But vary what you do. The brain craves novelty. Studies show improved endorphin responses when the exercise is varied. Do yoga one day and go for a run the next. Add intervals a couple days a week.

3. Get a double dose of cognitive benefit by exercising in a naturally beautiful environment. Researchers at the University of Michigan found performance on memory and attention tests improved by 20% after subjects walked through an arboretum as compared to a busy street. There is something about being in nature that revitalizes the brain beyond the exercise itself. When CEOs attend CCL's *Leadership at the Peak* course in Colorado, we incorporate morning hikes in the woods and the foothills of

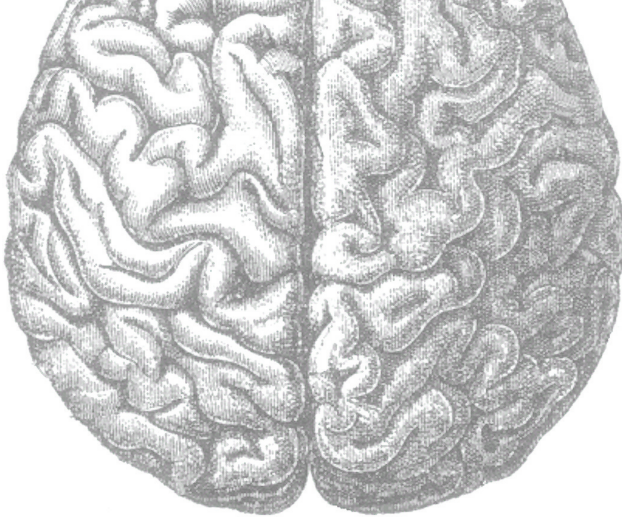
the Rockies. Hiking in this beautiful environment not only provides a breath of fresh mountain air, but also enhances mood and enjoyment and provides a sense of perspective and awe. If you don't live near a nature-filled environment, find a quiet city street with interesting natural elements, such as trees and flowers.

4. Use exercise to enhance social connections. Consider using exercise time to engage with kids, your spouse, or friends. If your days are filled with nonstop meetings and face time with other people, you might use exercise to provide valuable alone time instead. However, one study on rowers found that endorphin release was greater when rowing with the team than for the same workout rowing alone. Greater endorphin release is associated with an increased pleasure response, not to mention an increased ability to push harder. Most executives report that they exercise alone (most of the time). This is likely due to the need for time efficiency, i.e., it is easier to go it alone than try to coordinate with someone else. At the very least, however, try to find some workout partners for the weekends if possible.

What Leaders Say

CCL asked more than 1,500 senior leaders if they think exercise affects how they perform. Eighty-eight percent said exercise “clearly impacts” their performance, and 12% said it had some impact. None said it had no impact.

When we asked *how* exercise impacts performance, we heard it improved energy and helped with stress. But many of the most common responses were around brain performance. Benefits cited were clearer thinking, improved problem solving and focus, increased alertness during the day, improved mental clarity and creativity, and better mental health. Additional benefits cited were improved mood, outlook, attitude, self-confidence, and a sense of well-being. As one executive put it, “I just feel better and can think and focus more clearly.”



The Impact of Stress on Brain Health

“Any idiot can face a crisis; it is the day-to-day living that wears you down.”
—Anton Chekov

Recently I headed out for a trail run close to my house. I rounded a bend and came face to face with a very large black bear. This was a bit disconcerting as I knew a mother and cub had been hanging around the neighborhood. Heart pounding, I carefully backed up and headed in the opposite direction. I kept checking over my shoulder to make sure the bear wasn't taking a special interest in me. Luckily he or she wasn't.

After traveling up the road for about a mile, I had all but forgotten about the bear and was well into my running reveries. However, as I rounded a bend, I came face to face with a mountain lion. Bears are one thing, but mountain lions are a whole different concern. A friend of mine was killed by a mountain lion. My cat was eaten by a mountain lion. They are beautiful creatures but best admired from afar. What to do?

Flight or fight syndrome is the term used to describe that surge of endorphins we experience when faced with a threat. Yet neither fighting nor fleeing is the appropriate response when facing a mountain lion. Lucky for me, the lion turned and ran up the side of the trail before I had time to fully process what had

happened. As you can imagine my heart rate was racing, my blood pressure was up, I was pretty jacked. I was so unnerved that further down the trail I saw a stick and about jumped out of my skin, thinking it was a rattlesnake. Fortunately the rest of the run was uneventful, though, it was one of the fastest I've done in a while.

