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How exercise treatments can improve symptoms experienced by Alzheimer's disease patients

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Abstract. One of the most prevalent diseases in the world is Alzheimer's disease (AD). There are numerous therapies and remedies available today that promise a full recovery from AD. However, none of the available therapies can entirely reverse AD. Cognitive function, self-care skills, and daily functioning abilities all typically decline in AD patients. Even their sleep and mental health are problematic for some AD patients. One of the treatments for AD is aerobic exercise therapy. By allowing the patients to engage in aerobic activities, it can decrease the disease's progression. According to several research, aerobic exercise can enhance the cognitive function, capacity for self-care, and mental health of AD patients. There aren't many systematic reviews on exercise therapy and AD, though. As a result, the purpose of this work is to provide a concise explanation of the mechanisms underlying AD and its therapies based on recently published papers, and to draw conclusions regarding the safety and efficacy of exercise therapy.

Keywords: AD, exercise therapy, aerobic exercise.

1. Introduction

Alzheimer's disease (AD) is a degenerative neurological condition that causes memory loss, behavioral disorders, and cognitive deficits. The most typical type of dementia in seniors is this one. Although the exact cause of AD is still unknown, there are a number of established and accepted risk factors, including genetics, aging, and environmental variables. Amyloid plaques and neurofibrillary tangles are aberrant accumulations that are frequently found in the brains of AD patients. These alterations have the potential to impair memory formation and cognitive function by causing neuronal death and inhibited neuronal transmission. 50 million persons worldwide with AD as of 2019.

Early-stage AD may begin with moderate memory impairments that grew worse over time, impairing movement, communication, and daily living skills. Patients typically reported feeling confused, anxious, and depressed as their cognitive performance deteriorated. Despite the fact that AD is currently incurable, there are medications and other forms of treatment that may be able to help minimize the symptoms and delay the progression of AD.

2. Pathogenesis

There is a ton of study and theoretical support in this field, despite the fact that the precise mechanisms behind the development of AD are not entirely understood.

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The buildup of the protein -amyloid in the brain is one of the most important factors in the onset of AD. Alzheimer's lesions are plaques made of these proteins. According to studies, the aberrant breakdown of the -amyloid precursor protein (APP) is linked to the development of these plaques.[1] Normal -secretase or -secretase enzyme formation of -amyloid precursor protein results in fragments with vital activities. However, in people with Alzheimer's disease, -secretase is principally responsible for producing -amyloid precursor protein, which causes an excess of the protein and ultimately results in the development of Alzheimer's plaque.

Additionally, it is thought that aberrant tau protein aggregation plays a significant part in the mechanisms underlying AD [2] Normally, tau protein aids in the stability of microtubules in nerve axons. Neurofibrillary tangles are structures formed when the tau protein loses its function in AD patients. These tangles' development has an adverse impact on neuronal performance, resulting in neuronal degeneration and death.

Additionally, inflammatory responses aid in the growth of AD. Inflammation in the nervous system impairs nerve structure and function. According to studies, AD may develop as a result of the activation of inflammatory cells, inflammatory mediators and related signaling pathways.

In conclusion, AD development is a complicated process that depends on a number of variables. The development of AD is tightly correlated with the accumulation of -amyloid protein, aberrant tau protein aggregation, and inflammatory response. But further investigation is required to completely comprehend the underlying causes of AD.

3. Pathogenesis

The use of exercise therapy as a component of AD treatment has increased recently. Numerous studies have shown that patients with AD who receive exercise therapy see improvements in their cognitive and behavioral functioning.

One of the key benefits of exercise therapy is its ability to help AD patients with their cognitive function.[3] The appropriate form of physical activity can boost the production of neurotrophic factors and promote the growth of synaptic connections in the brain. These factors are crucial for promoting the development of new neurons, which are required for cognitive processes including memory, cognition, and attention. Exercise also promotes learning and cognitive function by increasing blood flow to the cerebral cortex and hippocampus [13].

