Exercise and Cognition in Elderly

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Abstract

In developed countries, the population is aging. The aging process brings forth a slew of physical and mental changes. There has been a progressive deterioration in the degree of cognitive processes closely tied to the aging process, which is most commonly associated with age-related disorders such as dementia, throughout time. Physical activity and exercise have been identified as a method for promoting older health, as well as encouraging the maintenance of functional ability and acting in the prevention and control of a variety of diseases. The benefits of physical activity in the preservation or even improvement of cognitive performance in both the old without cognitive impairment and the elderly with some degree of cognitive impairment or dementia have piqued researchers' interest in recent years. The goal of this study was to examine the effects of various types of physical activity and exercise on cognitive function in elderly people with and without prior cognitive impairment, to identify potential mechanisms underlying these effects, and to make exercise prescription recommendations to improve cognitive performance.

Keywords: Cognitive performance, elderly, physical activity, preservation

Introduction

In 2017, the world's population of people aged 60 and more was 962 million; this number is anticipated to rise to 2.1 billion by 2050.[1] Chronic illness frequency and severity are rising among the elderly as a result of changing demographics.[2] Memory, language, thinking, and everyday activities difficulties are all symptoms of dementia, which can progress to Alzheimer's disease and other neurological diseases.[3,4] Dementia affects 35.6 million people globally, with a predicted increase to 75.6 million by 2030, making it a serious public health issue.[5,6]

Mild cognitive impairment (MCI) refers to the point where normal cognition meets impairment. At some time in their lives, 60%–65% of persons with chronic intellectual impairments are expected to develop hospital disabilities.[7] Reducing or eliminating this behavior can have a favorable influence on health-care quality and costs. Indeed, if Alzheimer's disease (the most prevalent form of dementia) kills people within a year, the federal budget may be lowered by $ 113 billion by 2030.[8]

Adults have discovered that exercise and exercise can help them enhance their brain function. However, there are no exercise guidelines for improving cognitive function, and the processes behind this cognitive advantage are unknown. The primary goal of this case–control study is to review contemporary research on the effects of prolonged exercise and cognition on cognition, investigate the processes behind these effects, and make training documentation suggestions to enhance intellectual performance. Our major focus is on parents over the age of 50 years who are in good health. This research starts with a review of the evidence for the link between training and cognition, which is based on prior work by Bherer *et al*.[9] Kirk-Sanchez and McGough.[10]

According to expected and future studies, active persons suffer less dissatisfaction and impairment. Hammer and Sheda evaluated exercise and the likelihood of acquiring neurodegenerative illnesses in 16 prior studies including 163,797 physically challenged individuals. Hardworking employees had a 28% reduced risk of dementia and a 45% lower risk of Alzheimer's disease.[11] In a meta-analysis of 21

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long-term studies including 89,205 participants over 40 years, increased activity levels were likewise linked to lower mental retardation and impairment.[12] Another meta-analysis of 15 future research found that active persons (mostly the elderly) had a 38% reduced risk of depression.[13] Active older adults are less likely to develop Alzheimer's disease than their inactive peers, according to a meta-analysis by Daviglus *et al*.[14] and Beckett *et al*., Each comprising 9 ongoing studies among the elderly.[15]

Exercise Therapies

As demonstrated by randomized controlled trial (RCT) and aerobic exercise (AE) resistance exercise (RE), a mix of AE and RE, physiotherapy can enhance cognition in adults, and exercise is an empirical study and local meta-analysis of exercise and cognition (god Tai, Qigong, dance or yoga) Adults' cognition is improved by AE and RE, according to a meta-analysis. Colcombe and Kramer discovered that joint AE training (AE and RE) had a beneficial impact on cognition in a study of 18 randomized controlled trials in sedentary older adults.[16] Walking affects group status as well as obstacles among older individuals in a disability-free condition, according to a meta-analysis by Scherder *et al*. based on eight randomized controlled studies.[17] Northey *et al*. showed that AE, RE, and therapy treatments (AE and RE) were all effective for enhancing cognition in the elderly in a meta-analysis of 36 randomized controlled trials including adults.[18] Barha *et al*.[19] revealed that AE had a substantial effect on head function and healthy older individuals in a thorough evaluation of cognitive outcomes after a training program to date. It is worth noting, however, that this meta-analysis included a high number of training participants who thought it would improve cognition in women more than in males.[20]

