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THE IMPACT OF PHYSICAL ACTIVITY ON DEMENTIA IN ELDERLY AGE

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ABSTRACT

Population aging represents one of the greatest public health challenges of the 21st century. As global life expectancy continues to rise, the number of individuals affected by dementia is steadily increasing. Dementia is currently the seventh leading cause of death worldwide and a major contributor to disability and dependence among older adults. It is a clinical syndrome characterized by the progressive decline of cognitive functions such as memory, thinking, comprehension, and planning.
The gradual loss of these abilities profoundly affects individuals' daily functioning and quality of life, ultimately leading to increasing dependence, reduced autonomy, and social isolation. This imposes a significant burden not only on patients and their families but also on healthcare and social support systems.
In the absence of effective disease-modifying therapies, preventive strategies and the identification of modifiable risk factors have become a primary focus of research and public health policy. Physical inactivity is now widely recognized as one of these modifiable risk factors.
Purpose: The aim of this paper is to present the current state of knowledge regarding the relationship between physical activity and the risk of developing dementia in older age. Other modifiable risk factors for this condition will also be highlighted. The paper will discuss both the biological mechanisms through which physical activity affects cognitive functions and the findings of epidemiological and interventional studies supporting its protective role. Recommendations for physical activity as a component of preventive strategies in aging populations will also be outlined.
Materials and Methods: A comprehensive literature search was performed using the PubMed database, focusing on studies published between 2010 and 2025. Search terms included "dementia", "cognitive disorders", "elderly" and "physical activity". As part of our methodological analysis, we selected 27 publications that met the criteria of evidence-based medicine (EBM). The reviewed literature included studies based on meta-analyses as well as the most recent guidelines issued by leading international scientific societies. Relevant articles were selected and critically assessed to extract and evaluate key findings and conclusions.
Conclusions: Recent evidence from systematic reviews and meta-analyses underscores the critical role of modifiable risk factors in accelerating brain aging and cognitive decline. As life expectancy increases, there is a growing need to prioritize public health education and promote physical activity to prevent dementia and maintain quality of life in aging populations.

KEYWORDS

Dementia, Cognitive Disorders, Physical Activity, Elderly

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Introduction

Population aging represents one of the greatest public health challenges of the 21st century. As global life expectancy continues to rise, the number of individuals affected by dementia is steadily increasing. Dementia is currently the seventh leading cause of death worldwide and a major contributor to disability and dependency among older adults. [1] It is a clinical syndrome characterized by progressive impairment of cognitive functions, such as memory, thinking, comprehension, and planning. The gradual loss of these cognitive abilities has a profound impact on an individual's daily functioning and quality of life, ultimately leading to increasing dependence and social isolation. This represents a substantial burden for both patients and healthcare systems.

The prevalence of dementia is strongly age-dependent. While approximately 1% of individuals aged 60–65 are affected by dementia, the prevalence increases significantly with age. Some reports indicate that among those aged 85 and older, 10–35% exhibit signs of cognitive decline, and in certain cases, the proportion may even exceed 50%. [2] According to reports from the World Health Organization (WHO), the global number of people living with dementia was estimated at 57 million in 2021, and it is projected to exceed 153 million by 2050. [3] Dementia results from a variety of diseases and injuries that affect the brain. The most common cause is Alzheimer's disease, which accounts for approximately 60–70% of all cases. [4][5]

In the absence of effective causal treatments, prevention and the identification of modifiable risk factors have become crucial. The Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) was the first large-scale, long-term randomized controlled trial to demonstrate that cognitive decline can be prevented through a structured multidomain lifestyle intervention. The two-year intervention included dietary guidance, physical exercise, cognitive training, and vascular risk monitoring. The results of this study indicated that such a comprehensive approach can improve or maintain cognitive functioning in older adults at increased risk of dementia within the general population. The FINGER study laid the foundation for subsequent international efforts, such as the World-Wide FINGERS network, aimed at evaluating and adapting similar interventions across diverse cultural and healthcare settings. [6][7][8]

Dementia

Dementia is any disorder where significant decline from one's previous level of cognition causes interference in occupational, domestic, or social functioning. The impairment in cognitive function is commonly accompanied by deterioration in emotional control, social behavior, or motivation. Generally, dementia should be considered to be an acquired syndrome, with multiple possible causes, rather than a specific disease. Dementia can be caused by various diseases.