Exercise treatment also helps Alzheimer’s disease patients' behavioral problems. Patients with Alzheimer’s disease often experience behavioral abnormalities such as anxiety and sadness. Exercise gives patients a way to release tension, reducing anxiety, and engaging in physical activity, all of which help to curb impulsive behavior. [6] Regular exercise also helps to improve sleep, lessen nightly awakenings, and lessen daytime sleepiness. For Alzheimer’s disease patients, these changes help to slowly improve their quality of life and social functioning.

According to some more studies, there may be many processes in the effects of exercise treatment on Alzheimer’s disease. For instance, it has been shown that exercise controls the metabolism of the protein -amyloid in the brain, lowering its accumulation and slowing down the progression of Alzheimer’s disease. Also,through controlling inflammatory reactions, stress, and antioxidant defense systems, exercise therapy can protect neurons from harm. These systems work together to reduce Alzheimer’s disease symptoms and slow down the progression of Alzheimer’s disease.

It is important to notice that the particular workout program should be adjusted to the Alzheimer’s disease patients’ physical condition. Alzheimer’s disease patients are advised to begin with easy cardio exercises like walking, cycling, or taking dancing courses [7]. Exercise should be slowly increased in both length and intensity.

Aerobic exercise, commonly known as cardio or cardiovascular exercise, is a form of physical activity that increases the heart rate and respiration for an extended period. It involves rhythmic, continuous movements that activates large muscle groups. The goal of aerobic exercise is to improve cardiovascular fitness by improving the heart and lungs' efficiency in delivering oxygen to the body's tissues. Examples include activities like running, swimming, cycling, and fast walking. Regular

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practice in aerobic exercise can lead to a lot of health benefits, including improved heart health, increased lung capacity, weight management, stress reduction, and improved overall well-being. Aerobics activities can reduce symptoms that Alzheimer's disease patients have at the early stage of detection of the disease.[15]

3.1. Aerobic exercise and cognitive function

Numerous research has looked at how aerobic exercise affects people with Alzheimer's disease's cognitive performance. In one study [9], the authors looked at how a 6-month aerobic fitness program affected older persons with mild cognitive impairment, which is frequently an early symptom of Alzheimer's disease. According to the findings, the exercise group significantly outperformed the control group in terms of executive function and attention.

In one review [10], the author investigated how her 24-week physical exercise intervention affected individuals with Alzheimer's disease's cognitive function. The findings demonstrated that the exercise group performed cognitively noticeably better than the control group.

Additionally, in a meta- analysis [11], the authors examined the effects of cardio exercise on cognitive function in older adults with and without cognitive issues. The research, which included 19 randomized controlled trials, found that therapies involving aerobic exercise significantly improved participants' general cognition, attention, working memory, and executive function. Cardiovascular exercise has been shown to improve memory in people with Alzheimer's disease, although its exact mechanisms are yet unknown. However, a number of theories have been put forth. One possible explanation has to do with better vascular health and greater blood flow to the brain [13]. Cardiovascular exercise has been found to boost heart health and encourage the development of new blood vessels in the brain, which may increase the transport of oxygen and nutrients to the parts of the brain involved in cognition.

Furthermore, aerobic exercise has been linked to improved cognitive function, memory, and attention. Performing physical activities that raise the heart rate and increase blood flow to the brain can stimulate the release of chemicals that promote the growth and survival of neurons. This can improve cognitive abilities and make it easier for individuals with Alzheimer's to remember and follow through with self-care routines. By improving cognitive function, aerobic exercise can assist Alzheimer's patients in maintaining their self-care skills for a longer period of time.

3.2. Aerobic exercise and neuroplasticity

Another mechanism involves neuroplasticity. Neuroplasticity refers to the brain's ability to reorganize itself and form new neural connections in response to stimuli or experiences. Regular aerobic exercise, such as running, swimming, or cycling, has been found to improve neuroplasticity by promoting the production of growth factors that facilitate the survival, growth, and differentiation of new neurons. This exercise-induced neuroplasticity can lead to improvements in cognitive function, memory, and learning. Furthermore, aerobic exercise has also been linked to increased blood flow, neurogenesis (generation of new neurons), and the release of neurotransmitters that aid in synaptic plasticity and neuronal communication. These processes collectively contribute to the positive effects of aerobic exercise on the brain and its plasticity. Cardio exercise has been shown to stimulate the production of neurotrophic factors, such as brain-derived neurotrophic factor (BDNF), which support the survival and growth of neurons. Increases in brain-derived neurotrophic factor due to exercise may contribute to the preservation of cognitive function by promoting synaptic plasticity and neuronal adaptation [12].