Exercise has also been shown to boost cognition in adults. Wu *et al*. showed substantial gains in general reading, cognitive changes, working memory, speaking, and learning among handicapped and illiterate individuals in a study of 32 randomized controlled trials.[21] Zhang *et al*.[22] showed that mind-body training improves cognition, cognitive function, learning, memory, and language in individuals with intellectual impairments in a review of 11 randomized controlled studies. Physical activity benefits clever persons more than it does people with intellectual impairments, according to researchers.[22] Others, including Wayne. A meta-analysis of 11 randomized controlled studies published in 2014 revealed significant values for tai chi in the work of principals and people with intellectual impairments.[23] Finally, Gothe and Mccauley showed that yoga had detrimental impacts on attention, processing speed, memory, and fundamental function when compared to controls in a meta-analysis of 15 randomized controlled studies. It is worth noting that these meta-analyses spanned a range of ages, with six of them including adult randomized controlled trials.[24] In a broad group of 36 randomized controlled studies (23 done in healthy people), Sanders *et al.* reported relatively minor effects related to AE, RE, AE, and RE on exercise balance, immediate memory, and healthcare in the elderly.[25] The exclusion of numerous studies that do not describe strength training or treatment regimens that progressively raise the dosage might explain this finding.[26] In this article, other meta-analyses have shown opposing outcomes. Young J *et al.* A meta-analysis of a Cochrane review of 12 RCTs showed no evidence that varied AE dosage regimens (e.g., three 8-week programs and one offering one activity per week) enhance cognition in healthy individuals.[27] Kelly *et al.* Extension and discussion of concepts in tai chi, attention to speed and coordination, and lack of training were all shown to be beneficial impacts of IR in a meta-analysis of 25 randomized controlled trials on cognition in healthy people published in 2014. In those above the age of 60 years, AE had no effect on cognition. The findings of the authors can be explained by the fact that they evaluated the included literature between 2002 and 2012, narrowing the scope of the investigation. They also did not rule out large-scale or short-term investigations, both of which might compromise their findings.[28]

Other conflicting data comes from Etnier *et al.*'s meta-analyses, which revealed that AE and RE had no effect on general cognitive performance. The study selection and training dosage, however, are not mentioned in this study. However, a review of 134 research found that persons aged 45 to 60 had the largest influence on training habits and cognitive performance.[29] A meta-analysis of the influence of AE on Smith *et al.* intelligence's work is given, which includes 29 randomized controlled trials with and without impairments. The participants allocated to the AE intervention exhibited improved focus, processing speed, core function, and memory as compared to the nonaerobic exercise control group. It should be emphasized, however, that they also considered age 18+ as a factor in their research. Despite the fact that several of the studies in the meta-analysis focused on the elderly, seven of them were small, which might have negative consequences for the old.[30]

In the belly, the grey and white portions of the human brain, primarily the prefrontal cortex and hippocampus, atrophy.[31,32] According to 2-year research utilizing magnetic resonance imaging, physically challenged people lose 1%–2% of their subcutaneous volume each year, with those suffering from Alzheimer's disease losing even more. Another study discovered that higher age is linked to plasma levels and brain-derived neurotrophic factor (BDNF) levels, an essential growth factor in the association between brain health and exercise, according to immunosorbent enzyme tests. A randomized controlled experiment including 90 individuals with a 1-year follow-up revealed a link between age and BDNF levels in the blood, with adults over 65 years seeing the largest rise in BDNF following surgery. Importantly, they discovered that increases in BDNF blood levels and head function alter across time in the AE group, with adults benefiting the most from enhanced cognitive performance.[33-35]

