

Exercise: Can this help to improve or preserve cognitive function throughout adulthood?

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What was the study?

In their article “Effect of aerobic exercise on cognition in younger adults: a randomized clinical trial,” Dr. Stern and coauthors looked at how exercise affects thinking and memory. There are many reasons why scientists are interested in this area.¹ There is a growing body of research and several recently published studies in this area. In fact, in 2012, the *Neurology*® Patient Page covered the same topic of exercise and cognition.² The question seems clear: is there a way to preserve or improve thinking and memory in adults? More specifically, if we can find an answer to this question, can we use this information to help people with neurologic illnesses that cause problems with thinking and cognition (like Alzheimer disease [AD])?

Why was the study done?

There are many reasons why a person might have problems with thinking and memory. Some of these are genetic. Others are due to environmental factors like drugs or environmental toxins. For other people, problems with thinking are due to traumatic brain injuries, stroke, or in some cases a neurodegenerative disease (like AD).

In some instances, the cause can be treated. Some of the more common reversible factors that can lead to cognitive decline are vitamin deficiencies (B₁₂, B₁), thyroid disorders (low or high), metabolic derangements (hepatic, renal, calcium, sodium), infections (respiratory, urine, blood, or CNS), seizures, and depression. Many of these causes are easily identified by widely available medical tests. When they are promptly detected and diagnosed, treatment is started, and the cognitive problems can be improved. Because of this, health care providers must be aware of the signs of cognitive decline. That way, they can diagnose and treat reversible causes quickly and efficiently.

In other cases, the cause of the problems with thinking may not have a cure. AD is one example. Although there are many treatments for the symptoms of AD, there is no cure. Saying this, there are many medicines (including vaccines and antibodies) that are currently being studied to greatly improve the problems due to AD. At the same time, scientists are interested in ways to prevent the illness from getting started. In addition, if a person has problems with thinking, there may be therapies that could preserve cognition, and slow the progression of the underlying disease.

However, before addressing ways to improve thinking, it is important to understand how neurologic illnesses can affect cognition. When a neurologic illness occurs, its effect on thinking is usually gradual. At first, it is mild. The mildest form of cognitive dysfunction is called mild cognitive impairment (MCI). MCI is defined as a change in thinking with impairment in one or more cognitive domains (memory, executive function, attention, language, and visuospatial skills). In MCI, the problems that occur are usually not severe enough to affect the person's independence or other activities of daily life.³

In some people with MCI, the cognitive problems never worsen. However, it is estimated that 8%–15% of patients with MCI each year will progress to a more severe form of cognitive impairment called dementia.⁴ Dementia is defined as a progressive deterioration in memory affecting at least 2 other cognitive domains that is severe enough to interfere with social functioning or activities of daily life. Of all the different cognitive domains, it has been shown

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that executive function is most affected during aging. Executive functions are higher-level cognitive skills such as attention, planning, problem solving, abstract thinking, self-control, regulation of emotions, moral reasoning, and decision-making. Once these skills are impaired, and depending on the severity of impairment, it becomes much more difficult for a person to function on a day-to-day basis.

There has been a much-needed increased interest in improving and maintaining cognitive functioning over recent years. It is widely accepted that physical exercise, a balanced diet, good sleep hygiene, mentally stimulating activities, and limited alcohol intake all promote brain health. Several studies have shown that aerobic exercise increases attention processing speed, executive function, and memory in adults older than 55.⁵⁻⁷ However, these studies were limited. They had low enrollment and did not include a randomly assigned control group.

How was the study done?

Dr. Stern gathered information from 132 individuals aged 20–67 without any cognitive problems. To qualify for the study, the participants had to be right-handed, cognitively normal nonsmokers. They needed to be sedentary and had below average fitness using American Heart Association standards. Eligible participants were assigned to 2 different exercise groups. The first was assigned to aerobic exercise (the study defined as increasing their maximal heart rate during exercise). The second group started a regimen of stretching and toning exercises only (described as promoting flexibility and improving core strength).

Both groups had 66 participants in each of them. The 2 groups had similar characteristics. In other words, there was the same percentage of male and female participants. The people had the same age range, height, weight, and cognitive functioning before starting the study. Participants were then randomly assigned to either aerobic exercise or the stretching/conditioning regimen. For the next 6 months (24 weeks), the participants went to the gym 4 times per week. They either did aerobic or stretching exercises, depending on the group to which they were assigned. Individuals in these groups exercised for 30–40 minutes with 10–15 minutes of warm-up/cool down.

To measure what changed during the 6 months of exercise, participants went through many medical tests. They had these tests before starting the exercise program, during, and after completion of the 6 months. Medical tests included measurements of aerobic capacity (maximal oxygen uptake), several domains of cognition (executive function, episodic memory, processing speed, language, and attention), everyday function, body mass index (BMI; a measure of weight), and cortical thickness (the cerebral cortex is the outer most layer of the brain responsible for higher brain functions). In addition, the investigators measured a blood protein called

APOE ϵ 4. *APOE* ϵ 4 is involved in the metabolism of fats in the body. It has also been linked to AD and heart disease.

What did the study show?

