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Resistance Training and Dementia Risk: A Narrative Review

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Abstract

Background:

One of the key challenges of modern public health is the progressive aging of populations, which consequently leads to an increase in the prevalence of numerous conditions, including dementia. These diseases pose a major social problem, driving the search for effective methods to prevent them or mitigate their severity. One preventive measure recommended by the WHO is resistance training. Research indicates that it exerts a multi-level positive effect on dementia risk factors, thereby reducing the overall risk of developing the condition.

Objective:
To determine the impact of resistance training on modifiable risk factors for dementia and the overall risk of its onset, and thus to evaluate the utility of resistance training as a non-pharmacological method for preventing neurodegenerative disease.
Material And methods:
A review of scientific literature from PubMed And Google Scholar databases was conducted, including oryginał papers Published between 2021 And 2026. Studies concerning the impact of resistance training, dementia, Alzheimer disease, Irisin, BDNF, were analyzed.
Results:
Studies indicate that resistance training positively affects dementia risk factors and stimulates the secretion of protective factors against the development of the condition.
Conclusions:
Resistance training constitutes an effective, non-pharmacological method for preventing neurodegenerative disease, significantly reducing the risk of their onset. It can be successfully implemented in older adults and reduces symptoms in individuals with mild cognitive impairment (MCI)

Keywords

Resistance training, dementia, Alzheimer disease, Irisin, BDNF, dementia risk factors

1. Introduction

An aging population is an increasingly observed phenomenon in a growing number of countries worldwide. It particularly affects Europe, East Asia, and North America. The rising percentage of patients over the age of 65 carries numerous consequences and challenges, including those for the healthcare system. One of these challenges is the increasing incidence of dementia. The most common form of dementia is Alzheimer's disease (60-70%), followed by vascular dementia (15-25%) as the second most common, and dementia with Lewy bodies (10-15%) as the third [1]. A study published by The Lancet identified 14 modifiable risk factors for dementia, the management of which can prevent or delay the onset of dementia in up to 45% of cases. These include, among others, head injuries, hypertension, diabetes, and physical inactivity [2]. In the context of prevention, there is a growing emphasis on the positive role of resistance training, which - due to its metabolic specificity - allows for the control and reduction of various risk factors, such as the aforementioned diabetes and blood pressure. Furthermore, studies indicate that various molecules secreted during training (irisin, BDNF) exert a neuroprotective effect and reduce the risk of developing dementia. In this narrative review, we will present the impact of resistance training on the risk of developing dementia.

2. Material and methods

2.1 Literature search and study selection

A review of scientific literature from PubMed And Google Scholar databases was conducted, including oryginał papers Published between 2021 And 2026. Studies concerning the impact of resistance training, dementia, Alzheimer disease, Irisin, BDNF, were analyzed.

2.2 AI

AI was utilized for two specific purposes in this research. Text analysis of clinical reasoning narratives to identify linguistic patterns associated with specific logical fallacies. Assistance in refining the academic English language of the manuscript, ensuring clarity, consistency, and adherence to scientific writing standards. AI were used for additional linguistic refinement of the research manuscript, ensuring proper English grammar, style, and clarity in the presentation of results. It is important to emphasize that all AI tools were used strictly as assistive instruments under human supervision. The final interpretation of results, classification of errors, and conclusions were determined by human experts in clinical medicine and formal logic. The AI tools served primarily to enhance efficiency in data processing, pattern recognition, and linguistic refinement, rather than replacing human judgment in the analytical process.

3. Research results

3.1. Pathophysiology and Risk Factors of Dementia

According to ICD-11, dementia is a syndrome resulting from a chronic brain disease, characterized by progressive decline in at least one cognitive domain that affects the patient’s daily functioning [3]. Various mechanisms are believed to underline the pathophysiology of diseases that cause dementia. The most frequently cited mechanism involves proteinopathies, which cause the deposition of misfolded or hyperphosphorylated proteins - such as amyloid-beta (Alzheimer's disease), tau protein (frontotemportal dementia), and alpha-synuclein (dementia with Lewy bodies) - leading to nerve cell damage. Another commonly cited cause involves cerebral circulation pathologies, such as atherosclerosis, strokes, and micro-strokes, which disrupt cerebral perfusion contributes to the deterioration of the central nervous system (CNS) by hindering the clearance of deposit, including amyloid, and driving the production of more free radicals. Free radicals themselves also cause damage to nerve cells and accelerate neurodegeneration [12]. Additionally, there is a growing focus on the impact of insulin resistance on the onset of dementia [5].