If you've ever had a near accident in your car or gone skydiving, you've experienced the same type of adrenaline surge. It can be perceived quite differently by different people, triggering both stress and pleasure. For some, jumping out of an airplane is more terror than pleasure, and vice versa.

In stress lingo, there is a difference between distress (negative) and eustress (positive). Scientists describe *distress* as three things happening simultaneously. There is an aroused physiological state, like my elevated heart rate when I saw the bear and the mountain lion. The stressor must be perceived as negative (it was), and the person must not feel in control of the stressor (I didn't).¹¹⁵

—Sharon McDowell-Larsen

Physiologically we are pretty well-equipped to deal with acute stressors. The response is immediate and dissipates relatively quickly. What gets us into trouble is the less obvious, prolonged stress we encounter in modern living. It's the type of stress that is measured in days, weeks, and months, not minutes. There are actually two different types of physiological responses at play here. While the "flight or fight" mode is driven by adrenaline (and a concomitant massive release of energy), the other involves cortisol or glucocorticoids, also released by the adrenals. They have an impact that is far less noticeable.¹¹⁶

Probably the biggest moderators of distress are control and predictability. As control goes up, perceived distress goes down—and so do your cortisol levels. As your perceived level of control goes down, the distress and cortisol go up.¹¹⁷

When I worked at the US Olympic Training Center, I was involved in a study that looked at stress in elite athletes. We put a group of them through different tests and assessments, gathered training logs, and collected saliva. One of the tests involved exercising to the point of exhaustion. Given the competitive nature of these athletes, they went hard and dug deep. As expected, cortisol levels went

up immediately after the test. This is quite normal and healthy. But for some, cortisol levels dropped to pretest levels or lower within an hour. In other athletes, cortisol levels were still elevated *24 hours later*.¹¹⁸

What could account for this difference? Those who reported higher levels of perceived stress in their lives during the previous year continued to have high cortisol levels after the test. Those with low levels of reported stress saw even lower levels once the test was complete. Those who were stressed and who also had *poor* coping strategies (i.e., poor control) missed more training days because of illness and injury than those who had high stress and used *good* coping strategies (higher levels of control).

What does this have to do with the brain? As it turns out, stress and its hormonal by-products profoundly affect the brain. Protracted elevations of cortisol are bad for the arteries and are detrimental to good brain function and long-term brain health. Cortisol floods the system with excess glucose and fatty acids. If left unburned (one reason why exercise is so good), the glucose and fatty acids can contribute to heart disease, arterial dysfunction, and elevated insulin. And remember, too much insulin is bad for the brain as well.¹¹⁹

Stress also increases clotting factors in the blood. That's a good thing if you are on a battle field and get sliced with a sword, but not good when it comes to warding off heart attacks and strokes or promoting good blood flow. It is also bad for the immune system as it can damage and even destroy the white blood cells that are critically important for fighting infection and infectious agents. This is likely why our stressed athletes had to take more days off from training due to sickness.

The hippocampus is particularly vulnerable to prolonged elevations of cortisol, because it has receptors for cortisol on its surface. If the stress is not too severe, it actually helps the brain perform better, solve problems more effectively, and better retain information. However, under extreme and chronic conditions, these hormones damage the hippocampus, cause it to shrink, destroy hippocampal neurons, and prevent new neurons from forming.^{120,121,122,123}

But it gets worse. Remember the brain-derived neurotrophic factor (BDNF) produced during exercise? BDNF serves to protect and stimulate neuron production. However, when the stress gets really bad (as in catastrophic), hormones can turn off the gene that makes BDNF in hippocampal cells.¹²⁴ Even good coping strategies like regular exercise then are less effective.

Stress has been shown to be bad for brain function in just about every way we can measure. Whether it is memory, learning agility, math, or executive function, those brain functions that allow you to excel at work and as a leader are generally negatively affected if stress is left unchecked and if you fail to use appropriate coping strategies.



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Sleep: Strive to Hit Your Sweet Spot

“There is more refreshment and stimulation in a nap, even of the briefest, than in all the alcohol ever distilled.”

—Edward Lucas

Like exercise, sleep is critical for good health, mental sharpness, and consistent energy. In fact, we can last longer and function better on no food than on no sleep.

