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The Role of Physical Therapy in Slowing Cognitive Deficits in Patients with Alzheimer's disease

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ABSTRACT

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by cognitive decline, impairing memory, reducing executive function, loss of functional independence, and reduced quality of life. [1] At present it is a growing globally and is considered a global public health priority as per WHO with huge implications on the society. [2] Treatment with pharmacological drugs aims to manage the disease symptomatically. [3] Non-pharmacological interventions such as physical therapy (PT), cognitive rehabilitation, occupational therapy, etc are gaining importance as supportive therapies in managing the disease. [4] Physical therapy (PT) has been recognized as a valuable intervention in slowing cognitive deficits and preserving functional abilities in individuals with AD. Regular physical activity enhances cerebral blood flow, promotes neuroplasticity, and reduces the risk of comorbidities that exacerbate cognitive deterioration. [5] Additionally, PT interventions improve gait stability, reduce fall risk, and support activities of daily living, fostering greater independence and social engagement. [6] Integrating PT into multidisciplinary care may offer a non-invasive, effective strategy to slow cognitive decline and enhance the well-being of AD patients.

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KEYWORDS:
Alzheimer's disease, cognitive decline, Physical exercise

INTRODUCTION

Alzheimer's disease is a complex and multifactorial neurodegenerative disorder that is marked by progressive and severe dementia. [7] It is an age related progressive dementia and is considered to be the commonest cause of dementia in the older population. [8] Alzheimer's disease (AD) is prevalent throughout the world and is considered to be the leading cause of dementia in aging population (aged ≥ 65 years). [9] The worldwide prevalence of dementia is estimated to reach up to 24 million, with projections indicating it will double every 20 years until at least 2040. [10] The disease is estimated to have a high prevalence of 10–30% among individuals over 65 years old, with an incidence rate of 1–3%. [11] The exact cause of Alzheimer's disease is not known but there are some factors that contribute to its cause. These may be exacerbation of aging, anatomical pathway degeneration, environmental factors such as exposure to aluminium, malnutrition, genetic factors like mutations of certain proteins like APP, compromised blood brain barrier, infectious diseases. [12] Clinically, Alzheimer's disease begins with impairments in recent (short-term) memory, word-finding, and language skills, gradually advancing to widespread cognitive decline. These cognitive deficits are accompanied by various neurological and psychiatric symptoms, which become more frequent and severe as the disease progresses. [13] Neuropsychiatric symptoms, including apathy, depression, aggression, agitation, sleep disturbances, and psychosis, are now recognized as core features of Alzheimer's disease, manifesting to varying degrees throughout its progression. [14]

The progression of the disease can be divided into 4 stages - pre dementia, mild, moderate and severe stage. [15] The pre-dementia stage is often difficult to distinguish from normal aging or stress-related issues. One of the earliest signs is the decline in episodic memory. At this stage, sensory and motor functions remain unaffected, while other cognitive aspects, such as executive, verbal, and visuospatial abilities, may show only mild impairment. The individual remains independent and is not yet diagnosed with Alzheimer's

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disease. In the mild stages of Alzheimer's disease, memory loss becomes more pronounced, with recent declarative memory being more severely affected than other memory types, such as short-term, declarative, and implicit memory. In the moderate stage of Alzheimer's disease, recent memory continues to decline, and due to difficulty forming new memories, patients often appear to live in the past. While they can still perform basic activities of daily living (ADLs), they require assistance with tasks such as grooming and dressing. By this stage, patients typically lose insight into their condition and may develop delusions. At this stage, cognitive decline, aggression, depression, and incontinence become key predictors for nursing home placement. In the severe stage, even early memories may fade, and basic activities of daily living (ADLs) progressively decline. Communication further deteriorates to single words or phrases, resulting in significant language impairment. Behavioural disturbances become more pronounced, creating challenges for caregivers. [16]

There is no definite cure for AD but it is mostly symptomatic. Current treatment for AD is the use of drugs like donepezil, galantamine, rivastigmine (inhibitors of the acetylcholinesterase enzyme (AChE) and memantine (N-methyl-D-aspartate (NMDA) receptor antagonist). [17] Non pharmacological treatment options commonly used for treatment of AD are light therapy, controlled positive air pressure, acupressure, exercise, physical rehabilitation, occupational therapy, behavioural therapy and aromatherapy. [4][18]

Link Between Physical Activity and Cognitive Function:

Regular physical exercise strengthens the resilience of cells, tissues, and organs against oxidative stress, enhances energy metabolism, promotes vascularization, and stimulates neurotrophin synthesis. These factors play a crucial role in supporting neurogenesis, muscle development, memory enhancement, and brain plasticity, all of which contribute to the prevention of Alzheimer's disease (AD). [19] Consistent physical exercise improves cerebral blood flow, boosts neuroplasticity, and promotes neurotrophic factors like brain-derived neurotrophic factor (BDNF), which supports neuron survival and synaptic plasticity. Structured physical therapy interventions can help slow the progression of cognitive decline in Alzheimer's patients by stimulating brain activity and mitigating the effects of neurodegeneration. [20] Regular physical activity is thus not only beneficial for overall brain health but may also play a critical role in preserving cognitive function in individuals with Alzheimer's disease. Exercise has been associated with improvements in memory, attention, and executive function, as well as a reduction in behavioral symptoms such as agitation and depression. While exercise does not reverse the damage caused by Alzheimer's, it can enhance overall quality of life and may help individuals maintain their cognitive abilities for a longer period. Regular physical exercise strengthens the resilience of cells, tissues, and organs against oxidative stress, enhances energy metabolism, promotes vascularization, and stimulates neurotrophin synthesis. These factors play a crucial role in supporting neurogenesis, muscle development, memory enhancement, and brain plasticity, all of which contribute to the prevention of Alzheimer's disease (AD).

Physical therapy for Alzheimer's disease (AD):

Physical therapy focus on maintaining mobility, preventing falls, and improving overall function to enhance quality of life. Since AD is a progressive neurodegenerative disorder, PT interventions must be tailored to the patient's stage of the disease.

Aerobic exercise:

Regular aerobic activity, such as walking, cycling, or dancing, helps preserve hippocampal volume, reduces beta-amyloid accumulation, and enhances executive function. It has been shown to slow cognitive decline, improve memory, and enhance brain function in individuals with Alzheimer's disease by increasing cerebral blood flow, promoting neuroplasticity, and boosting brain-derived neurotrophic factor (BDNF), which supports neuron survival. [21] Additionally, it improves cardiovascular health, reduces fall risk, and alleviates depression and anxiety, contributing to overall well-being. Incorporating aerobic exercise into a structured routine can help maintain independence and quality of life for individuals with Alzheimer's disease.

Resistance training:

Resistance exercise benefits individuals with Alzheimer's disease by enhancing muscle strength, improving mobility, and reducing fall risk, which helps maintain independence. It also promotes neuroplasticity, increases brain-derived neurotrophic factor (BDNF), and supports cognitive function by improving executive processing and memory. [22] Additionally, resistance training enhances energy metabolism, reduces inflammation, and contributes to better mood regulation, decreasing symptoms of depression and anxiety. Regular strength training, such as weightlifting or bodyweight exercises, can slow physical and cognitive decline, making it a valuable intervention for individuals with Alzheimer's disease.

Balance training:

Balance training plays a crucial role in managing Alzheimer's disease by reducing fall risk, enhancing postural stability, and improving overall mobility, which helps maintain independence in daily activities. [21] [22] It also engages cognitive functions such as attention and coordination, promoting neuroplasticity and slowing cognitive decline. Exercises like tandem walking, single-leg stands, and stability ball exercises strengthen proprioception and muscle control, reducing the

likelihood of injuries. Additionally, balance training can boost confidence, decrease anxiety related to movement, and contribute to a better quality of life for individuals with Alzheimer's disease.

Dual task training:

Dual-task training, which combines cognitive and motor tasks, is highly beneficial for individuals with Alzheimer's disease as it enhances executive function, attention, and memory while improving mobility and reducing fall risk. By engaging the brain and body simultaneously—such as walking while counting or performing coordination exercises with verbal recall—this training strengthens neural connections and promotes neuroplasticity. It also helps maintain independence in daily activities by improving multitasking abilities, which are often impaired in Alzheimer's. Additionally, dual-task exercises can reduce cognitive decline, increase confidence in movement, and enhance overall quality of life. [23]

Benefits of Physical Therapy in Alzheimer's Patients:

Cognitive Benefits

- Enhances executive function, memory, and attention through structured movement.
- Stimulates neuroplasticity and slows cognitive decline. [21]
- Dual-task training improves multitasking and problem-solving skills.

Physical Benefits

- Improves muscle strength, endurance, and flexibility.
- Improves body mechanics and posture
- Reduces associated risk factors like diabetes, obesity [23]
- Enhances balance and coordination, reducing fall risk.
- Preserves mobility and functional independence. [24]

Emotional & Behavioural Benefits

- Reduces anxiety, agitation, and depression through structured physical activity.
- Improves sleep patterns and overall mood.
- Encourages social interaction and engagement. [25]

Functional & Quality of Life Benefits

- Supports independence in daily activities such as walking, dressing, and transferring.
- Helps prevent complications like contractures and pressure sores in later stages.
- Provides caregiver education and support for safe patient handling.

CONCLUSION

Physical therapy plays a crucial role in slowing cognitive deficits and maintaining functional independence in individuals with Alzheimer's disease. Through structured exercise programs that incorporate aerobic activity, resistance training, balance exercises, and dual-task training, PT can help enhance cognitive function, reduce fall risk, and improve overall quality of life. While further research is needed to refine exercise protocols and assess long-term effects, integrating physical therapy into Alzheimer's care plans is a promising strategy for promoting brain health and preserving independence in affected individuals.

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