The Lancet article mentioned in the introduction lists the following modifiable risk factors for developing dementia:

1. Early life (up to 18 years of age)
- Less education (lack of secondary education)
2. Midlife (from 45 to 65 years of age)
- Hearing loss
- High LDL cholesterol
- Obesity
- Diabetes
- Traumatic brain injury (TBI, e.g., from accidents or contact sports)
- Excessive alcohol consumption
3. Late life (over 65 years of age)
- Vision loss (untreated vision impairment) - a new factor in the 2024 report
- Smoking
- Depression
- Social isolation (infrequent social contact)
- Physical inactivity
- Air pollution

3.2 Strength training in the elderly

A study published in 2025 investigated the impact of resistance training on cognitive functions and structural brain changes in older adults. The experiment was conducted on a nonrandomized group, which was to remain inactive for the following 24 weeks, consisted of 22 individuals (mean age 70.68 years). The experimental group, which was to follow a training protocol for the next 24 weeks, also included 22 individuals (mean age 65.64 years). The experimental group performed a workout twice a week, consisting of 10 exercises for major muscle groups, done in three sets of 10 repetitions; as the subjects' strength increased, the resistance weight was progressive. Brain MRI scans were performed, and patients' cognitive functions were assessed using various tests both before and after the 24-week experiment. At the end of the experiment, an increase in upper and lower limb strength was observed in the experimental group. Compared to the control group, their scores also improved in the RAVLT (reflecting episodic memory performance), verbal learning, and delayed recall abilities. No significant changes were observed in tests assessing language, executive functions, and functional independence. Neuroimaging at the end of the study revealed a reduction in the right hippocampus and precuneus in the control group whereas these structures maintained their baseline size in the experimental group. The white matter in the experimental group exhibited better integrity, showing higher fractional anisotropy and lower mean diffusivity than in the control group. The cited experiment clearly demonstrated that resistance training has a positive effect on cognitive function and brain structure, even in patients already exhibiting mild cognitive impairment. However, the limitations of this study include a lack of randomization, a small sample size, and a 5-year higher average age in the control group, which warrants caution then interpreting these results [6].

3.3. Resistance training and other dementia risk factors

Strength training significantly affects metabolic risk factors for dementia. A meta-analysis published in Osong Public Health and Research Perspectives addressed this issue by analyzing the impact of resistance training on selected parameters in individuals with type 2 diabetes. The analysis included studies involving middle-aged patients (40-59 years old) and older adults (over 60 years old). Workouts in the analyzed studies were performed 1-7 times a week for a duration of 8-54 weeks. A decrease in HbA1c and LDL levels was observed, alongside an increase in HDL. Interestingly, a significant decrease in total cholesterol was shown only in older patients, while middle-aged individuals demonstrated a significant drop in triglycerides [7]. In another experiment, the effects of a combined strength/endurance training program on the lipid profile of healthy men aged 35-45 were investigated. The control group maintained their current recreational physical activity, while the experimental group followed a training program designed by the study's authors. It included strength and endurance exercises in 60-minute sessions, 3 times a week for 8 weeks. At the end of the study, significant changes were observed in the lipid profile of the men in the experimental group. Total cholesterol decreased by 19.3%, triglycerides by 23.7%, and LDL by 15%, while HDL cholesterol remained unchanged [8].

3.4. BDNF

An important aspect in the context of dementing diseases is the protective role of BDNF (brain-derived neurotrophic factor). BDNF is an essential protein that forms the foundation of brain neuroplasticity and is responsible for the proper functioning of many of its operations. BDNF is primarily produced by excitatory glutamatergic neurons in the form of a precursor (pro-BDNF), which is secreted at the axon terminal after the propeptide is cleaved. BDNF increases the density and stability of dendritic spines, allowing the formation of permanent synaptic connections that enable learning. It also exerts a neuroprotective effect through the activation of AKT/mTOR pathways, stimulates neural stem cells to divide, and helps young neurons survive and integrate into the existing network. It has also been proven that BDNF, via TrkB receptors on oligodendrocytes, promotes myelination during development as well as the remyelination of damaged neurons (e.g., as a result of multiple sclerosis) [9][23].