Neuroplasticity, or the brain's capacity to form and control synaptic connections, appears to be an essential process for enhancing cognition in people of all ages. Colcomb *et al.* adults who train in the air had more nerve activity in the frontal and parietal areas of the brain than control subjects in randomized controlled trials utilizing magnetic resonance imaging.[36] In their RCT,[37] Voss *et al*. showed benefits in a mix of local performance that supports the main network and the frontal lobe after 12 months of training for AEs and seniors. According to a cohort study of 165 healthy individuals, those with high physical activity had a fuller hippocampus size and performed better in memory function than those with low physical activity.[38] Some of the increased risk linked with exercise appears to be due to neurosurgery. This research looks at the impact of growth factors including BDNF, insulin-like growth factor-1 (IGF-1), and vascular endothelial growth factor (VEGF) in improving cognitive performance in the elderly.

Relationship between Exercise Therapies and Upregulation of Growth Factors

According to high-quality research, there is a relationship between physical treatment and control in teenagers and adults. Others include Catherine Deneuve[39] found an increase in BDNF levels after exercise in 910 healthy people of all ages, and a meta-analysis of 29 studies employing AE and RE in 910 healthy adults of all ages found an increase in BDNF levels after exercise in 910 healthy adults of all ages. Changes in BDNF levels were shown to be unrelated to sex or age, suggesting that BDNF levels rise with exercise independent of age or gender. Surprisingly, the authors discovered substantial variations across the included studies in demographic analyses, training programs, evaluation techniques, and study scores. There is evidence that the sort of exercise you perform affects teenage coordination. Others include Catherine Deneuve.[39] After screening for AE and RE in healthy people, it was discovered that AE, but not RE, had a substantial impact on the rise in BDNF levels in healthy participants. In addition, a randomized controlled trial of 66 people with moderate cognitive impairment (MCI) discovered that high AE levels raised BDNF and IGF-1 levels, whereas high RE dosages elevated IGF levels.[40,41] They discovered a substantial rise in serum IGF-1 levels and one or two comparison tests for control in 62 older adults who participated in the RCT and a double-blind trial (24 weeks of severe RE and 24 weeks of RE). According to the study, AE therapy aims to raise BDNF levels, whereas RE treatments attempt to raise IGF-1 levels. Although many young individuals appear to benefit from exercise, little is known about how exercise impacts cognitive performance. A 16-week program of aerobic exercise, endurance, and various training enhanced athletes' posture, training speed, attention, and thinking compared to monitoring a waiting list, according to a randomized controlled trial of 49 active older women. This study's potential for increased activity was significantly higher than prior studies that employed only one or two forms of training.

The Effects of Exercise Interventions

Stein *et al*. conducted a systematic review of seven randomized controlled trials evaluating exercise outcomes (4 AE, 2 RE, and a combination of 1 AE and RE) with IGF-1 levels and cognitive performance in adults, and discovered that three of the studies added IGF-level I, three it remained stable, and one had a low IGF-1 level, all of which had a positive effect on cognitive performance. This result may be explained by the aforementioned premise that resistance training raises IGF-1 levels; in fact, IGF-1 levels and cognitive performance both rose in the RE system.[42,43]

Growth Hormone

The material for growth hormone is combined with exercise in other randomized controlled studies. In a research of 40 people, high blood pressure levels of BDNF, IGF-1, and VEGF were not substantially linked with exercise, and there was no difference in quick vs delayed sexual intercourse. IGF-1 levels, changes in hippocampus volume, and changes in IGF-I, on the other hand, are active in eliminating temporal delays. In this sort of randomized controlled study, the authors discovered that primary function rose, plasma BDNF levels decreased, and plasma IGF levels were unchanged in the elderly with glucose tolerance.[44,45] A 1-year randomized controlled experiment comparing walking and stretching in healthy volunteers found no significant variations in blood BDNF, IGF-1, or VEGF levels across groups. Using functional magnetic resonance imaging, however, alterations in teenagers and walkers are linked to an increase in functional contacts between the parahippocampal gyrus and the medial gyrus.[46] Finally, while there was no difference in BDNF blood levels across groups, Erickson *et al.* discovered that hippocampus volume (which was greater in group AE compared to control) was related to higher BDNF levels.[47]