3.3. Aerobic exercise and self-care ability

Aerobic exercise can also play a significant role in increasing the self-care ability of individuals with Alzheimer's disease. Self-care refers to the ability to independently carry out daily tasks. As AD progresses, these activities can become challenging due to cognitive and physical decline. However, putting regular aerobic exercise into their routine can have positive effects on the self-care ability of Alzheimer's patients.

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Firstly, aerobic exercise improves cardiovascular health, leading to increased stamina and energy levels, enabling individuals to carry out daily self-care activities with greater ease. Secondly, aerobic exercise promotes mental well-being by reducing stress and anxiety levels. This improved mental state enhances individuals' motivation and ability to engage in self-care practices such as maintaining a healthy diet, practicing good hygiene, and managing medication routines. Overall, incorporating aerobic exercise into one's routine positively influences self-care ability and promotes overall well-being.

3.4. Aerobic exercise and physical fitness

Engaging in aerobic exercise can improve physical fitness, strength, and flexibility, which are all essential for carrying out self-care activities. Regular participation in activities such as walking, dancing, or swimming can help maintain muscle and range of motion. [14] By improving physical health, aerobic exercise can improve the individual's ability to perform daily tasks independently.

Firstly, aerobic exercise improves cardiovascular fitness by strengthening the heart and increasing its efficiency in pumping blood throughout the body. This leads to better circulation, improved oxygen delivery to the muscles, and enhanced overall endurance. As a result, individuals who regularly participate in aerobic exercise are better equipped to engage in prolonged physical activities without experiencing excessive fatigue.

Furthermore, aerobic exercise contributes to weight management and body composition. It helps burn calories, making it an effective tool for weight loss or maintenance. Regular aerobic exercise, combined with a balanced diet, can lead to reduced body fat, increased lean muscle mass, and improved overall body composition.

In addition to cardiovascular and weight-related benefits, aerobic exercise also enhances muscular strength and endurance. As individuals engage in activities such as running, swimming, or cycling, they utilize various muscle groups. Over time, this leads to the strengthening and toning of these muscles, resulting in improved muscular strength and endurance.

Moreover, aerobic exercise positively influences bone health. Weight-bearing aerobic exercises, such as jogging or hiking, can help increase bone density, which is essential and important for maintaining strong and healthy bones.

3.5. Aerobic exercise and mental well-being

Additionally, aerobic exercise is known to have a positive impact on mood and mental well-being. Alzheimer's disease often leads to feelings of frustration, confusion, and anxiety. Engaging in regular physical activity releases endorphins in the brain, which are natural mood enhancers. These endorphins can help reduce stress and improve overall emotional well-being, making it easier for individuals with Alzheimer's to engage in self-care activities. By decreasing negative emotions, aerobic exercise can contribute to a more positive thinking, motivation, and willingness to engage in self-care tasks.

Firstly, aerobic exercise promotes the release of endorphins, often referred to as "feel-good" hormones, in the brain. Endorphins are natural chemicals that act as painkillers and mood elevators. They help reduce feelings of sadness, anxiety, and stress while inducing a sense of happiness and relaxation. This release of endorphins during aerobic exercise can lead to an immediate boost in mood and an overall improvement in mental well-being.

Furthermore, aerobic exercise has been found to reduce symptoms of depression and anxiety. Regular participation in activities such as running or swimming has been linked to a decrease in depressive symptoms, as exercise helps regulate neurotransmitters in the brain that are associated with mood regulation. It also provides a distraction from negative thoughts and promotes a sense of accomplishment and self-esteem, which can be beneficial for individuals dealing with anxiety.

