Review

MUSIC AND ALZHEIMER DISEASE

Goran Belojević

Faculty of Medicine, University of Belgrade

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Abstract

Alzheimer's disease (AD) is a chronic and devastating neurodegenerative disorder. It is the most prevalent form of dementia (around 70%) and is rapidly increasing in incidence. The etiology and risk factors for AD are multifactorial and still unclear. Two main pathophysiological processes that characterize AD are the hyperphosphorylation of tau protein and the accumulation of amyloid beta in the brain. The crucial symptoms of AD include loss of concentration and memory, depression, and disorientation in time and space. Therapy for AD includes both pharmacological and non-pharmacological measures; however, the therapeutic effects are generally modest and do not halt disease progression. Music therapy (MT) is an emerging and promising non-pharmacological treatment for AD. It may slow cognitive deterioration, particularly in relation to autobiographical memory, and improve executive functioning and psychological symptoms such as depression, anxiety, and agitation. Music particularly engages brain regions responsible for emotional processing, such as the limbic and paralimbic systems. Types of music interventions include active music therapy, music-based interventions, caregiver singing, individualized listening to music, and background music. MT can be carried out by qualified music therapists, caregivers, or through personal engagement. No serious side effects of MT have been reported so far. The results of randomized controlled trials support the use of MT in conjunction with pharmacological treatment. This combined approach may reduce psychological and behavioral symptoms and improve cognitive functioning in people with AD.

Keywords: music, Alzheimer disease, therapy

Corresponding Author: Goran Belojević; E-mail: goran.belojevic1956@gmail.com

Introduction

Dementia is a clinical condition that currently affects about 60 million people, with an estimated 10 million new cases emerging each year[1]. Among the various forms of dementia, Alzheimer's disease (AD) named after the German psychiatrist and pathologist Alois Alzheimer[2] is the most common, representing approximately 60–70% of all cases. It is the seventh leading cause of death and the major cause of disability and dependency among the elderly, with a financial burden of more than one trillion US dollars annually[1].

AD is marked by several pathological changes, including cortical and hippocampal atrophy, ventricular enlargement, the presence of neurofibrillary tangles formed by hyperphosphorylated tau protein[3], the buildup of amyloid beta (Aβ) leading to amyloid plaques[4], and a reduction in neuronal synapses within the brain[5].

The typical clinical manifestations of AD include memory loss, impaired concentration, mood disturbances such as depression, disorientation in time and space, neglect of personal care, and difficulties with language skills such as speaking, reading, and writing. In advanced stages, patients often lose the ability to recognize close relatives and may experience problems with swallowing and urinary control[6],

The exact cause of AD remains unclear. Two leading hypotheses have been proposed: the cholinergic hypothesis, which attributes the disease to reduced acetylcholine synthesis in cholinergic neurons resulting from decreased choline acetyltransferase activity[7] and the amyloid hypothesis, which links neurodegeneration to the toxic accumulation of Aβ in the brain[8].

A wide range of risk factors contributes to the development of AD, and they can be grouped into several categories: genetic predisposition, demographic factors such as age and sex, traumatic brain injury, infections, cardiovascular conditions, lifestyle influences, obesity, diabetes mellitus, and environmental exposures.

It is estimated that roughly 70% of AD cases are linked to mutations in dominant genes[9]. Advancing age, particularly beyond 65 years, represents the strongest risk factor for AD[10]. Concerning the influence of gender on AD, two thirds of patients are women[11]. A history of head trauma increases the likelihood of developing AD within five years by approximately 20%[12]. Persistent bacterial or viral infections of the central nervous system may contribute to Aβ deposition and the formation of neurofibrillary tangles[13]. Moreover, cardiovascular disorders such as stroke, heart failure, atherosclerosis, and hypertension can impair cerebral circulation, leading to hypoxia and loss of brain tissue, thereby elevating the risk of AD[14]. Lifestyle factors play an important role in modulating the risk of AD. Engaging in regular aerobic exercise[15], maintaining mental stimulation through activities such as reading, playing chess, or solving puzzles[16], participating in leisure pursuits[17], pursuing lifelong learning[18], avoiding or quitting smoking[18], ensuring adequate sleep[16], and adopting stress-reduction strategies[19] have all been associated with a lower likelihood of developing AD.

