The Impacts of Exercise on Brain Health, Longevity, Stress Management, and Mood

BY DEBRA AUSTIN

The brain is the lawyer's most important asset, and taking care of your brain is essential to supporting longevity. Research indicates that the two most significant things you can do to protect your brain and enhance your longevity are to exercise and reduce stress. This article summarizes recent literature related to the impact of exercise and stress reduction on brain health and overall longevity. One benefit of maintaining familiarity with research is that it can inform and motivate behavior change otherwise difficult to foster amidst a high-demand career.

Exercise, Brain Health, and Longevity

Our memory is powered by a brain structure called the hippocampus, which resides deep in the brain. The hippocampus is especially vulnerable to stress and the aging process, but it can be protected and enhanced by exercise. Exercise, which is any activity that raises your heart rate, benefits the brain in three ways: it enhances blood and oxygen flow, elevates key neurotransmitters, and stimulates the production of brain derived neurotropic factor (BDNF). Increased blood and oxygen flow helps distribute nutrients deeper into the brain and aids in the elimination of waste. Exercise increases and rebalances serotonin, which is important for mood and sleep, and dopamine, which influences motivation. BDNF strengthens existing brain cells in the hippocampus, which is our memory processor. It also protects these critical neurons from the damage that stress hormones can cause.[1]

A 2011 meta-analysis of 1,603 studies on the relationship between cognition and exercise found that exercise prevented cognitive decline and healed cognitive impairment.[2] Exercisers had larger hippocampus volumes, as well as greater synaptic connections, the links between brain cells that are vital for information processing, thinking, and memory.[3] Aging causes the hippocampus to shrink 1% to 2% per year in older adults without dementia, and this loss is understood to increase the risk of cognitive impairment. Research indicates that exercise is protective against hippocampal shrinkage. In one study, for example, researchers sought to assess the impact of a one-year program of moderate-intensity aerobic exercise on hippocampus volume in older adults.[4] The 120 study participants were all between 55 and 80 years old, sedentary, healthy, and without dementia. Researchers assigned 60 participants to the walking exercise group and 60 to the stretching control group. They discovered that the exercise group increased the size of their hippocampus by 2% in a year, while the control group suffered a decrease of 1.4% during that time frame.[5] The exercise group also had better performance on a spatial memory task.[6] Increased hippocampal volume was directly related to improved memory function.[7]

In a study of older adults, with 1,507 participants over the age of 71 (65% female, 53% Black, and 47% white), researchers examined 186 variables that relate to longevity over 2-year, 5-year, and 10-year periods.[8] Researchers found that the strongest determinants of longevity were physical function, fewer years of smoking, and greater concentrations of small high-density lipoprotein (HDL) particles.[9] HDL is the beneficial type of cholesterol, and researchers theorize that small HDL particles help reduce inflammation and clear toxins from the system.[10] Exercise is one of the most effective ways to increase your HDL and decrease your LDL, also known as "bad cholesterol."[11] The American Heart Association recommends an average of 150 minutes of moderate exercise per week. It can take 4 to 12 months of exercise, such as swimming or cycling, to lower your cholesterol. The capacity

for physical activity was the strongest predictor of longevity in this study.[12]

In another study considering exercise and mortality, researchers examined data from 412,413 American adults (55% female, 27–61 years old) and compared physical activity with all-cause and cardiovascular mortality from 1997 to 2019.[13] They discovered that regular exercise, compared with inactivity, was associated with a 24% lower risk of all-cause mortality for both women and men.[14]

Exercise, Brain Health, and Stress Management

In addition to factors related to aging, stress is very hard on our hippocampus. When we experience stress, our fight-or-flight stress response system is activated. Our stress response system was designed to deal with short-term challenges, and our rest-and-digest system was intended to return calm and balance to our brain and body upon resolution of the provocation.

Our stress response begins when our amygdala senses a physical or psychological threat. The amygdala initiates a process where the thalamus focuses our attention, the hypothalamus informs the pituitary, and the pituitary instructs the adrenal glands to release stress hormones. Stress hormones (adrenaline, aka epinephrine, and glucocorticoids, mainly cortisol) increase heart rate, raise blood pressure, and elevate blood sugar to provide an energy boost to help the body deal with the challenge.

During chronic stress, continuous fight-or-flight activation causes iterative damage to the brain. Stress hormones are released when the amygdala senses threat, and when a continuous stream of stress hormones keeps the amygdala aroused, the result is the release of additional stress hormones. The hippocampus is highly susceptible to stress hormones because it has abundant glucocorticoid receptors. Glucocorticoids damage and kill brain cells in the hippocampus, also weakening the connections between brain cells. Under chronic stress, the amygdala is over-sensitized, and the hippocampus is compromised. The hippocampus is the brain structure most vulnerable to cell death, causing its shrinkage, which can lead to memory loss and depression.

Exercise, Brain Health, and Mood

A 2015 study of 12,825 lawyers practicing in 19 states found that 19% reported suffering from anxiety, 23% dealt with significant stress, and 28% had depression.[15] In a 2023 study, researchers wanted to synthesize the evidence on the impact of exercise on anxiety, depression, and psychological distress in adults.[16] They reviewed 97 studies with 128,119 participants experiencing good health, chronic diseases, and mental health conditions. They found that physical activity improved symptoms of anxiety, depression, and stress in all populations.[17] All modes of physical activity, including aerobic exercise, resistance training, mixed aerobic and resistance exercise, and yoga, were beneficial.[18] Higher intensity exercise was associated with greater improvements in symptoms.[19]

To better understand why exercise improves depression symptoms, a different group of researchers reviewed studies that examined different impacts of exercise on depression.[20] Studies involved moderate to vigorous aerobic exercise, such as running or cycling, for 30 to 60 minutes one to three times per week. They discovered impacts on:

- **Neuroplasticity:** Exercise can increase cerebrum and hippocampus volumes, improve blood flow throughout the brain, and increase BDNF levels, which operates like fertilizer for brain cells in the memory and emotion-processing hippocampus.
- **Stress hormones:** Prolonged exposure to stress hormones can reduce birth of new brain cells, decrease BDNF circulation, and increase cell death in the hippocampus. Exercise reduces the stress hormone cortisol and increases BDNF levels, which is likely to reduce brain cell death and improve brain cell birth.
- **Inflammation:** Depression is associated with chronic increased low-level inflammation. Exercise can reduce numerous inflammatory factors, creating a lasting anti-inflammatory environment.
- **Oxidative stress:** When oxidative stress outweighs antioxidants, it can damage DNA, proteins, and lipids, and cause cell death. The brain is particularly vulnerable to oxidative stress because it has a high metabolic rate and low antioxidant levels. Exercise reduces oxidative stress indicators and increases antioxidants.
- **Psychological factors:** Exercise can improve self-esteem, enhance socialization and social support, and increase self-efficacy.[21]

The Takeaways

The research summarized in this article illustrates the importance of exercise on brain health and longevity as well as stress and mood management. Exercise protects the brain against the neurodegeneration associated with aging and reduces the damage that stress hormones can cause. The capacity for physical activity is a strong predictor of longevity, and exercisers may reduce their risk of all-cause mortality by as much as 24%. Moderate intensity walking can increase hippocampus volume in just a year. Higher intensity exercise may provide greater relief from stress, anxiety, and depression symptoms. Hippocampus loss with aging is not inevitable, and it can be reversed with moderate-intensity exercise. Greater physical fitness is neuroprotective, and it is never too late to enhance cognition or augment brain volume with exercise. CL

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NOTES

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21. *Id.*