

# Exercise Transforms Your Brain and Protects Against Cognitive Decline

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## STORY AT-A-GLANCE

- › Alzheimer's disease is a severe form of cognitive decline, affecting around 47 million people globally with projections to reach over 131 million by 2050; it disrupts neuronal communication and causes progressive brain cell deterioration
- › A Penn State College of Medicine study demonstrated that daily physical activity, regardless of intensity, improves cognitive processing speed by approximately 60 milliseconds, effectively reducing cognitive age by about four years
- › Aerobic exercises boost brain health by increasing brain-derived neurotrophic factor, enhancing spatial learning, memory, and visual pattern separation, stimulating neurogenesis in the hippocampus and improving synaptic plasticity
- › Resistance training provides superior cognitive benefits for older adults, requiring lower exercise intensities to achieve significant improvements in cognitive performance
- › Incorporating consistent physical activity into your daily routine while supporting mitochondrial health by minimizing your exposure to toxins will help reduce your risk of cognitive decline and promote long-term brain health

A healthy cognitive function is vital for navigating daily life, but it's something many take for granted until it starts to slip. Alzheimer's disease is a striking example of what happens when cognitive decline worsens. Characterized by the accumulation of amyloid plaques and tau tangles in the brain, Alzheimer's disease disrupts neuronal

communication and causes brain cell death, leading to impaired memory, language and daily functioning.

Globally, an estimated 47 million people worldwide are living with dementia, with Alzheimer's disease accounting for 60% to 80% of these cases. This number is expected to surge to over 131 million by 2050 as the global population ages. In the United States alone, the prevalence of Alzheimer's among those aged 65 and older is projected to rise significantly, with life expectancy after diagnosis typically ranging from three to nine years.<sup>1</sup>

Alzheimer's disease (AD) presents significant challenges due to its progressive nature and lack of a cure. Conventional treatments, which include medications, often focus on managing symptoms rather than stopping its progression, but they often come with side effects and have limited efficacy. As a result, there is a growing interest in alternative approaches, such as physical activity, which offers a low-cost and accessible means to combat cognitive decline.

## **Daily Activity, No Matter How Small, Boosts Brain Speed**

A recent study<sup>2</sup> from Penn State College of Medicine explored how different types of physical activity affect cognitive processing speed. To conduct this study, the participants were asked to log their physical activities and complete cognitive tests five times a day for a week using a mobile app. This approach allowed researchers to gather dynamic, real-time data, providing a more comprehensive understanding of how daily movements influence cognitive processes.

The results showed that participants experienced improved cognitive processing speed by approximately 60 milliseconds immediately after physical activity. This is equivalent to a reduction in cognitive age by about four years. The improvement was evident in tasks like symbol-matching, which assesses how quickly the brain processes and responds to visual information.<sup>3</sup>

One of the key mechanisms behind these cognitive benefits is the heightened sense of alertness that accompanies physical activity. Movement increases physiological arousal in the brain, which in turn boosts alertness and cognitive readiness. As a result, you're better prepared to focus your attention and perform tasks with greater efficiency.

Interestingly, while higher-intensity exercises benefit cognitive health by releasing beneficial chemicals and neurotransmitters that support neuronal function and enhance communication between brain cells, the research confirms that even everyday activities deliver meaningful cognitive advantages.

Physical activity, regardless of intensity, is also linked to improved cardiovascular function, which enhances blood flow to the brain, creating an environment that supports optimal brain performance.

These findings highlight the profound impact that everyday physical activities have on cognitive processing speed. Whether it's a brisk walk, a household chore or light stretching, engaging in any form of movement leads to significant short-term improvements in brain function. Hence, incorporating regular physical activity into your daily life is a simple yet effective strategy for enhancing your mental performance and maintaining cognitive health.<sup>4</sup>

## **Exercise Fuels Your Brain Flexibility and Sharpens Your Memory**

The Penn State College of Medicine study aligns with earlier research from 2015, published in *Cellular and Molecular Life Sciences*,<sup>5</sup> which demonstrated how aerobic and resistance exercises enhance cognitive functions and maintain brain health without the use of medications. By examining adult and elderly populations, the study provided comprehensive insights into how different types of physical activity influence the brain.

Participants engaged in aerobic activities, such as running or cycling, and resistance training, like weightlifting. Both types of exercise significantly improved spatial learning and memory, skills essential for navigating environments and recalling locations.

Regular physical activity was found to induce structural changes in the hippocampus, a region responsible for memory and navigation.

In both human and animal models, exercise increases the size of the dentate gyrus, where new neurons are generated. Remarkably, in rodents, this area could double or triple in size with consistent activity, directly enhancing memory and learning outcomes.