In contrast, obesity[20] and diabetes[21] increase susceptibility, primarily through mechanisms involving neuroinflammation, oxidative stress, and amyloid-beta accumulation. Nutritional status is also critical: malnutrition[22], high intake of saturated fats, and excessive caloric consumption[23]. elevate the risk, whereas diets rich in fish, polyphenols, antioxidants, and vitamins appear to exert a protective effect against AD[23].

Environmental exposures further contribute to disease development. Air pollutants—such as low ozone, carbon monoxide, particulate matter, nitrogen oxides, sulfur oxides, and lead—have been linked to oxidative stress, neuroinflammation, tau phosphorylation, neurodegeneration, and Aβ deposition in the cortex[24]. Additionally, certain metals have been implicated: aluminum accumulation in the brain may promote tau protein phosphorylation[25], while exposure to lead and cadmium has been associated with the aggregation of amyloid plaques[26].

Although significant research efforts are underway, current pharmacological therapies

for AD remain only partially effective. These comprise anti-amyloid monoclonal antibodies, such as lecanemab[27] and donanemab[28]. Acetylcholinesterase inhibitors (donepezil, galantamine, rivastigmine) and the NMDA receptor antagonist memantine provide limited improvements in cognition, often requiring high dosages that can cause adverse reactions such as nausea and vomiting[29]. Likewise, antidepressants such as fluoxetine[30] and sertraline[31] may alleviate certain neuropsychiatric symptoms but are linked to side effects and increased mortality risks, making them a less desirable treatment option. Therefore, early intervention at the stage of mild cognitive impairment, the precursor to AD—is of particular importance[32].

On the other hand, non-pharmacological interventions appear more beneficial in addressing the behavioral and psychological symptoms of AD. Currently, non-pharmacological interventions for AD include various approaches, including cognitive training[33], sensory and multisensory stimulation[34,35], exercise-based therapies[36], acupuncture[37], transcranial ultrasound stimulation[38], play-based therapies[39], and music therapy[40].

This narrative review will focus on how music therapy (MT) can contribute to improving the quality of life for individuals affected by AD.

Materials and Methods

The Pub Med base has been searched for full papers published in English since the last three decades. We used key words “music”, “Alzheimer disease”, “dementia” and “therapy”.

Effects of Music on AD - Biological Plausibility

Because musical memory often remains largely preserved even in the advanced stages of Alzheimer’s disease, music can provide an effective and meaningful way to engage and communicate with individuals affected by the condition. Research indicates that MT can help slow cognitive deterioration in people with AD, especially in domains linked to autobiographical memory[41]. It may also affect certain pathological processes, including the buildup of amyloid plaques and alterations in glucose metabolism. In addition, MT has been linked to improvements in behavioral and psychological symptoms, such as reduced agitation, anxiety, depression, aggression, and impairments in episodic memory[42]. MT has emerged as an especially effective approach, demonstrating significant improvements in the quality of life and self-worth of individuals with AD[43]. Executive functioning of elderly patients with early-stage AD may also be markedly improved using music therapy[44].

Music has the capacity to trigger emotional reactions in listeners by engaging multiple brain regions, particularly those linked to emotional processing and regulation, such as the limbic and paralimbic systems[45]. Beyond emotional engagement, music also contributes to the stimulation of both motor and cognitive functions, which can be especially valuable during neural rehabilitation[46]. Findings from neurochemical research indicate that music exerts beneficial effects on health and well-being by influencing motivation, reward pathways, pleasure, immune response, and social connectedness, while simultaneously lowering stress and physiological arousal[47]. Evidence also suggests that music therapy supports cardiovascular health by reducing heart rate, as well as systolic and diastolic blood pressure[48].