Global estimates of dementia prevalence are up to 7% of individuals above the age of 65 years. Dementia can be divided into two broad categories: neurodegenerative which is caused by progressive brain cell death, which in the current state of medicine is irreversible, and non-neurodegenerative which is caused by other factors like vascular disease, infections, or trauma which is potentially reversible.[9][10]

Modifiable Risk Factors of Dementia

The global rise in life expectancy and the progressive population aging have contributed to a steady increase in the number of individuals living with dementia, a profoundly disabling condition. This has led to a growing number of research focused on strategies for preventing or delaying the onset of dementia. In recent years, increasing attention has been directed toward modifiable risk factors for dementia, and the medical literature has provided growing evidence supporting their role in the development of the disease. [11]

In 2017, the Lancet Commission on Dementia Prevention, Intervention, and Care identified nine potentially modifiable risk factors: low educational attainment, hypertension, hearing impairment, smoking, obesity, depression, physical inactivity, diabetes, and low social engagement. An updated report from the Commission in 2020 added three additional risk factors based on emerging and compelling evidence: excessive alcohol consumption, traumatic brain injury, and air pollution. Research suggests that these 12 modifiable risk factors collectively account for approximately 40% of dementia cases globally, implying that a substantial proportion of cases could be prevented or delayed through appropriate public health and clinical interventions. The most recent update from the Lancet Commission in 2024 provided further hopeful evidence regarding dementia prevention. The report added two more convincing risk factors: untreated vision loss and elevated low-density lipoprotein (LDL) cholesterol. It also reinforced earlier findings, noting that the evidence supporting the effectiveness of addressing multiple modifiable risk factors has become even stronger. Altogether, the 14 modifiable risk factors for dementia currently identified by the Lancet Commission are: low education, hypertension, hearing impairment, smoking, obesity, depression, physical inactivity, diabetes, low social contact, excessive alcohol intake, traumatic brain injury, air pollution, untreated vision loss, and high LDL cholesterol. [2][3][11][12][13]

Additionally, according to the WHO Guidelines for Risk Reduction of Cognitive Decline and Dementia from 2019, evidence from the past two decades has demonstrated a clear association between cognitive impairment and dementia and several modifiable risk factors. These include low educational attainment and lifestyle-related factors such as physical inactivity, tobacco use, unhealthy diets, and harmful alcohol consumption. In addition, certain medical conditions such as hypertension, diabetes, hypercholesterolemia, obesity, and depression have been linked to an increased risk of developing dementia. Other modifiable risk factors may include social isolation and a lack of cognitive stimulation. [14]

This paper will focus on one of these key modifiable risk factors, on physical inactivity and examine its role in the development of dementia, including underlying mechanisms and current evidence from epidemiological and interventional studies.

Physical Activity

Research suggests that the mechanisms underlying the beneficial effects of physical activity on cognitive function and the reduced risk of dementia may operate both directly on brain structures and indirectly through various physiological pathways.

On the direct side, physical exercise helps to maintain cerebrovascular integrity, by sustaining blood flow and the supply of oxygen and nutrients to the brain. Furthermore, the benefits of physical activity on cognitive function appear to be partly mediated by its influence on brain-derived neurotrophic factor (BDNF) [15], as well as changes in cerebral blood flow and vascular function such as reduced hypertension and increased nitric oxide production which together enhance brain plasticity and reduce neuroinflammation. [3][12] Moreover, physical activity promotes neuroplasticity and neurogenesis and is associated with structural changes in the brain, including improved integrity of white and gray matter and increased hippocampal volume. [16]

Indirectly, physical activity contributes to overall cardiovascular and metabolic health, reducing modifiable risk factors such as hypertension, diabetes, obesity, and dyslipidemia all of which are associated with an elevated risk of cognitive decline. By addressing these systemic factors, physical activity lowers the risk of both cardiovascular and cerebrovascular events, offering global neuroprotective benefits. [14]

Studies show that being physically active at any age is associated with better cognitive function at the age of 69 compared to physical inactivity, with the strongest association observed in those who maintained long-term physical activity. [3][17]

One year of aerobic exercise in a large RCT of seniors was associated with significantly larger hippocampal volumes and better spatial memory; other RCTs in seniors documented attenuation of age-related gray matter volume loss with aerobic exercise. [18]

Aerobic exercise is associated with a reduced risk of cognitive impairment and dementia. It involves physical activity that elevates heart rate (HR) and increases oxygen consumption (VO_2). Current evidence indicates that 150 minutes per week of moderate-intensity aerobic exercise is sufficient to support cellular function, enhance memory performance, and improve hippocampal capacity. The majority of clinical studies have employed moderate aerobic training, typically defined as exercise that raises HR to approximately 60% of the individual's maximum HR. [18]

This level of intensity appears appropriate given the advanced age and common comorbidities of the target population, which may limit tolerance to more vigorous exercise regimens. Nevertheless, further research is warranted to refine exercise prescriptions that optimally mitigate the risk of cognitive decline and neurodegeneration.