Another striking finding was the impact of aerobic exercise on visual pattern separation, which helps you distinguish between similar images – a key component of memory retention. Young adults who maintained a routine of aerobic exercise showed superior memory performance compared to less active individuals.

Resistance training provided unique benefits for elderly participants, leading to sustained improvements in spatial memory and other cognitive functions over six months.<sup>6</sup>

The study also explored biological mechanisms underlying these improvements. One major factor identified was the increase in brain-derived neurotrophic factor (BDNF), a protein that plays an essential role in brain plasticity, enabling the brain to adapt, reorganize and form new connections. Higher BDNF levels were consistently linked to improved memory and cognitive flexibility.

Exercise also boosts insulin-like growth factor 1 (IGF-1), which supports neuron growth and survival, further enhancing learning and memory.<sup>7</sup>

Synaptic plasticity (how efficiently neurons communicate) was another area of focus. Exercise-induced increases in BDNF and IGF-1 improved synaptic plasticity, creating an environment conducive to efficient information processing and retrieval. Long-term potentiation (LTP), a mechanism essential for memory formation, was also enhanced. In rodent models, running significantly strengthened LTP, highlighting exercise's role in memory storage and recall.

Moreover, the study emphasized that regular physical activity supports neurogenesis, particularly in the hippocampus. The ongoing generation of new neurons fosters

cognitive resilience, helping the brain adapt to age-related decline or neurodegenerative conditions. This continuous renewal process ensures the brain forms new memories and responds effectively to new challenges.<sup>8</sup>

## **Resistance Exercises Show Superior Cognitive Effects**

Another paper providing evidence of exercise's benefits for cognitive health focused on the unique effects of resistance training in older adults. Published in *Ageing Research Reviews*,<sup>9</sup> this systematic review aimed to determine the minimal and optimal doses of different exercise modalities to achieve significant cognitive benefits.

By analyzing data from multiple studies, the researchers examined a diverse group of participants, including healthy individuals and those with mild cognitive impairments.

The study population primarily consisted of older adults, with many participants being overweight or obese. The findings revealed that resistance training, such as weightlifting or using resistance bands, provided substantial cognitive improvements compared to aerobic exercises like walking or cycling. Specifically, resistance exercises demonstrated a stronger association with enhanced cognitive performance, highlighting their superior effectiveness in promoting brain health.<sup>10</sup>

The authors noted that resistance training required lower doses to deliver cognitive improvements compared to aerobic exercises. This means that older adults could attain better cognitive outcomes with less intensive resistance training than what is typically recommended for aerobic exercises. Resistance bands, in particular, were identified as the most effective tool for enhancing cognitive function, offering the greatest probability of producing substantial results.<sup>11</sup>

To measure the energy cost of physical activities, researchers used METs (Metabolic Equivalent of Task), which represent the amount of energy expended during an activity compared to rest. They determined that approximately 724 METs-minutes per week – equivalent to a moderate level of activity – were needed to observe clinically important cognitive gains.

Interestingly, the research highlighted that doses beyond 1,200 METs-minutes per week did not provide additional clear benefits. This suggests that there is an optimal range of exercise intensity and duration beyond which the cognitive advantages plateau. The study also emphasized that overweight and obese older adults experienced significant cognitive improvements even at lower exercise levels than those typically recommended.

Compared to aerobic exercises, resistance training has a more pronounced effect on cognitive functions, as it promotes the release of chemicals and neurotransmitters.

The researchers emphasized the importance of tailoring exercise programs to individual needs, especially for older adults at risk of cognitive decline, to maximize the cognitive benefits while accommodating physical limitations, making resistance training a key strategy for preserving brain health in aging populations.<sup>12</sup>

## **Aerobic Exercise Reduces Cognitive Decline in Alzheimer's Disease**

Focusing on the impact of aerobic exercise on Alzheimer's disease, a pilot randomized controlled trial published in the *Journal of Alzheimer's Disease*<sup>13</sup> investigated whether regular aerobic activities, such as cycling, could slow or stabilize cognitive decline in older adults diagnosed with mild to moderate Alzheimer's. The study involved 96 community-dwelling older adults aged 66 and above, all of whom were living with mild-to-moderate Alzheimer's disease.

Participants were randomly divided into two groups – 64 engaged in a cycling program, while 32 participated in stretching exercises. The findings showed that those who took part in the cycling regimen experienced a slower decline in overall cognitive abilities compared to what is typically expected with Alzheimer's progression.

Over a six-month period, the cycling group's scores on the Alzheimer's Disease Assessment Scale-Cognitive (ADAS-Cog) increased by only 1 point on average, which is much less than the usual 3.2-point increase seen as the disease advances. These

results suggest that aerobic exercise, such as cycling, leads to short-term improvements in cognitive processing speed.

