KOSIŃSKA, Agnieszka, BALWIERZ, Magdalena, KALINOWSKA, Karolina, ŚWIRK, Urszula, KARCZMARZ, Jan, ORZECHOWSKA, Joanna, GUTOWSKA, Marika, ORZECHOWSKI, Michał, PAPROCKA, Aleksandra and FIJAŁEK, Paulina. Fighting Alzheimer's with Movement: The Role of Physical Activity in Disease Management. Quality in Sport. 2025;38:58214. eISSN 2450-3118.
https://doi.org/10.12775/QS.2025.38.58214
https://apcz.umk.pl/QS/article/view/58214

The journal has been 20 points in the Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 25.01.2025. Revised: 10.02.2025. Accepted: 11.02.2025 Published: 11.02.2025.

Fighting Alzheimer's with Movement: The Role of Physical Activity in Disease Management

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Abstract

Introduction and purpose

This article investigates the role of physical activity in Alzheimer's disease. It reviews existing research to explore how exercise affects cognitive decline, identifies mechanisms through which physical activity may slow disease progression, and evaluates practical recommendations for integrating exercise into Alzheimer's management. The goal is to provide valuable insights for individuals and healthcare professionals on using physical activity as a non-pharmacological approach to managing Alzheimer's disease.

State of knowledge

The article examines the current literature on Alzheimer's disease, with a focus on the effects of physical activity on cognitive function. By understanding the relationship between exercise and brain health, targeted interventions can be developed to slow cognitive decline. The impact of physical activity on overall Alzheimer's disease progression is also highlighted.

Material and Methods

A review of literature from 2009 to 2024 was conducted using databases such as PubMed, ScienceDirect, and Google Scholar. Keywords included "Alzheimer's disease," "physical activity," "cognitive decline," and "exercise." The review focused on English-language primary research articles from peer-reviewed journals.

Summary

The review underscores the positive effects of physical activity in managing Alzheimer's disease. Evidence suggests that regular exercise helps improve cognitive function, slow disease progression, and enhance overall quality of life. This highlights the effectiveness of physical activity as a valuable, non-pharmacological approach to managing Alzheimer's.

Keywords

Alzheimer’s disease; physical activity; dementia; cognitive function; disease progression; exercise

Introduction

Alzheimer's disease is a progressive neurological disorder that affects memory, thinking, and behavior. It is the leading cause of dementia, gradually impairing cognitive function and independence. While the exact causes are not fully understood, factors like age, genetics, and lifestyle play a role. Currently, there is no cure, and the focus is on prevention, early diagnosis, and improving quality of life for those affected. [1]

Purpose

The purpose of this article is to explore how physical activity influences Alzheimer’s disease and cognitive health. By reviewing existing research, the article aims to clarify the impact of exercise on cognitive function, identify the mechanisms through which physical activity supports brain health, and evaluate practical recommendations for incorporating exercise into Alzheimer’s prevention and management strategies. It seeks to provide valuable insights for both individuals and healthcare professionals on using physical activity as an effective, non-pharmacological approach to combat cognitive decline and improve quality of life.

Material and methods

This review was conducted by searching for articles published from 2009 to 2025 from databases including PubMed, Science Direct, and Google Scholar databases, using keywords such as „Alzheimer’s disease”, “neurodegenerative disease” and “presenile dementia”. The Inclusion criteria were articles in English, primary research and articles in peer review journals.

Results

Our review provides a comprehensive overview of preventive measures and the most recent strategies for managing Alzheimer’s disease, emphasizing the role of physical activity. By analyzing numerous studies, we highlight the positive impact of regular exercise on cognitive health and its potential to reduce the risk of Alzheimer’s. Our findings indicate that engaging in physical activity can significantly delay cognitive decline, enhance memory function, and

improve brain health in individuals at risk or already diagnosed with Alzheimer's disease. This growing body of evidence underscores the effectiveness of physical activity as a valuable, non-pharmacological approach to promoting cognitive resilience and improving overall quality of life.