While aerobic exercise is known to enhance cognitive function, it is not the only form of physical activity with such benefits. Research suggests that the relationship between exercise and cognitive improvement follows an inverted U-shaped dose–response curve for certain modalities, including aerobic training, structured resistance exercises, and resistance band activities. In these cases, moderate engagement yields the greatest cognitive benefits, whereas both insufficient and excessive dosages may diminish the effect.

In contrast, other forms of exercise, such as bodyweight and machine-based resistance training, mixed aerobic modalities, and walking demonstrate non-linear but consistently positive associations with cognition. These activities appear to provide ongoing cognitive benefits at higher doses without evidence of a plateau or decline.[19][20][21]

Importantly, exercise programs should be tailored to the individual's functional capacity. Personalizing physical activity according to physical limitations and preferences minimizes the likelihood of nonadherence due to pain, discomfort, or excessive fatigue, thereby enhancing long-term compliance and therapeutic efficacy.

During a mean follow-up of 6.2 years (SD, 2.0), 158 participants developed dementia. The incidence rate of dementia was 13.0 per 1000 person-years for participants who exercised 3 or more times per week compared with 19.7 per 1000 person-years for those who exercised fewer than 3 times per week. [22]

Recommendations

Based on the 14 identified modifiable risk factors, the Lancet Commission in 2024 outlined a set of targeted, life-course interventions aimed at reducing the risk of developing dementia. The recommendations include [3]:

- Ensuring access to high-quality education and promoting cognitively stimulating activities in midlife to preserve cognitive functioning
- Providing access to hearing aids for individuals with hearing loss and reducing harmful noise exposure to prevent hearing impairment

- Effectively diagnosing and treating depression as a key component of mental health and cognitive resilience
- Promoting the use of helmets and protective headgear during contact sports and cycling to reduce the risk of traumatic brain injury
- Encouraging regular physical activity, as individuals who exercise are less likely to develop dementia
- Reducing tobacco use through public education, price regulation, smoke-free policies, and access to smoking cessation support
- Preventing or controlling high blood pressure
- Screening for and treating elevated LDL cholesterol levels beginning in midlife
- Maintaining a healthy weight and addressing obesity as early as possible, which also contributes to diabetes prevention
- Limiting high alcohol consumption through pricing policies and raising public awareness of the risks associated with excessive drinking
- Prioritizing age-friendly and socially inclusive environments, enhancing housing options, reducing social isolation, and facilitating participation in social and community activities
- Providing access to screening and treatment for vision loss, which may otherwise contribute to cognitive decline
- Minimizing exposure to air pollution, a growing environmental risk factor associated with cognitive impairment

Based on the 2019 World Health Organization Guidelines on Risk Reduction of Cognitive Decline and Dementia, physical activity is recognized as a key intervention in the prevention of cognitive impairment and dementia. The WHO provides two specific recommendations regarding physical activity:

Recommendation 1:

- Physical activity should be recommended to adults with normal cognitive function to reduce the risk of cognitive decline.
  - Quality of evidence: Moderate
  - Strength of recommendation: Strong

Recommendation 2:

- Physical activity may be recommended to adults with mild cognitive impairment (MCI) to reduce the risk of further cognitive decline.
  - Quality of evidence: Low
  - Strength of recommendation: Conditional

These guidelines emphasize the importance of promoting regular physical activity not only for general health benefits but also as a potentially protective factor against the deterioration of cognitive functions. [14]

The specific recommendations regarding the duration, intensity, and type of physical activity are outlined in the World Health Organization's 2020 Guidelines on Physical Activity and Sedentary Behaviour. [23][24]

In these guidelines, the WHO emphasizes that regular physical activity is a key protective factor in the prevention and management of noncommunicable diseases, such as cardiovascular diseases, type 2 diabetes, and several forms of cancer. Moreover, it contributes to mental health, helping to prevent cognitive decline, symptoms of depression and anxiety, and also supports the maintenance of a healthy body weight and overall well-being. [23]

The public health recommendations presented in the WHO 2020 guidelines apply to all populations and age groups, from children aged 5 years to adults aged 65 and older, regardless of gender, cultural background, or socioeconomic status. The guidelines are suitable for individuals of all levels of ability. People living with chronic conditions and/or disabilities, as well as pregnant and postpartum women are also encouraged to follow the recommendations, to the extent possible and as appropriate to their circumstances. [23]

WHO Physical Activity Recommendations by Age Group:

Children and Adolescents (5–17 years):

Regular physical activity is associated with improved cardiorespiratory and muscular fitness, better cardiometabolic health, stronger bones, healthier weight, and improved cognitive performance, including academic outcomes and executive functioning.