In the context of dementing diseases, numerous studies have observed a correlation between BDNF and dementia. In one study, BDNF levels were found to be reduced in the hippocampi of deceased Alzheimer's disease patients [9]. In a Korean cohort initiated in 2014, healthy volunteers aged 55-90 without mild cognitive impairment (MCI) were recruited; they were subsequently monitored for the onset of MCI, and various blood markers, including BDNF, were analyzed. Following the completion of data collection in 2021 and analysis of the results, it was revealed that after adjusting for risk factors, the risk of developing MCI was up to 86% lower in patients with high BDNF concentrations compared to the low BDNF group [13]. In a 2023 study aimed at measuring blood BDNF levels relative to the severity of cognitive impairment, it was paradoxically observed that BDNF was lower in patients with MCI than in those with Alzheimer's disease. Furthermore, as the severity of cognitive impairment increased, BDNF concentrations rose; however, the authors of the study explained this correlation as the body's attempt to compensate for cognitive deficits by secreting BDNF to protect central nervous system (CNS) neurons [11].

The cited publications clearly indicate that BDNF reduces the risk of dementia, and its concentration is significantly influenced by resistance training. In a 2026 study, a team from Valencia investigated the effects of two types of resistance training - using elastic bands and in - water exercises - combined with creatine supplementation on various physiological parameters including cognitive abilities and neuroplasticity expressed through BDNF levels. The final analysis included 103 individuals over the age of 60 (mean age 68.2 years). The participants were divided into six groups to evaluate the impact of both types of resistance training with and without creatine supplementation, as well as the effects of the supplementation alone. The entire training program lasted 16 weeks, with participants performing three 1-hour sessions per week on non-consecutive days. At the end of the study, a significant increase in BDNF levels ranging from 8% to 14% was observed in the exercising individuals, with higher concentrations found in those taking creatine. A similar correlation was noted regarding inflammatory factors and biomarkers of oxidative stress, which decreased in both training groups, with the effect being even more pronounced in the creatine-supplemented groups [10].

In another experiment, researchers investigated the effects of resistance training alone versus resistance training combined with omega-3 fatty acid supplementation on neurobiomarkers, inflammatory and oxidative stress markers, and the lipid profile in young, physically active men (aged 19-25 years). Thirty participants performed resistance training for 8 weeks, 3 times a week on non-consecutive days, with half of them additionally receiving 3,150 mg of omega-3 fatty acids (EPA, DHA) per day. Following the completion of the study, the outcomes were found to be superior in the omega-3 group. This group experienced an increase in strength and an improved lipid profile, characterized by a decrease in triglycerides and LDL alongside an increase in HDL. Furthermore, inflammatory markers and MDA levels decreased, while glutathione and BDNF levels rose. In contrast, the control group only showed an increase in strength and a slight increase in BDNF [14].

Another randomized trial from 2021 investigated the effect of resistance training on BDNF levels and depressive symptoms in hemodialysis patients. The subjects were assigned to two groups: a control group of 76 patients with an average age of 66 who did not exercise, and a study group consisting of 81 individuals with an average age of 67 who performed three training sessions per week on non-consecutive days for 6 months. The training sessions lasted approximately 60 minutes and were performed immediately before each hemodialysis session.

At the end of the experiment, the study group showed an approximately 68% increase in BDNF levels, a reduction in depressive symptoms, and an improvement in oxidative stress markers, such as an increase in glutathione levels [15].

3.5. Impact on insulin resistance

Alzheimer's disease is sometimes referred to as "type 3 diabetes". This is because insulin has a significant impact on the central nervous system. Insulin and insulin-like growth factor (IGF) receptors are widespread throughout the CNS and affect nerve cells primarily through two pathways. The PI3K/Akt pathway regulates metabolic functions, stimulating lipid and protein synthesis, while the second pathway, via MAPK, promotes the growth and survival of nerve cells. A high concentration of insulin and IGF receptors is found, among other places, in brain regions associated with learning, such as the hippocampus. It has been proven that insulin influences learning and memory processes by affecting the formation of new neural connections and stimulating neurogenesis [16].