As a means of improving adult cognitive function, there are variances in youth evaluation. There are recognized issues with a person's growth factor size, which might explain the discrepancies in the results. For example, by monitoring BDNF levels, Knaepen *et al*.[48] discovered major issues in blood collection and biochemical analysis, such as blood clotting time, retention, and reducing BDNF levels to enhance plasma volume transmission and exercise. Circadian rhythms also induce circulatory alterations when BDNF levels are high.[49,50] The researchers should use and disclose the usual technique to decrease the size mistake. It is also difficult to determine how high a BDNF level corresponds to a central BDNF level; only one study found a relationship between the two and the study included those with psychosis.[51]

Microglia and Cytokines

In the aged, microglia and cytokines increase the development of proinflammatory indicators, causing alterations in the function of vascular cells, endothelium, and microvascular systems, and ultimately nerve damage.[52,53] Inflammation, both acute and chronic, can increase the generation of active oxygen and other neurotoxic chemicals. Because the human hippocampus and basal ganglia contain more inflammatory enzymes than other brain areas, they can induce inflammatory damage.[54,55]

C-reactive protein (CRP), interleukin (IL)-6 and beta-1, and tumor necrosis factor-alpha (TNF-alpha) are inflammatory indicators that are elevated in the stomach and linked to brain injury. The researchers discovered that people with higher levels of IL-6 and CRP were 24% more likely to acquire mental impairment than those with lower levels of inflammation in a long-term study of 3031 healthy persons.[56] Type 2 diabetes, atherosclerosis, multiple sclerosis, and all circulatory problems are examples of chronic diseases.[57,58] According to research on adults and patients with type 2 diabetes, those with high inflammation had less hippocampus and median lobes throughout that period than those with low inflammation.[59,60]

Blood levels of IL-6 were shown to be adversely linked with minor mental status tests and BMI of 3,298 multiracial people after controlling for age, education, and neurological risk, resulting to the findings mentioned in tall. Inflammation has been shown to have an impact on cognition.[61] According to a thorough analysis of 13 RCTs, acute and chronic obstructive pulmonary disease clinics can be decreased following AE and RE. The findings are robust in adults, with strong AE being found to be more beneficial in decreasing inflammation.[62] In a randomized controlled trial of more than 60 people who engaged in weight, resistance, and motor neuron training for 16 weeks, lower levels of TNF and IL-6 and greater levels of BDNF were found in the same exercise compared to a study without exercise (including balance, coordination, agility, walking, and training). Athletes with moderate cognitive impairment (MCI) enhance their cognitive function and attention in another research.[63] In the elderly, AE is thought to produce anti-inflammatory chemicals, which inhibit the activity of proinflammatory cytokines.[64]

Cardiovascular and Cerebrovascular Disease Risk

High blood pressure, dyslipidemia, diabetes, and hyperinsulinemia are all cardiovascular and cerebrovascular disease risk factors that raise the chance of cognitive impairment and dementia. Hypertension was found to have a negative association with attention, visual perception, cognition, memory, learning, psychomotor function, and executive function in older people, which supports these findings. It revealed that elevated blood pressure and fasting blood glucose were linked to an increased risk of cognitive impairment and dementia later in life in 3,381 persons during 25 years.[65,66] Increased rates of cognitive deterioration in the elderly are linked to decreased arterial blood flow and metabolism in the putamen, pallidum, and left hippocampus in hypertensive patients.[67,68] The subcortical white matter network can be disrupted by reduced cerebral perfusion induced by cardiovascular illness and age, decreasing the speed and precision of the process in the elderly.[69] With aging and cardiovascular illness, free radical generation rises, altering the routes of smooth muscle vasodilators.[70,71] With age and coronary artery disease, the cerebrovascular response to carbon dioxide diminishes, increasing the risk of neurological injury.[72]