- Children and adolescents should accumulate an average of at least 60 minutes per day of moderate-to-vigorous intensity aerobic physical activity.

- Vigorous-intensity aerobic activities, along with muscle- and bone-strengthening exercises, should be performed at least 3 times per week.

Adults (18–64 years):

Among adults, physical activity is linked to reduced all-cause mortality, a lower risk of cardiovascular disease, type 2 diabetes, and site-specific cancers. It also improves mental health, cognitive function, and sleep quality.

- Adults should engage in at least 150–300 minutes of moderate-intensity aerobic activity per week, or 75–150 minutes of vigorous-intensity aerobic activity, or an equivalent combination.
- In addition, muscle-strengthening activities involving major muscle groups should be performed on two or more days per week.

Older Adults (65 years and above):

In addition to the benefits listed above, physical activity in older adults is especially important for preventing falls, maintaining bone health, and preserving functional mobility and independence.

- Older adults should meet the same aerobic and muscle-strengthening activity recommendations as younger adults.
- Furthermore, multicomponent physical activities including balance training and strength exercises should be performed at least 3 times per week to improve physical function and reduce fall risk.
- To gain additional health benefits, older adults may increase their moderate-intensity aerobic activity to more than 300 minutes per week, or engage in over 150 minutes of vigorous-intensity activity, or a combination of both. [23]

In turn, the U.S. Department of Health and Human Services (HHS) suggests that multicomponent exercise programs consisting of balance training, muscle-strengthening exercises (at least twice per week), and aerobic activities of at least moderate intensity performed three or more times per week for 30 to 45 minutes per session over a period of at least 3 to 5 months appear to be the most effective in improving functional capacity in older adults with frailty. [15]

It is worth highlighting that engaging in any form of physical activity is better than remaining inactive. Even light-intensity movement can offer health benefits, especially for individuals who are currently sedentary or have limited mobility. Starting with small, achievable steps can pave the way toward more consistent and beneficial levels of physical activity over time. [19][23]

Recommended Activities for The Elderly

In a 2024 systematic review, Fosstveit et al. examined the effects of different exercise intensities on cardiorespiratory fitness in older adults. Although high-intensity interval training (HIIT) was shown to produce modest improvements in aerobic capacity, the authors concluded that regular, low-impact aerobic activity yields the most substantial and sustainable benefits for older populations. These forms of exercise also carry a lower risk of adverse events, making them a safer alternative to high-intensity regimens [25].

Similarly, a systematic review published in JAMA Internal Medicine by Gardner et al. in 2020 analyzed 46 randomized controlled trials involving older adults with a mean age of 73 years. The findings indicated that moderate-intensity exercise, performed two to three times per week and often combined with balance training, was associated with a reduced risk of falls. Conversely, exercise frequency exceeding three sessions per week was linked to an increased risk of falls in individuals at higher vulnerability levels [26].

A 2025 systematic review in BMC Sports Science, Medicine and Rehabilitation assessed the effectiveness of HIIT on cardiometabolic health and quality of life among elderly individuals. While HIIT was found to have potential health benefits, the authors emphasized that such training should be approached with caution and performed under professional supervision due to concerns over safety and long-term adherence in this population [27].

Conclusions

Recent systematic reviews and meta-analyses have significantly expanded our understanding of modifiable risk factors. These findings suggest that the presence of such risk factors may predispose individuals to accelerated brain aging and cognitive decline. Medical advancements over the past century have necessitated a shift in focus toward the treatment, management, and prevention of diseases that were previously negligible in societal impact due to shorter lifespans. To sustain long-term quality of life in aging populations, proactive investment in public health education regarding modifiable risk factors and the promotion of regular physical activity across all age groups is imperative. Notably, the economic burden of preventive measures

such as awareness campaigns and exercise promotion is substantially lower than the projected costs of managing dementia in populations where inadequate prevention leads to higher disease prevalence. Furthermore, targeted interventions will be implemented for patients exhibiting early-stage dementia symptoms. Recent analyses and meta-analyses confirm that for older adults, the safest and most effective forms of physical activity are low-impact, moderate-intensity exercises performed two to three times per week (e.g., walking, swimming, or stationary cycling). While high-impact activities and vigorous interval training may offer certain health benefits, they require a cautious approach, appropriate adaptation, and supervision by healthcare professionals. These forms of exercise are not recommended as the primary mode of physical activity for the elderly population. Empirical evidence from cited studies demonstrates that structured exercise regimens can significantly decelerate disease progression and prolong quality of life in affected individuals.

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