There are various mechanisms through which insulin resistance negatively affects the nervous system. Insulin resistance causes reduced glucose transport via GLUT4 transporters, which impairs learning capacity; this occurs because these transporters - present alongside GLUT1 and GLUT3 transporters - allow for increased glucose supply to neurons during periods of heightened demand, such as learning. Furthermore, insulin influences tau protein phosphorylation; the impairment of its signaling pathway leads to hyperphosphorylation of the tau protein, resulting in the formation of neurofibrillary tangles. Interestingly, in the central nervous system, insulin is degraded by the same enzyme as beta-amyloid. In the context of insulin resistance, this leads to the enzyme being occupied by insulin, consequently neglecting the clearance of beta-amyloid. Undegraded beta-amyloid begins to accumulate and forms amyloid plaques [16][24].

A 2021 meta-analysis analyzed 12 randomized controlled trials that investigated the effects of resistance training on insulin sensitivity in older adults. Insulin sensitivity was measured using the HOMA-IR index and hemoglobin A1c levels. The analysis included 232 patients in the intervention (exercise) groups and 209 in the control groups. The participants were non-athletes over 60 years old, with a mean age of over 65. In the analyzed studies, the training programs lasted longer than 6 weeks and were not combined with other exercise modalities. The results of the meta-analysis showed that resistance training allowed non-diabetic participants to reduce both their HOMA-IR scores and hemoglobin A1c levels, with the greatest effect observed when the program lasted longer than 12 weeks [18].

A randomized study published in January 2026 investigated the effects of resistance and aerobic training on insulin resistance and blood pressure in patients with type 2 diabetes. The participants were assigned to three groups (13 individuals each). The CART group performed cardio training first, followed by resistance training; the CRAT group performed resistance training first, followed by cardio; and the COT group served as a control group and did not perform any training. The study participants were aged 45 to 59, with a mean age of 51.7 years. The training program lasted 12 weeks and consisted of three 60-minute sessions per week. During the resistance portion of the workout, participants performed 8 different strength exercises for 20 minutes at a load of 65% 1RM. In the aerobic portion, the subjects spent 25 minutes running or brisk walking on a treadmill at an intensity of 60-70% HRR. Insulin resistance levels were determined using the HOMA-IR index. At the end of the study, significant changes were observed in both experimental groups. Fasting glucose levels were lower in both groups by approximately 8-10%. Blood pressure values decreased in both groups, slightly more so in the CRAT group, while the HOMA-IR index also dropped more significantly in the CRAT group - by about 18-22% from the baseline value, compared to approximately 11-14% in the CRAT group [17].

3.6. Irisin

Irisin is a myokine formed by the cleavage of a polypeptide fragment from the membrane protein FNDC5, which is located primarily in the muscles. It is released in response to physical activity or cold exposure and has the ability to cross the blood-brain barrier [19][20]. Irisin has numerous functions, including those unrelated to the CNS, such as increasing insulin sensitivity, converting white adipose tissue to brown adipose tissue, and increasing the body's energy expenditure. In the context of dementias, its functions within the CNS appear particularly interesting. It has been proven that FNDC5/irisin increases the secretion of the previously mentioned BDNF and influences the maturation and growth of young neurons in the hippocampus. Furthermore, mouse studies have shown that irisin reduces the formation of alpha-synuclein aggregates, which play a significant role in the pathophysiology of Parkinson's disease and dementia with Lewy bodies [21]. Evidence is also emerging that FNDC5/irisin reduces inflammation and oxidative stress [20].

A meta-analysis published in 2021 analyzed experiments investigating the effects of long-term resistance training on blood irisin levels. The meta-analysis ultimately included 7 studies involving 282 participants aged approximately 20 to 70 years; the experimental groups followed a resistance training program, while the control group did not train. The training programs lasted a minimum of 8 weeks, and irisin concentrations were measured using ELISA assays. The results showed that irisin levels in young patients under 60 years of age either did not change or increased slightly, whereas in the group of patients over 60 years of age, irisin increased by approximately 10% up to as much as 25% [22].

4. Conclusions

A review of the literature reveals a distinct correlation between resistance training in patients and the modification of risk factors for dementia. Resistance training exerts multifaceted effects: it improves lipid profiles, enhances insulin sensitivity, and elevates levels of endogenous neuroprotective factors such as BDNF and irisin. Furthermore, these factors interact with each other, as seen with irisin stimulating BDNF production. Additionally, several studies indicate that the beneficial effects of resistance training are more prominent in the elderly population.

Disclosure

The authors report no disclosures.

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