The positive benefits of EA on cardiovascular and cerebrovascular health in people of all ages have been well demonstrated in the scientific literature. Healthy males aged from 18 to 79 with superior aerobic ability had 17% higher cerebral blood flow than their sedentary counterparts, according to a cross-sectional study of 307 individuals. Brown *et al.* discovered a significant link between physical fitness, cerebral vascular regulation, and cognitive performance in a cross-sectional investigation of 42 healthy older women.[73-78] When compared to age-appropriate inactive controls, aerobic older people exhibited better heart function, including increased stroke volume, wall thickness, and end-diastolic volume. In the elderly, chronic autoexposure raises cardiac output, fraction clearance, and left ventricular contraction.[79-81]

Enhanced cardiovascular and cerebrovascular functioning, according to some studies, may be linked to improved cognitive ability. According to Vidoni *et al*.,[82] changes in fitness levels impact cognitive advantages in older individuals participating in AE treatments. AE training for 12 weeks enhanced immediate and delayed memory outcomes and increased cerebral blood flow in the anterior girdle area compared to controls in randomized controlled trials of the elderly.[83] Finally, greater fitness levels across participants of all ages were linked to improved executive function and enhanced brain oxygenation in the frontal area of the brain when compared to women with lower fitness levels.[84] Exercise-induced cognitive enhancement might be linked to an improved ability of the brain's blood vessels to adapt to chemical, mechanical, or neurological demands. By raising the production of endothelial nitrous oxide synthase, increased blood flow can induce vasodilation.[85] Exercise has also been found to increase the flow of oxygen and glucose to the brain, which improves cognitive efficiency.[86] Despite evidence that higher cardiovascular fitness is linked to improved cognition, two meta-analyses[87] discovered that cardiovascular fitness is a modulatory advantage for the cognitive benefits of exercise in older individuals. Smiley-Oyen *et al.* found an improved executive function for those who performed AE in an RCT-mediated analysis of 57 older adults; however, changes in aerobic fitness are not associated with changes in executive function,[88] providing more evidence to refute the cardiovascular fitness hypothesis. Finally, two other randomized controlled trials found that dynamic, neural, and motor training improved cognitive performance in older adults without increasing cardiovascular capacity.[89,90]

The HPA Axis is Another Method

Another method to enhance intelligence work is to attend an hypothalamic–pituitary–adrenal assessment (HPA) camp. With age, people's capacity to adapt and cope with stress deteriorates. Four out of every eight studies looked at chronic RE and joint treatment in the elderly and found a reduction in blood cortisol levels over time; however, some studies had no control group and no morning cortisol test.[91] Chronic stress can alter glucose absorption, neuroendocrine function, and autonomic function by increasing axis function.[92] High stress has a detrimental influence on work memory, cognitive difficulties, and mood swings, according to a new meta-analysis of 51 pilot studies involving 2486 participants of various ages. The scientists discovered that stress levels had no influence on cortisol effects or resistance to a functional memory and that cortisol injections had no effect on total head function.[93]

The scientists discovered that the influence of pressure on the boss decreased over time; however, because only three trials involved parents, this study is unlikely to have an impact on them. Long-term and part-time data show that individuals with severe chronic stress are 2.7 times more likely to acquire Alzheimer's disease and that greater cortisol levels in the elderly are linked to poorer cognition.[94-97] In a long-term study of 52 patients aged,[98] high and low cortisol levels were linked with mild-intensity cognitive impairment (MCI), but not with normal cognition.