Exactly how much sleep a person needs can vary from person to person, but the sweet spot seems to be in the seven- to eight-hour range. Only about 10% of the population can function optimally on less than seven hours. Below are some ways that lack of sleep can negatively impact brain function.

Lack of sleep can mimic dementia. Irritability, forgetfulness, and even nausea can occur after only a couple of days without proper sleep. Extend that out a few more days and you can exhibit symptoms of Alzheimer's.¹²⁵

Lack of sleep inhibits learning. Sleep helps consolidate memory, improve judgment, promote learning and concentration, boost mood, speed reaction time, and sharpen problem solving and accuracy. If you want a shortcut way to solve problems, sleep on it. Present a problem, then allow 12 hours to pass, of which eight of those hours are sleep. Research shows a better solution will be the outcome. Alternatively, sleep loss hurts attention, executive function, immediate memory, quantitative skills, logical reasoning, and mood. In fact, it hurts thinking in just about every way thinking can be measured.¹²⁶ Physiologically, prolonged sleep disruption or restriction may lead to major decreases in hippocampal cell proliferation, cell survival, and neurogenesis.¹²⁷ Even mild sleep restriction in animal studies interferes with the increase in neurogenesis that normally occurs with learning.¹²⁸

Lack of sleep can boost insulin levels and increase insulin resistance. This outcome results in elevated blood glucose levels and increased risk for diabetes. And elevated insulin is not good for the brain either.

Other negative effects of sleep deprivation include higher cortisol levels, increases in C-reactive protein (CRP), increased resting blood pressure, and decreased immune function. Again, cortisol and increased inflammatory responses, of which CRP is an indicator, hurt brain function.¹²⁹

CCL's data on senior executives shows that only a small percentage (15%) get the recommended seven to eight hours of sleep a night. The average reported by male and female executives is just 6.6 hours. Part of the problem is that many have become so adapted to being sleep deprived that they don't know how exhausted they really are.

A 2003 sleep study showed that subjects reported being more fatigued the first few days after reduced sleep. By day four, though, they had adapted to a new baseline level of drowsiness and reported feeling fine—even as their cognitive performance continued to go down. As Van Cauter, a sleep researcher from the University of Chicago points out, “We are not wired biologically for sleep deprivation. We're the only animal that intentionally sleeps less than we need to.”¹³⁰

Getting a solid night's sleep can certainly be an ongoing challenge with travel, work, and family demands. Sometimes it comes down to a choice between more sleep and getting in a workout. What isn't known is whether the benefits of regular exercise and a good diet can compensate for the detriments associated with less sleep. Likely the answer is yes it can, but only up to a point. Either way, though, it is important to guard that sleep time and make every effort to get quality sleep.



Sleep Tips

1. Go to bed and get up at the same time every day.

This is critically important. When we constantly change times, our external cues are out of sync with our internal clock. This can play havoc with sleep and wakefulness cycles.

2. Sleep in a dark room.

Melatonin is the hormone that helps with sleep. It is destroyed by light exposure. It also tends to peak around 10 to 11 p.m. It appears that as we get older, an earlier bedtime is needed to take advantage of that peak.

3. Have good light exposure first thing when you wake up.

Daylight is best. This helps to produce more of the hormones associated with wakefulness and alertness. Increased production of these hormones will result in increased production of melatonin and better sleep. Daylight exposure during the day can also help with this. For those living in northern climates where the sun comes up later in the day, having a special lamp that exposes us to light similar to daylight can help. Even 15 to 20 minutes of light exposure is good. Lamps that emit diffuse white light at 10,000 LUX are best.

4. Have a clear period to wind down before bed.

Refrain from watching the news, reading e-mails, and watching TV (or anything that might get you aroused) before bed. To wind down before going to bed, try some light reading, dimming the lights, or sitting in a hot tub.

5. Engage in moderate to vigorous exercise daily.

Caffeine takes about 10 hours to metabolize, so if you must drink coffee, limit it to one cup in the morning. Alcohol may help you fall asleep, but it can interfere with REM (short for rapid eye movement) sleep when it starts to metabolize.

7. Keep dinner light and starch-based, and eat at least one to two hours before going to bed.

8. Drink plenty of fluids during the day, but stop drinking one to two hours before bed.

This will help limit bathroom trips during the night.

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