Alzheimer

Alzheimer's disease is a progressive neurodegenerative disorder and the most common cause of dementia worldwide. It primarily affects older adults, with age being the strongest risk factor. According to global estimates, over 55 million people are living with dementia, and Alzheimer's accounts for 60-70% of these cases. The prevalence is expected to triple by 2050 due to aging populations, making it a growing public health concern. [2] While the exact cause remains unclear, the disease is characterized by cognitive decline, memory loss, and behavioral changes, profoundly impacting individuals, families, and healthcare systems. Understanding Alzheimer's is crucial for developing strategies to manage and prevent this devastating condition. [3]

Signs and symptoms

One of the earliest and most noticeable symptoms is memory loss, particularly forgetting recently learned information. People with Alzheimer's may struggle to remember important dates, events, or even familiar names and faces. This short-term memory loss often leads to repetitive questions or misplaced items. [4,5]

Another common symptom is difficulty with problem-solving and planning. Tasks that were once routine, like following a recipe or managing finances, become challenging. Over time, individuals may lose the ability to concentrate or make decisions, causing frustration and confusion. [6,7]

As the disease progresses, communication problems arise. People with Alzheimer's often have trouble finding the right words, following conversations, or expressing their thoughts clearly. This can lead to withdrawal from social situations or feelings of isolation. [8]

Changes in mood and personality are also significant signs. Someone with Alzheimer's might experience increased anxiety, depression, or irritability. They may become suspicious, confused, or easily upset, especially in unfamiliar environments. [9,10]

In advanced stages, physical abilities like walking, swallowing, and controlling movements can deteriorate, requiring full-time care. [11,12]

Causes

One of the primary factors linked to Alzheimer's is age. The risk of developing the disease increases significantly after the age of 65. [13]

Genetics also plays a critical role. Certain genes, such as the APOE-e4 gene, have been identified as increasing the risk of Alzheimer's. While having this gene doesn't guarantee the disease, it can make an individual more susceptible. In rare cases, genetic mutations can cause early-onset Alzheimer's, which typically begins before the age of 65. [14]

Other potential contributors to Alzheimer's include cardiovascular issues. Conditions like high blood pressure, diabetes, and obesity can increase the risk by affecting blood flow to the brain. Similarly, head injuries, such as those caused by accidents or repeated trauma, may raise the likelihood of developing the disease. [15]

Lifestyle and environmental factors are also believed to influence the risk. Poor diet, lack of exercise, smoking, and insufficient mental or social engagement can contribute to cognitive decline, which may eventually lead to Alzheimer's. [16,17]

Although researchers continue to explore the underlying causes, it is clear that Alzheimer's disease is not caused by a single factor. A combination of biological, genetic, and lifestyle elements interact to create a complex picture. Understanding these causes is essential for developing strategies to prevent or delay the onset of the disease. [18]

Patophysiology

The disease is characterized by the accumulation of two hallmark proteins: amyloid-beta and tau. Amyloid-beta is a fragment of a larger protein called amyloid precursor protein (APP). In a healthy brain, APP is broken down and cleared efficiently. However, in Alzheimer’s, this process is disrupted, resulting in the formation of insoluble amyloid-beta fragments. These fragments aggregate into plaques that deposit between neurons, disrupting communication and triggering an inflammatory response. This inflammation, while initially protective, becomes chronic and contributes to further neuronal damage. [19,20]

In addition to amyloid plaques, Alzheimer’s is marked by the formation of tau tangles within neurons. Tau is a protein that normally helps stabilize microtubules, which are

essential for transporting nutrients and signals within cells. In Alzheimer's, tau undergoes abnormal chemical changes, causing it to detach from microtubules and clump together. These tau tangles disrupt the internal structure of neurons and impair their function, ultimately leading to cell death. [21,22] Another critical aspect of the disease is the loss of synaptic connections, particularly in areas associated with learning and memory. This synaptic dysfunction is compounded by a significant reduction in acetylcholine, a neurotransmitter essential for cognitive processes. The combination of amyloid toxicity, tau pathology, and neurotransmitter deficits results in a progressive decline in brain function. [23]

As the disease advances, the effects of these pathological changes spread throughout the brain. The hippocampus, a region crucial for memory formation, is one of the first areas to be affected. Over time, damage extends to other areas of the cortex, leading to widespread brain atrophy. The ventricles, or fluid-filled spaces in the brain, enlarge as surrounding tissue deteriorates, further reflecting the extent of neuronal loss. [24] Vascular factors may also play a role in the pathophysiology of Alzheimer's. Reduced blood flow, small vessel disease, and other vascular changes can exacerbate the neurodegenerative process by impairing oxygen and nutrient delivery to brain cells. [25] In essence, the pathophysiology of Alzheimer's disease is a complex interaction of abnormal protein accumulation, inflammation, synaptic dysfunction, and vascular contributions. These processes work together to disrupt the delicate balance of brain function, ultimately leading to the progressive cognitive decline and memory loss that define the disease. [26]

Diagnosis

Diagnosing Alzheimer's disease involves a thorough evaluation of a person's medical history, cognitive function, and physical health to identify patterns consistent with the condition. There is no single definitive test for Alzheimer's, so the process relies on a combination of clinical assessments, imaging studies, and sometimes laboratory tests. [27]