Cortisol Levels

Cortisol levels have been shown to change throughout the day, increasing during the day and then decreasing during the day.[99,100] The difficulty in detecting cortisol levels can explain some of the errors in such a study. Controlling the release of catecholamines and cortisol during exercise can assist people of all ages to reduce stress. Yoga activities, such as a randomized controlled trial of 25 randomized controlled trials with patients with or without chronic illness,[101] enhance the sympathetic nervous system and HPA values (compared to cortisol levels, heart rate, and blood pressure) compared to controls. The elderly, however, were not included in this study. During exercise, the HPA component is activated, resulting in a higher glucocorticoid distribution in the tissues. By suppressing the inflammatory process and generating muscle and cytokines, this action lowers inflammatory stress.[102]

Training has been shown to relax the sympathetic nervous system and the HPA region.[103] In a meta-analysis of forty intervention trials (the majority of the participants are older), Tai Chi was found to have positive effects on anxiety and depression.[104] According to a 42-item survey of adults and adolescents, individuals who practice tai chi and yoga had better mental health results than those who do AE.[105]

Yoga and tai chi may assist strengthen the ability of the parasympathetic nervous system, which can improve cognitive performance,[106] despite the fact that the system is unknown. A randomized controlled study including 118 people revealed that participants in yoga had superior control functions and a lower cortisol response than a single control group after an 8-week yoga session. Changes in self-stress and cortisol levels are expected to work in clinical studies, suggesting that lowering HPA response may be one of the most effective physical training techniques for improving cognition.[107]

Exercise Guidelines

Although publications on movement alterations can give knowledge, there are presently no training recommendations focusing on the acquisition of intelligence in the elderly. Factors linked to the exercise program, such as exercise kind, strength, session duration and frequency, as well as program time, can all influence exercise frequency.

In numerous investigations,[63,108] AE and RE training were linked to effectiveness. We conclude that while this sort of instruction can help people improve their cognition, combining it with other types of training can give educational advantages. Other types of exercise, such as AE (upper and lower extremities versus lower extremities, concentric versus eccentric, and fluid versus floor dependent), RE (continuous resistance training and plyometric exercise measurement), and exercise neuromotor, could be studied in future randomized controlled trials (i.e., strength, balance, and internal training). As a result, most exercise regimens may not have results, and it is advised that exercise medication be increased over time. As a result, we propose that older individuals exercise 5–7 times/week to get technical advantages. The amount of training performed can be a good indicator of benefits.[109-112]

Some experts feel that the advantages of learning may not surface for 6 months or a year after beginning a training program, while others believe that beneficial outcomes might be seen within 8, 12, or 16 weeks. A 2018 randomized controlled trial research of 98 physically challenged individuals revealed that doing at least 52 h of moderate exercise was related to improved results. In addition, their multidisciplinary study discovered that total long-term dedication is the most important predictor of cognitive progress.[113] Astiaso *et al.* performed the same in their systematic review.[114] According to Sanders *et al.*, the impact of program time on cognition might influence training frequency and duration; hence, it is preferable to concentrate on training. As a result, we suggest that the adult training program be at least 52 h long. Future studies should guarantee that the training's overall results are readily displayed and that all team members perform at the same level.

Conclusion

Several studies have indicated that people should include exercise and exercise in their daily routine to prevent the negative effects of aging on the body and mind during the last several decades. We still do not understand how exercise impacts mental deterioration. A key topic is whether daily exercise (i.e., programs including movement and skeletal muscle usage) and regular exercise (i.e., planned and programmed exercise to improve training) give comparable advantages in terms of avoiding age perception decrease. Exercise is distinct from exercise in that it is well-controlled in terms of strength and time, whereas exercise studies may include nonspecific variables. Future studies are needed to establish the type, intensity, and length of training that can help people enhance their cognitive capacities.

The goal of this book is to give a summary of the research on the benefits of exercise on cognition, as well as a list of life practices that can help you start this connection. Exercise, particularly multimodal physical and mental training, appears to help adults' cognition, according to the findings. This technique is supported by a number of systems that are both varied and linked. However, there are several data gaps, such as the absence of sophisticated studies on the mediator of intellectual activity in adults. The optimal training criteria and subtypes for raising this scale will need to be determined in future studies.

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Conflicts of interest

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