The mechanisms behind these improvements are complex. Aerobic exercise alters the processing of amyloid precursor protein, leading to a reduction in the production of toxic amyloid-beta plaques, which are a hallmark of Alzheimer's pathology. It also impacts tau proteins, preventing the formation of tangles that impair neuronal communication. Additionally, aerobic activities stimulate the release of beneficial chemicals and neurotransmitters, which help slow disease progression.

Aerobic exercise also addresses non-hallmark pathologies associated with Alzheimer's, such as neuroinflammation and oxidative stress. These factors exacerbate cognitive decline, but regular aerobic activity mitigates their effects by promoting cardiovascular health and improving blood flow, ensuring that brain cells receive vital oxygen and nutrients.

While the cycling group showed significant stabilization of overall cognition, some specific domains, such as attention, processing speed and language, did not show immediate improvements over the long term. However, the overall trend indicates that aerobic exercise plays an important role in stabilizing global cognition, even if certain cognitive functions do not exhibit immediate improvements.

Importantly, the study emphasized the safety and practicality of aerobic exercise for older adults with Alzheimer's disease. With minimal risk of adverse events, activities like cycling offer a non-pharmacological approach to managing cognitive decline, making them a valuable option given the limited treatment alternatives available.<sup>14</sup>

## **Get More Movement Into Your Life to Combat Cognitive Decline**

To address the root cause of cognitive decline, which is often linked to a sedentary lifestyle, incorporating regular physical activity into your daily routine is essential. Here are effective strategies to enhance your brain health through everyday movement:

- 1. Prioritize walking and moderate-intensity exercise** – If you're looking to boost your brain power, starting with walking is a fantastic choice. Aim for at least 30 minutes of brisk walking most days of the week. Additionally, activities like cycling, swimming or dancing at a moderate pace provide similar benefits, keeping your mind sharp and agile.
- 2. Add strength training into your workouts** – Incorporate strength training exercises, such as weightlifting or resistance band workouts, into your weekly routine. Aim to perform these exercises at least twice a week to support your body and brain as you age.
- 3. Incorporate balance and flexibility exercises** – Activities like yoga, tai chi or Pilates not only improve balance and flexibility but also reduce stress and enhance mind-body coordination. These movements support neural connectivity and improve body awareness, contributing to better cognitive health as you age.
- 4. Maintain consistency with your exercise habits** – Consistency is key when it comes to reaping the cognitive benefits of exercise. Establish a regular workout schedule that fits your lifestyle and stick to it. Whether it's morning jogs, evening yoga sessions or weekend hikes, making exercise a habit ensures ongoing support for your brain's health and helps prevent cognitive decline over time.
- 5. Combine physical activity with mental engagement** – Enhance the benefits of your exercise routine by engaging your mind simultaneously. Activities like dancing, team sports or even walking while listening to educational podcasts will stimulate both your body and brain. This combination not only improves physical health but also reinforces neural connections, boosting overall cognitive resilience.
- 6. Explore outdoor activities for added benefits** – Movement in nature, such as hiking, gardening or outdoor yoga, combines physical activity with the restorative effects of being in a natural environment. Exposure to sunlight and fresh air also helps regulate your mood, reduce stress and enhance overall mental clarity.



# Support Your Mitochondria to Protect Your Cognitive Health

In addition to regular exercise, enhancing mitochondrial function is an important step to lower your risk of chronic diseases, including dementia, and to prevent cognitive decline. Research published in *Neurology*<sup>15</sup> indicates that an inflammatory diet significantly increases dementia risk, a condition rooted in mitochondrial dysfunction.

Three major toxins impair your mitochondrial function by affecting intracellular calcium and overall cellular health. Elevated intracellular calcium leads to increased superoxide and nitric oxide levels, which combine to form peroxynitrite, a potent reactive oxygen species that contributes to poor health. These toxins include:

- 1. Excessive linoleic acid (LA) consumption** – LA, an omega-6 polyunsaturated fat abundant in vegetable oils and processed foods, is among the most detrimental components of the Western diet. Overconsumption negatively impacts your metabolic rate and gut microbiome, two crucial factors for your health.
- 2. Endocrine-disrupting chemicals (EDCs)** – EDC exposure, often from microplastics, overstimulates your estrogen receptors. Microplastics are so prevalent that you might ingest a credit card's worth of plastic weekly.<sup>16</sup> This plastic contains phthalates and bisphenol A (BPA), which activate estrogen receptors. Estrogen increases intracellular calcium levels, leading to peroxynitrite formation.
- 3. Excessive electromagnetic field (EMF) exposure** – Daily EMF exposure, such as from cellphones, has hidden health consequences. EMFs activate voltage-gated calcium channel (VGCC) receptors within cells, triggering calcium influx and catalyzing peroxynitrite production.<sup>17</sup>

## Sources and References

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