The diagnostic journey often begins with a detailed medical history, including any changes in memory, behavior, or cognitive abilities. Input from family members or caregivers is crucial, as they may notice subtle signs that the patient is unaware of. The doctor will also review the individual's medical conditions, medications, and lifestyle factors that might contribute to cognitive decline. [28]

A key component of the diagnosis is a series of cognitive and neuropsychological tests. These tests assess memory, problem-solving skills, attention, language, and reasoning. Tools like the Mini-Mental State Examination (MMSE) or the Montreal Cognitive Assessment (MoCA) are commonly used to identify cognitive impairments and gauge their severity. [29]

To rule out other potential causes of symptoms, blood tests and laboratory work may be performed. These tests help exclude conditions like thyroid dysfunction, vitamin B12 deficiency, or infections, which can mimic Alzheimer's symptoms. [30]

Brain imaging plays a vital role in supporting the diagnosis. Techniques such as magnetic resonance imaging (MRI) or computed tomography (CT) scans can reveal structural changes in the brain, such as atrophy in the hippocampus or other regions associated with memory. More advanced imaging, like positron emission tomography (PET), can detect amyloid plaques or tau tangles, which are hallmarks of Alzheimer's disease. Additionally, functional imaging can assess brain activity and blood flow patterns to identify abnormalities. [31,32]

In some cases, cerebrospinal fluid (CSF) analysis may be performed to measure levels of amyloid-beta and tau proteins. Abnormal levels of these proteins in the CSF can provide strong evidence of Alzheimer's disease, even in its early stages. [33]

Early and accurate diagnosis is crucial for managing Alzheimer's disease. It allows for timely intervention, planning for future care, and participation in clinical trials that may provide access to emerging treatments. [34]

Treatment

Although there is no cure for Alzheimer's disease, various treatments aim to alleviate symptoms, slow disease progression, and improve the quality of life for patients and their caregivers. Treatment involves a combination of medication, lifestyle adjustments, and supportive care tailored to each individual's needs. [35]

Medications are often used to address the cognitive symptoms of Alzheimer's, such as memory loss and confusion. Drugs like cholinesterase inhibitors, including donepezil and rivastigmine, work by boosting levels of acetylcholine, a neurotransmitter that plays a key role in learning and memory. These medications are commonly prescribed in the early and moderate stages of the disease. For patients in more advanced stages, memantine may be introduced. This drug regulates glutamate, another brain chemical, to improve communication between nerve cells. [36,37]

Recent breakthroughs have introduced new therapies that target the underlying biology of Alzheimer's. Monoclonal antibodies, such as aducanumab, are designed to reduce amyloid plaques in the brain, a hallmark of the disease. While these treatments hold promise, they are most effective when administered in the early stages and may not be suitable for all patients due to potential side effects and cost considerations. [38]

In addition to medications, lifestyle interventions play a significant role in managing Alzheimer's. Creating a structured daily routine can help reduce confusion and anxiety. Activities that stimulate the brain, such as puzzles or reminiscing about past events, can preserve cognitive function for longer. Physical activity, a balanced diet, and good sleep hygiene also contribute to overall brain health and may slow the progression of symptoms. [39]

Supportive care is equally critical for managing the emotional and behavioral challenges associated with Alzheimer's. Patients often experience mood swings, agitation, or depression, which can be addressed through therapy or, in some cases, medications. Caregiver support is essential, as family members play a vital role in providing care. Education about the disease, access to respite care, and participation in support groups can alleviate the emotional and physical burden on caregivers. [40]

While the journey with Alzheimer's is challenging, advances in treatment and comprehensive care strategies offer hope. By combining medical interventions with compassionate support, it is possible to improve the quality of life for those affected by the disease and their loved ones. [41]

Prognosis

Alzheimer's disease is a progressive and incurable condition, with the rate of decline varying widely among individuals. On average, people live 4 to 8 years after diagnosis, though some may survive up to 20 years depending on factors such as age, overall health, and access to care. [42] In the early stages, individuals may maintain independence with mild memory issues and minor cognitive difficulties. As the disease progresses, memory loss, confusion, and behavioral changes become more pronounced, eventually leading to a loss of independence. In the advanced stages, patients often require full-time care due to severe cognitive impairment and physical decline, such as difficulty walking or swallowing. [43]

The disease's progression is relentless, but early diagnosis and interventions can help manage symptoms, prolong quality of life, and provide time for planning and support. While

current treatments cannot halt the disease, they can ease its burden for both patients and caregivers. [44]