In dementia care, music therapy provided over extended periods (e.g., three months or longer) has been shown to meaningfully reduce anxiety, though improvements in behavioral disturbances are generally moderate[49]. Apart from its emotional benefits, music therapy is associated with cognitive gains, particularly in attention and memory, among people with dementia[50]. With respect to language, studies have demonstrated that regular participation—twice weekly over three months—can improve speech fluency and content in individuals with AD[51]. Remarkably, patients with a background in professional music who later develop AD have occasionally retained the ability to learn

and perform new pieces, indicating that long-term musical training may provide distinctive neurocognitive advantages despite advanced cognitive decline[52].

Mechanisms of the effects of music on people suffering from AD are summarized in Figure 1.

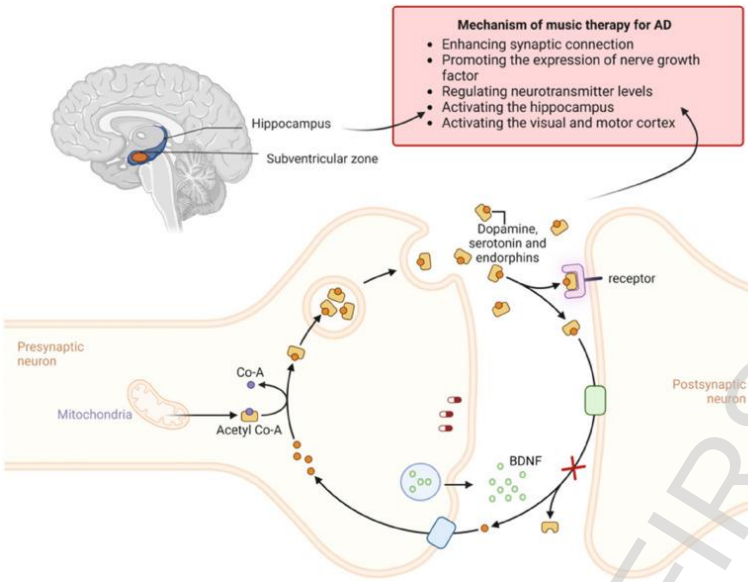

Figure 1. Mechanisms of music therapy for Alzheimer's disease

With the journal's permission, taken from: Lin TH, Liao YC, Tam KW, Chan L, Hsu TH. Effects of music therapy on cognition, quality of life, and neuropsychiatric symptoms of patients with dementia: A systematic review and meta-analysis of randomized controlled trials. Psychiatry Res. 2023;329: 115498. 10.1016/j.psychres.2023.115498

Types of Music Interventions

The literature identifies several distinct types of music interventions, including active music therapy aimed at psychological or rehabilitative outcomes, music-based interventions, caregiver singing, individualized listening to music, and background music[53].

Active music therapy (AMT) is characterized by the active involvement of individuals with dementia in music-making, either one-on-one or in group sessions, under the guidance of a qualified music therapist. This form of therapy may incorporate improvisation or familiar songs, with the intention of supporting speech, memory, and executive functions. Evidence shows that group AMT can produce rapid and substantial reductions in depressive symptoms, particularly among those with mild to moderate dementia[54]. In nursing home contexts, where many residents present with moderate to severe dementia, AMT has also been associated with enhanced quality of life, manifested through reductions in agitation, behavioral issues, and reliance on psychotropic drugs[55]. AMT may also be delivered by family caregivers who maintain a close emotional connection with the person with dementia. In these cases, the role of the professional music therapist is generally advisory, guiding the process while the primary goal remains the improvement of non-verbal communication between caregiver and a person with dementia. Since this approach is typically implemented in home environments, the available studies often lack the methodological rigor of randomized controlled trials which limits the strength of the evidence base. Even so, reports from both caregivers and individuals with dementia highlight perceived benefits, including greater relaxation, comfort, and feelings of happiness[56].

