

The effects of physical exercise on elderly cognitive and brain functions

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Abstract: With advancements in technology, the life expectancy of our senior citizens has gone up tremendously. We have become an older society. Once you reach the age of 55, ones brains basic cognitive functions begin to regress. In this review, we explored the effects of exercising on the cognitive functioning of older adults. We focused on two subsections of this subject, which were the effects of exercise on non-diseased brain cognitive function and diseased as well. Diseased meaning, suffering from Alzheimer's and Dementia. How can we as a society prolong our senior citizens cognitive brain functions, this is one of the questions that kick started the research into this topic? There has been tremendous amount of research surrounding this subject in a whole. This piece was written in aim to give an overview of the studies and research that has been conducted on the subject so far.

Keywords: Capitalize each Keyword and separate by a comma

1. Introduction

In today's society, with the advancement in technology, research and science in general, the life expectancy has prolonged. From 1999 to 2050, the world population aged 65 and over is expected to triple stated by the US census [1]. We have become a society filled with elder adults. With old age comes advanced aging. Our bodies tend to regress once we turn 30. Chronological aging, or senescence, is associated with an increased risk of chronic conditions and diseases such as cognitive impairment, cardiovascular disease, and metabolic syndrome [2]. An increasing amount of studies have uncovered that lifestyle has a significant effect on how well the brain ages. For example, in Fratiglioni [3] reported that three lifestyle factors can play a significant role in slowing the rate of cognitive decline and preventing dementia: a socially integrated network, cognitive leisure activity, and regular physical activity. In this review, we will focus and explore the effects physical activity has on the advanced aging of the brain and the clinical problems that come along with it. Physical activity can be classified as one's everyday bodily movements. Physical exercise is different from physical activity in that the activity is planned and structured to improve specific physical skill or fitness. There is evidence to suggest that physical activity and exercise can to some extent stop or slow down the adverse effects that are associated with advanced aging of the brain.

Maintaining physical activity has been associated with protections against chronic diseases, such as cardiovascular, obesity, and some cancers [4, 5]. Physical activity has also shown to protect the aging mind from disease such as dementia and Alzheimer's [6]. The promise of physical activity being the complete cure is still under review and researched. While researching the topic of "effects of physical exercise on an elderly adults cognitive brain function", I found that there were multiple studies surrounding effects of physical exercise on cognitive function of an elders brain. The cases we will be focusing on in this review surrounding the effects of physical exercise on elderly cognitive brain function is on a healthy senior citizen, senior citizen suffering from Alzheimer's and Dementia, and specifically the effects of aerobic exercise. This review is an overview that is intended to review the studies that have attempted to assess if and how physical exercise impacts the cognitive and brain function of elder adults.

2. Methods

A literature review was conducted using Google Scholar, Texas A&M library databases, and EndNote. The keywords used were "Alzheimer's, healthy, physical exercise, elderly adults, cognitive, and brain function".

3. Physical Exercise by Healthy Senior Citizens

There is a stereotype in science when it comes to aged brains. For example, in human neuroscience, the aged brain has historically been stereotyped as brittle and non-conforming with little room for augmentation or enhancement [8]. Due to recent research, the brain is a lot more plastic and responsive than previously thought. Even with the recognition that elder brains are more plastic and retain much more as well, there is still major evidence that an older brain endures serious hippocampal atrophy during advanced aging (See Fig 1) [8].

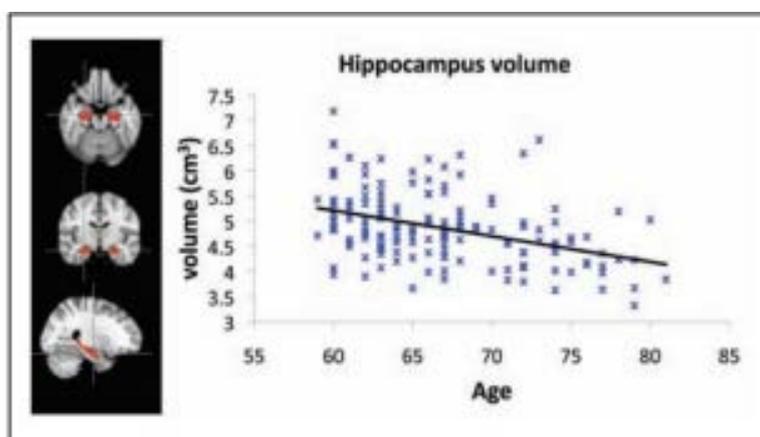


Figure 1. The mean hippocampal volume (for both left and right hemispheres) atrophies in late adulthood. These data were collected using a high-resolution magnetic resonance imaging scan and the hippocampus demarcated using an automated segmentation algorithm (from Erickson et al [8]).

The Hippocampus is a small organ in the brain located in the Brain's temporal Lobe and helps make the limbic system, which controls emotions. The Hippocampus is also associated with memory, specifically long-term memory. The Hippocampus also takes part in spatial navigation. It is easy to see how regression in this organ can cause many problems for anyone. There has been longitudinal studies to back this, for example, longitudinal studies have reported between 1% and 2% annual hippocampal atrophy in adults older than 55 years without dementia [9]. In one study, they aimed to see if one's performance on tasks assessing verbal and visuospatial memory were affected by their cardiorespiratory fitness. The data from ninety-nine cognitively normal men and women aged 60–80 years was used. Fitness was assessed by peak oxygen consumption, and verbal and visuospatial memory were evaluated using well-validated measures. Participants were categorized into: lower-fit Met carriers, higher-fit Met carriers, lower-fit Val/Val, or higher-fit Val/Val. Higher-fit individuals performed better on a task assessing visuospatial memory, compared with lower-fit individuals [10]. To be more specific the higher fit group had fewer errors on the Continuous Paired Associate Learning Task (CPAL), which was used to measure visual memory. On the CPAL test, participants were asked to learn and remember pictures beneath different locations on a computer screen [10]. In this experiment, the higher fit group was significantly younger and had a lower BMI.