Correlation between physical activity and Alzheimer's disease

While there is no cure for Alzheimer's, research has shown that physical activity may play a key role in reducing the risk of developing the disease and even slowing its progression in those already affected. This connection between exercise and brain health has become a focal point for researchers, as it suggests that simple lifestyle changes could have a meaningful impact on preventing or delaying Alzheimer's. [45]

One of the main ways physical activity helps protect the brain is by improving cardiovascular health. Exercise helps improve blood flow, lower blood pressure, and regulate blood sugar—all factors that are linked to a reduced risk of Alzheimer's. This is important because conditions like hypertension, diabetes, and heart disease are known to increase the likelihood of developing the disease. By promoting better circulation, exercise ensures that the brain gets the oxygen and nutrients it needs, which in turn helps maintain cognitive function and supports overall brain health. [46,47]

Exercise also directly benefits the brain at a cellular level. Physical activity boosts the production of brain-derived neurotrophic factor (BDNF), a protein that helps neurons grow, survive, and function. Higher levels of BDNF have been linked to better memory, learning, and cognitive performance. Additionally, studies have shown that physically active individuals tend to have fewer amyloid plaques and tau tangles in their brains—two key features of Alzheimer's. Reducing the accumulation of these proteins can slow the disease's progress and help maintain cognitive abilities for a longer period. [48,49]

Another benefit of regular physical activity is its ability to reduce inflammation and oxidative stress. Chronic inflammation in the brain is a contributing factor to Alzheimer's, and exercise has been shown to regulate the body's inflammatory responses, offering protection to brain cells. Physical activity also increases the production of antioxidants, which can help protect brain cells from damage caused by oxidative stress, another contributor to Alzheimer's disease. [50,51]In addition to the physical benefits, exercise plays an important role in mental and emotional health. Depression, anxiety, and stress are common in individuals at risk for Alzheimer's, and these factors can worsen cognitive decline. Exercise helps combat these issues by releasing endorphins, improving mood, and reducing stress hormones like cortisol. By

improving overall mental well-being, physical activity can create a more supportive environment for brain function and help mitigate some of the cognitive challenges associated with Alzheimer's. [52,53] Numerous studies have shown the positive impact of physical activity on cognitive health. Engaging in regular aerobic exercise—like walking, swimming, or cycling—has been associated with improved memory, concentration, and overall brain function. Even less intense activities like gardening, yoga, or light stretching can have a significant effect on reducing stress and maintaining mobility and independence in those already living with Alzheimer's. [54,55,56]

Discussion

Alzheimer's disease has become a growing concern due to its profound impact on cognitive function and quality of life. The rising prevalence of this condition is often linked to factors such as aging, genetics, and unhealthy lifestyle choices, including physical inactivity. Just as a sedentary lifestyle can increase the risk of developing Alzheimer's, regular physical activity has been shown to provide significant benefits in both prevention and management. Lack of exercise is strongly associated with poorer brain health, while consistent physical activity helps improve memory, delay cognitive decline, and support overall brain function. Promoting an active lifestyle is essential in addressing Alzheimer's disease. Encouraging regular exercise, such as walking or aerobic activities, can be an effective strategy to enhance brain health and reduce the risk or progression of Alzheimer's-related problems.

Conclusion

While physical activity is not a cure for Alzheimer's disease, it represents a powerful tool in reducing its impact. By integrating regular exercise into daily routines, individuals can take proactive steps to protect their brain health and improve their quality of life. For those already living with Alzheimer's, physical activity can enhance mobility, independence, and emotional well-being, offering a sense of empowerment in the face of the disease. As research continues to uncover the mechanisms behind this correlation, it becomes increasingly clear that staying active is one of the most effective strategies for safeguarding cognitive function and promoting long-term brain health.

DISCLOSURE

Author's contribution

Conceptualization, Agnieszka Kosińska; methodology, Magdalena Balwierz; software, Karolina Kalinowska; check, Urszula Świrk; formal analysis, Jan Karczmarz; investigation, Joanna Orzechowska; resources, Marika Gutowska; data curation, Michał Orzechowski; writing - rough preparation, Agnieszka Kosińska; writing - review and editing, Magdalena Balwierz; visualization, Aleksandra Paprocka; supervision, Paulina Fijałek; project administration, Karolina Kalinowska; receiving funding - no specific funding.

All authors have read and agreed with the published version of the manuscript.

Financing statement

The study received no specific funding

Institutional Review Board Statement

Not applicable – Not required

Informed Consent Statement

Not applicable – Not required

Data Availability Statement

The data presented in this study is available upon request from the correspondent author.

Conflict of interest

The authors deny any conflict of interest

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