Unlike active music therapy, *music-based interventions* (MBIs) do not involve a professional music therapist and are not designed to achieve defined therapeutic outcomes. Instead, participants may engage informally in activities such as singing, dancing, listening to music, or playing simple rhythmic instruments. The effectiveness of MBIs has been examined in several RCTs, providing a comparatively solid evidence base. For instance, a program of group music sessions held twice a week for 30 minutes over a six-week period in nursing homes was shown to reduce agitation, including both aggressive and non-aggressive behaviors, expressed physically and verbally[57]. Percussion instruments, in particular, are well-suited for such group settings, as they require no prior musical expertise and have demonstrated notable effectiveness in alleviating anxiety[58].

Providing care for a patient with dementia (PWD) is often both physically and emotionally challenging, particularly when resistance or aggression arises. To enhance communication and strengthen the caregiver–patient relationship, caregivers sometimes integrate singing or vocal sounds into daily interactions. Because dementia frequently impairs verbal communication, misunderstandings between caregivers and PWD are common. Singing, however, can help patients intuitively understand the context or intent of an interaction, even when spoken explanations are limited[59]. During routine care activities—such as assisting with hygiene, dressing, bathing, or toileting—individuals with dementia may resist through physical tension, grasping objects, or pulling away. Research indicates that the use of singing in these situations reduces resistant behavior and encourages positive emotional responses, greater alertness, and a sense of enjoyment in patients[60].

Individualized listening to music (ILM) is a person-centered approach in which patients are exposed to music that reflects their own tastes and preferences, with the aim of promoting relaxation and improving well-being. It is particularly useful for managing behavioral symptoms that may occur during stressful situations, difficulties in communication, adaptation to new environments, or while receiving care. Information about the patient's preferred music is most often obtained from family members or other individuals who know them well. ILM can be carried out by healthcare professionals as well as informal caregivers, making it suitable for implementation in both institutional settings and private homes. Although several RCTs have explored the benefits of ILM, the relatively small number of participants limits the broader applicability of these findings. ILM

is based on selecting music that reflects the personal preferences of the individual, often incorporating songs that hold particular meaning from earlier life experiences. For effective implementation with PWD, it is important to collect detailed information about the individual's musical background—preferably with input from family members or close acquaintances—using validated tools such as structured questionnaires[61]. ILM can be introduced across different care contexts, ranging from the patient's home to institutional environments such as nursing facilities. Since agitation is observed in an estimated 70–90% of people with dementia[62], ILM has demonstrated notable effectiveness in reducing these behaviors[63,64]. Furthermore, because agitation and anxiety are closely related, ILM has also been shown to help alleviate anxiety symptoms[65].

In contrast to ILM, *background music* (BM) does not focus on personal preferences but instead involves playing prerecorded music in shared spaces where people with dementia spend time, either during activities or periods of rest. The aim of BM is to create a more positive emotional atmosphere rather than to achieve specific therapeutic goals. Studies have shown that BM can foster greater social engagement and help reduce disruptive behaviors in individuals with dementia[66]. For example, introducing BM during mealtimes in nursing home settings has been linked to significant reductions in both verbal and physical aggression among residents with dementia[67].

Combined musical therapy

Recognizing the potential benefits of combining different music-based approaches, recent research has investigated the effects of integrated music therapy interventions. In one study conducted over six weeks in a nursing home, participants attended 45-minute sessions twice weekly. Each session was structured to include a welcome song, rhythmic exercises such as clapping and playing percussion instruments, movement activities accompanied by background music, song recognition games, and a closing song. This comprehensive approach was associated with notable improvements in individuals with moderate AD, including enhanced cognitive functions (such as memory and orientation), reductions in neuropsychiatric symptoms—including depression, anxiety, delirium, hallucinations, agitation, and irritability—and improvements in language skills[68].

Conclusion

RCTs provide strong evidence supporting the benefits of music therapy for individuals with AD, highlighting its potential to enhance cognitive functioning and reduce psychological and behavioral symptoms. One of the key strengths of this approach is that it is non-invasive and generally free of adverse side effects. Additionally, the ability to tailor and combine different types of music interventions according to individual preferences increases its versatility and effectiveness in meeting the unique needs of patients with AD.

Conflict of Interest

The author declares no conflict of interest.

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