4. Physical exercise effects on Cognitive function in elder adults at risk of Alzheimer's

According to the Alzheimer's Association [11], one in eight people aged 65 and older (13%) and 43% of people 85 and older have Alzheimer's disease. Currently, there is no cure for Alzheimer's disease. This is one of the multiple diseases that plague older adults going through advanced aging. Authors in another study discuss the evidence that a single nucleotide polymorphism in the brain-derived neurotrophic factor (BDNF) gene and age-related changes in BDNF protein or receptor expression contribute to hippocampal atrophy [9]. The Hippocampus like said before in this review, is a small organ in the brain that controls memory, spatial navigation. Increase of BDNF by aerobic exercise appears to ameliorate hippocampal atrophy, improve memory function, and reduce depression [9]. In a study done by Haley, it was found exercise prevents and reduces the risk of developing secondary conditions that arise from functional decline and physical disuse [12], Secondary conditions such as Dementia and Alzheimer's. Functional fitness such as walking has been associated with a huge amount loss of dependence in older adults with disabilities. The relations among physical fitness levels, specifically aerobic fitness, cognition, and physical health in older adults, is well established [14]. In the Meta-analysis by Patricia [7] they decided to synthesize all the available evidence on physical exercise on impaired older adults. In one of the studies 578 exercise training participants with cognitive impairments improved more

than the 511 control and comparison subjects on functional performance measures. They also found cognitively impaired exercise group (n423) showed improvements in cognitive tasks [7]. The physical activities that the test subjects underwent were, walking, cycling, and weights training. From the multiple studies and reviews on this subject, it can be seen that Physical exercise has a positive effect on the cognitive functioning of adults suffering from brain impairments. In one study completed in 2017 by a group of researcher's, they assessed the effect of 26 weeks (6 months) aerobic exercise program on memory, executive function, functional ability and depression in early AD [13]. The methods included [13], this study was a 26-week randomized controlled trial comparing the effects of 150 minutes per week of aerobic exercise vs. non-aerobic stretching and toning control intervention in individuals with early AD. A total of 76 well-characterized older adults with probable AD (mean age 72.9 [7.7]) were enrolled and 68 participants completed the study. Exercise was conducted with supervision and monitoring by trained exercise specialists. Neuropsychological tests and surveys were conducted at baseline, 13, and 26 weeks to assess memory and executive function composite scores, functional ability (Disability Assessment for Dementia), and depressive symptoms (Cornell Scale for Depression in Dementia). Cardiorespiratory fitness testing and brain MRI was performed at baseline and 26 weeks [13]. Aerobic exercise was associated with a modest gain in functional ability (Disability Assessment for Dementia) compared to individuals in the ST group ($X^2 = 8.2$, $p = 0.020$ [13]). In the end of the overall assessment there was no clear effect of intervention on other primary outcome measures of Memory, Executive Function, or depressive symptoms. However, secondary analyses revealed that change in cardiorespiratory fitness was positively correlated with change in memory performance and bilateral hippocampal volume [13]. The best exercise that was used to measure the results was walking. Walking on a treadmill to be exact, walking on a treadmill was the safest exercise for the subjects to complete due to their age and range of motion. Walking seems to be the go to exercise for older adults if they plan to increase over brain functionality.

5. Summary and Practical Applications

In this review, we explored the topic of "The effects of physical exercise on cognitive function in older adults". While exploring the topic we found that while an elders brain is aging, depending on its stimulation, is at risk of becoming impaired by diseases such as dementia and Alzheimer's. Physical exercise effects on a "healthy" elder brain, healthy meaning, without disease was the first subsection of the topic we explored. In the study by Erickson, "Aging of the hippocampus", they highlighted the fact that the hippocampus was responsible for many cognitive functions such a memory, spatial navigation, and emotional regulation. It was found that the Hippocampus regressed after the age of 55 years. In the study, they wanted to see if one's verbal and visual spatial memory would be affected by cardiorespiratory fitness. They measured the subjects cardio fitness, by using their VO2 maxes. The next step was to put the subjects through cognitive testing. Tests showed that the subjects that were higher fit made fewer errors on the visual spatial test, in comparison to their lower fit counterparts. The next subsection explored was the effects of physical exercise on older adults suffering from Alzheimer's or dementia. We found that physical exercise could reduce or prevent brain Alzheimer's or dementia according to Haley [12]. In the Meta analysis that we reviewed [7], participants who suffered from some kind of illness, actually improved more than the control group. In this, we can see that physical exercise has positive effects on the cognitive functioning of elder's adults. In one study with rats, physical activity helped cells proliferate in the dentate gyrus, which was associated with enhanced learning rates [8]. Since we are now a society full of older adults, it is our mission to, make sure our elders stay active and brains stay stimulated. Brain regression is inevitable, but if we keep our aging people active, we can slow down the regression significantly.

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