In addition to its impact on mood, aerobic exercise has been shown to improve cognitive function and overall brain health. Studies have indicated that regular aerobic exercise can enhance memory,

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attention, and decision-making skills. It also promotes the growth of new brain cells and improves the connectivity between different regions of the brain, leading to better cognitive performance.

Moreover, engaging in aerobic exercise provides a valuable opportunity for social interaction and connection. Group activities such as dance classes or team sports not only provide physical benefits but also contribute to a sense of belonging and social support, which are vital for maintaining good mental health. An improvement in mental well being is also beneficial for improving other symptoms that AD patients are suffering, such as self-care.

3.6. Aerobic exercise and sleep in Alzheimer's Disease patients

Several studies have explored the relationship between aerobic exercise and sleep in Alzheimer's Disease patients. One study found that regular aerobic exercise improved sleep efficiency, reduced the frequency of night-time awakenings, and increased total sleep time in individuals with AD [17]. Another study showed that participation in moderate-intensity aerobic exercise led to better sleep quality and reduced daytime sleepiness in this population [19].

The mechanisms underlying the beneficial effects of aerobic exercise on sleep in Alzheimer's Disease patients are not fully understood. However, it is believed that exercise may regulate the circadian rhythm, which is responsible for coordinating the sleep-wake cycle [20,21]. Exercise has been shown to modulate the production of certain hormones, such as melatonin, which plays a vital role in regulating sleep patterns. Additionally, exercise has been found to reduce anxiety and depression, both of which can contribute to sleep disturbances.

Furthermore, as mentioned earlier, aerobic exercise has been shown to improve cognitive function in individuals with AD. It can enhance memory, attention, and executive functioning, which are all essential components of sleep regulation. By improving cognitive function, aerobic exercise may indirectly contribute to improved sleep quality and quantity in this population.

It is important to note that the type, intensity, and duration of aerobic exercise are critical factors that determine its benefits on sleep in AD patients. Moderate-intensity exercises, such as walking or cycling, performed for a duration of at least 30 minutes, three to five times per week, have been found to be most effective.

In conclusion, there is a clear relationship between aerobic exercise and sleep in Alzheimer's Disease patients. Regular participation in aerobic exercise has been shown to improve sleep quality, increase sleep duration, and reduce sleep disturbances in this population. Exercise may regulate the circadian rhythm, modulate hormone production, and improve cognitive function, all of which contribute to better sleep outcomes. Incorporating aerobic exercise as part of a comprehensive treatment plan for individuals with Alzheimer's Disease can have significant benefits for their overall well-being and sleep quality. Further research is needed to explore the specific mechanisms underlying this relationship and to optimize exercise interventions for this population.

In summary, the relationship between aerobic exercise and mental well-being is highly significant. Regular engagement in aerobic activities leads to the release of endorphins, reduces symptoms of depression and anxiety, improves cognitive function, and provides opportunities for social connection [8]. By incorporating aerobic exercise into their routine, individuals can experience improved mental well-being and overall quality of life. Therefore, these exercises have significant impacts on the progression and symptoms of the AD.

4. Conclusion

Exercise therapy can only slow down the progression of AD, however, it cannot cure AD completely. Some aerobic exercises such as swimming and sunning requires special fields that not everyone can access easily. Also, some aerobic exercise must be conducted under the guidance of professional coaches, which might not be easy to access for some patients. The exercise therapy might also bring some negative side effects that are not yet understood. Therefore, the exercise therapy might still not be widely conducted due to all these limitations.

The effects bought for AD patients by aerobic exercises are not yet well understood. The treatments might be more effective when their results and process are fully understood. In the future, as more medicine develops, AD patients will receive better treatments, and people might also gain more knowledge related to the effects of aerobic exercise on AD patients.

A lot of studies do show that exercise therapy can slow down the progression of AD. Exercise therapy is also proved to be useful in terms of improving AD patients' cognitive function, fitness, sleep, mental well-being, self-care abilities. However, the effects and mechanism of exercise are still not yet well understood. Also, a lot of requirements must be met in order to conduct the exercise therapy on AD patients, such as the field requirements and safety requirements. Generally speaking, the exercise therapy is among one of the safest treatments for AD patients.

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