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The Role of Physical Exercise in Cognitive Function

Michael Schwenk, PhD, University of Arizona Interdisciplinary Consortium on Advanced Motion Performance (iCAMP) and Arizona Center on Aging, and Jane Mohler PhD, MSN, NP-c, University of Arizona Center of Aging

The fear of memory loss leading to Alzheimer's disease (AD) is a great concern of older Americans, yet to date there has been no effective method of prevention and few effective treatments for AD. Recent and accumulating evidence demonstrates that it is not just the body that benefits from exercise, but the brain, too. Although there is no current evidence that regular physical exercise can actually prevent AD, several prospective observational studies have found that physically active older adults may be less prone to cognitive decline and have a lower prevalence of AD than those who are sedentary. The physical benefits of regular aerobic exercise, including reducing the risk of cardiovascular disease and diabetes, strengthening the bones and muscles, and reducing stress, are well known. The benefits of aerobic exercise on cognitive function are less well known, but may include improved executive function (the ability to think abstractly and to plan, initiate, sequence, and monitor), multi-tasking, task switching, selective attention, and working memory, along with an increase in the volume of brain structures important for memory.

Exercise and Cognitive Impairment

Aerobic exercise can improve memory, reasoning, judgment and thinking skills for older adults with mild cognitive impairment (MCI). A 2013 study from the University of Maryland School of Public Health showed that an exercise intervention in older adults ages 60-88) with MCI (improved memory recall and brain function as measured by functional MRI (fMRI) neuroimaging. After just 12 weeks of a moderate exercise program, subjects improved their neural efficiency -- using fewer neural resources to perform memory tasks, compared to baseline. A 2012 study at University of California Irvine study showed a single 6-minute interval of moderately intense exercise improved

memory in individuals with memory deficits, an effect postulated to be related to the exercise-related release of norepinephrine, known to play a role in memory modulation.

In particular, executive functioning seems to be susceptible to improvements induced by physical activity, implying a specific exercise effect on higher cognition rather than on other basic cognitive domains. Indeed, there is emerging evidence that executive function is the critical "cognitive component" that is important when facing real life mobility tasks that are complex and challenging. The strongest exercise effects on executive function have been noted for combined aerobic exercise and strength training and for more intensive exercise. Dual-task studies indicate that both attention and control of executive functions can be improved when performing a cognitive and a motor task simultaneously (e.g., walking while counting backwards), even in patients with early to moderate dementia. Recent evidence also points to dancing as a "natural" intervention combining exercise and cognitive challenge. However, specific recommendations for optimal dual tasking exercise regimens are lacking and further studies are required.

Research has demonstrated that even acutely impaired geriatric inpatients with dementia are able to carry out and benefit from some forms of exercise, dispelling the often held view that they are unable to participate in rehabilitation programs.

The bottom line is that exercise may have a preventive and ameliorating effect on cognitive decline (in addition to helping to maintain strength, balance, and flexibility). Regardless of the fitness level, most older adults can likely benefit from, and may well be able to perform, some sort of exercise regimen.

TIPS FOR DEALING WITH PHYSICAL ACTIVITY AS AN APPROACH TO IMPROVE COGNITIVE FUNCTION

- Recommend that all older adults participate in regular physical activity.
- For those who are physically fit, recommend at least 150 minutes per week of moderate-intensity activity, 75 minutes of vigorous intensity activity, or a combination of the two.
- For those who lack sufficient fitness for moderate- or vigorous-intensity activity, recommend activities of which they are capable. The goal is to avoid being sedentary.
- Include muscle strengthening and flexibility training in the activity regimen.

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Continued from front page

How Does it Work?

While observational studies have demonstrated an association between exercise and preserved cognition in older adults, causation has not been unequivocally demonstrated. If there is a causal mechanism, any of several mechanisms could be involved.

For example, a number of studies have been conducted to examine the effect of exercise on human brain structure and function. Research using fMRI have demonstrated that increased cerebral blood volume in the dentate gyrus of the hippocampus, a center involved in memory, occurs in association with improvements in cardiorespiratory fitness and performance in verbal learning and memory. Other mechanisms might include stimulation of neuroplasticity, improving neuronal function, up-regulating growth factors, increasing neuroendocrine response to stress, decreasing neuroinflammation, and/or reducing neuro-pathologic load. Improvements related to dual-task performance might be due to a better coordination of cognitive resources and improved attention-control strategies. Non-human animal research has had similar findings and has contributed to our understanding neurocognitive plasticity in humans.

However, many unanswered questions remain in the field of exercise neuroscience. Nonetheless, there is accumulating evidence that physical exercise has benefit. It should be encouraged in all older adults, including those with mild cognitive impairment and dementia.

How Much Physical Activity Do Older Adults Require?

Current recommendations are that adults age 65 years or older who are generally fit and have no limiting health conditions should do a least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity. It is thought that aerobic activity can be broken up into smaller chunks of time during the day, as long as they are at least 10 minutes each. If chronic conditions preclude activity at the recommended minimum amount, older adults should perform physical activities as tolerated to avoid being sedentary. In addition to aerobic activities, exercise prescriptions for older adults should also include muscle strengthening and flexibility exercises performed at least twice weekly.

References and Resources

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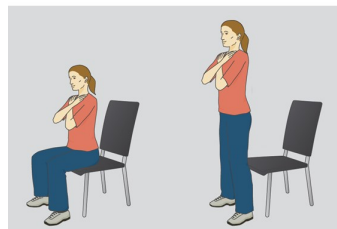
An example of a simple strength exercise program for individuals with limited fitness is provided in the figure below. The progression of activities should be individualized and tailored to tolerance and preference. For the exercises below, recommend 30 seconds of rest between each set of 10 exercises.



2 sets of 10 repetitions

Chair Dips

Hold the backrest of a sturdy chair
Stand hip width apart
Lift your heels as much as possible
then bring them back to floor
Repeat this movement 10 times
Rock back on your heels and lift
your toes to stretch between sets
Rest and Repeat 10 times
Do heel raises with one leg to increase intensity of this exercise



2 sets of 10 repetitions

Chair Sit to Stand to Sit

Sit on a sturdy chair
Cross your arms on the chest
Rise from the chair to a fully up
right position
Slowly return to a sitting position
Repeat this movement 10 times
Rest and repeat 10 more times
Use armrest to ease this exercise
Raise your arms overhead as you
stand for more work



2 sets of 10 repetitions

Stair Steps

Hold the handrail of a staircase for
safety
Step up on a step one foot at a
time
Step down one foot at a time
Repeat 10 times alternating the
leading foot
Rest and Repeat another 10 times

In summary, older adults gain substantial health benefits from regular physical activity, including potential positive effects on cognitive performance.

Interprofessional care improves the outcomes of older adults with complex health problems

Editors: Mindy Fain, MD; Jane Mohler, NP-c, MPH, PhD; and Barry D. Weiss, MD
Interprofessional Associate Editors: Tracy Carroll, PT, CHT, MPH; David Coon, PhD; Jeannie Lee, PharmD, BCPS;
Lisa O'Neill, MPH; Floribella Redondo; Laura Vitkus, BA

The University of Arizona, PO Box 245069, Tucson, AZ 85724-5069 | (520) 626-5800 | <http://aging.medicine.arizona.edu>

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