At the end of the study, when the 2 groups were compared, there was a significant increase in aerobic capacity and a decrease in weight (BMI) in the aerobic group. More importantly, aerobic exercise was shown to improve executive function. Not only that, the older participants saw a greater improvement than younger participants. This is important because it suggests that older individuals with cognitive impairment will likely see a greater performance increase with aerobic exercise. Cortical thickness (measured in a region of the left frontal lobe) was significantly increased in the aerobic exercise group. Finally, individuals carrying *APOE* ϵ 4 showed less improvement in executive function with aerobic exercise than individuals without *APOE* ϵ 4, suggesting that *APOE* ϵ 4 genotype may be a possible moderator of aerobic exercise effects.

What does this mean?

Doctors have a lot to learn about diagnosing, treating, and maintaining cognition as we age. Studies like this help doctors (and patients) know how to best prevent and manage cognitive decline. For those who want to live a healthier lifestyle and attempt to maintain or improve cognitive function as they age, this study showed that moderate aerobic exercise improves cognitive function in adults. There are many reasons why aerobic exercise can help cognition. For instance, aerobic exercise leads to increased oxygen uptake to vital organs like the brain. In addition, routine aerobic exercise improves sleep, which has a positive effect on daytime cognitive function. Most importantly, the study showed the older individuals in the aerobic group had a greater improvement in executive function than did the younger participants. This proves that it is never too late to start aerobic activities.

The authors discussed the limitations of their study. First, it was a relatively small sample size. Second, the exercise period was for 6 months. A longer study could have looked at the sustainability of aerobic exercise effects beyond 6 months.

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About Alzheimer disease

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What is Alzheimer disease?

Alzheimer disease (AD) is a neurologic disease that affects the brain. A gradual loss of memory is one of the main symptoms that a person would experience. Other problems include difficulties with language and changes in behavior. The loss of neurologic function can occur gradually over 5 to 20 years. At some point, if the disease becomes severe, a person with AD will need help with daily tasks such as eating, grooming, and proper hygiene. In other words, Alzheimer's affects both the patient and the people around them.

About 5 and a half million Americans have AD. It is estimated that more than 360,000 new cases occur each year. This number will probably increase as the population ages because *aging* itself is a major risk factor for the development of AD. AD is the sixth leading cause of death for adults. It kills more than 100,000 Americans each year.⁸

What are the symptoms?

Loss of recent memories (also called short-term memory) is usually the earliest warning. For instance, the person will repeat stories in the same conversation. They may forget the details of the previous day: for instance, they may not recall what they had for lunch. Other features include: misplacing belongings, difficulty doing familiar tasks, trouble finding the right words to say, and not following conversations. For some people, there can be changes in mood, behavior, or personality.

Because AD is so gradual, in its early stages, many people fail to recognize that something is wrong. They may assume that such behavior is a normal part of getting older: “just a senior moment.” Although forgetting things is common, if it is something that is getting worse, it may be a sign of a more serious problem. The key to treatment is early diagnosis. It is critical to see a doctor when you recognize or suspect AD symptoms.

How is AD diagnosed?

When AD is suspected, it is important to have a complete medical and neurologic workup. In the first doctor's visit, a detailed history and examination is needed. Often, blood tests are ordered, and brain imaging studies are requested.

What causes AD?

The cause of AD is not fully known. It is *not* contagious. Although genetic forms have been identified, the most common form of AD does not run in families.

What are the treatments?

Although there is currently no cure for AD, there are treatments that may help the symptoms of AD:

- **Memory symptoms.** The cognitive symptoms of AD should be treated as early as possible to slow the progression of the disease. Drugs called cholinesterase inhibitors may be considered in patients with mild to moderate disease. Vitamin E may also slow the progression but should only be used if prescribed by the doctor.

- **Behavioral problems.** Suspiciousness, aggression, or resistance to care may be treated first by understanding what triggers these behaviors. Caregivers may learn how to change things in the environment to improve cooperation. Some examples include providing low lighting and music to improve eating behaviors, taking regular walks, scheduling toileting, and following consistent routines. Certain medications may also help, including drugs to treat depression.

Keeping your brain healthy

- **Avoid harmful substances**—alcohol and drugs should be avoided. In certain situations, these substances can cause damage to brain cells.
- **Challenge yourself**—read frequently, do crossword puzzles, play games which constantly challenge the mind. In short, keep mentally active. Learn new skills. This strengthens the brain connections and promotes new ones. One way of thinking about this is that a person needs to exercise their mind as well as their body.
- **Exercise regularly**—even low-moderate level activity such as walking or gardening 3 to 5 times per week can make you feel better.

- **Stay socially active**—stay in contact with family, friends, church, and your community. Social interactions also challenge our brains and contribute to better brain health.

Caregiver health

Families and friends can help by recognizing that AD impacts not only the patient, but also the caregiver. To take the best care of the patient with AD, the primary caregiver must take care of himself or herself. They should be encouraged to learn more about the disease, avoid isolation, and seek support from family, friends, and professionals. Don't be afraid to ask your doctor questions!

For more information

Brain & Life

brainandlife.org

Alzheimer's Association

alz.org

Family Caregiver Alliance

caregiver.org

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