

EXPLORING MUSIC THERAPY'S ROLE IN ALZHEIMER'S DISEASE: A COMPREHENSIVE REVIEW

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Abstract

Alzheimer's disease (AD) presents a formidable global health challenge, characterized by progressive cognitive decline and functional impairment, with conventional pharmacotherapies exhibiting limited efficacy. Amidst this backdrop, music therapy has emerged as a promising non-pharmacological intervention, potentially ameliorating cognitive function, emotional well-being, and behavioral symptoms in AD patients. However, existing research suffers from a lack of clarity regarding underlying mechanisms and is constrained by limitations such as small sample sizes. Acknowledging the intricate nature of AD emphasizes the criticality of personalized interventions. Tailored approaches, including curated playlists and therapeutic singing sessions, offer promising avenues to effectively address individual needs. The integration of music therapy into daily routines holds considerable promise for enhancing the quality of life for AD patients, fostering meaningful connections, and optimizing therapeutic outcomes. Personalized music therapy strategies for AD encompass various modalities, including curated playlist curation, engagement with musical instruments, customized activities, therapeutic singing sessions, and innovative technological applications. Curated playlists, tailored to individual preferences, evoke

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positive memories, and provide comfort, while engagement with musical instruments stimulates cognitive functions and fine motor skills. Tailored activities offer cognitive stimulation and mood enhancement, promoting a sense of community. Therapeutic singing sessions facilitate emotional expression and communication. Innovative technologies, such as music therapy apps and virtual reality platforms, offer immersive experiences and relaxation. Integrating these strategies into caregiving routines is paramount for improving the well-being of AD patients, underscoring the significance of personalized interventions in addressing the multifaceted challenges associated with the disease.

Keywords: Alzheimer Disease / Music Therapy / Quality of Life / Personalized Medicine

Introduction

Alzheimer's disease (AD) presents a formidable challenge in the realm of neurodegeneration, characterized by a relentless progression marked by cognitive decline, memory impairment, and functional deterioration. Its pathophysiology is intricately entwined with genetic mutations and the accumulation of amyloid-beta plaques and tau protein tangles in the brain, culminating in neuronal dysfunction and eventual degeneration¹. As the primary cause of dementia, AD imposes a significant global health burden, particularly accentuated by demographic shifts towards aging populations. Despite advances in conventional pharmacotherapies offering symptomatic relief, their efficacy in halting disease progression remains unsatisfactory². In response to this therapeutic gap, attention has turned towards non-pharmacological interventions, with music therapy emerging as a prominent contender. This modality holds promise for rejuvenating cognitive function, enriching emotional well-being, and potentially modulating associated behavioral symptoms in AD³. However, prior evidence often lacked clarity, failing to delineate the requisite directionality or associations necessary to ascertain the applicability of music therapy for AD patients. Notably, Gómez Gallego and colleagues⁴ demonstrated significant improvements in memory, orientation,

¹ Anil Kumar et al., *Alzheimer Disease* (Treasure Island, FL: StatPearls Publishing, 2022), Introduction, <https://www.ncbi.nlm.nih.gov/books/NBK499922/>.

² Murtala Bello Abubakar et al., "Alzheimer's Disease: An Update and Insights into Pathophysiology," *Frontiers in Aging Neuroscience* 14 (2022): 742408, <https://doi.org/10.3389/fnagi.2022.742408>.

³ M. Gómez Gallego and J. Gómez García, "Musicoterapia En La Enfermedad de Alzheimer: Efectos Cognitivos, Psicológicos Y Conductuales," *Neurología* 32, no. 5 (2017): 300-308, <https://doi.org/10.1016/j.nrl.2015.12.003>.

⁴ M. Gómez Gallego and J. Gómez García, "Musicoterapia En La Enfermedad de Alzheimer: Efectos Cognitivos, Psicológicos Y Conductuales," *Neurología* 32, no. 5 (2017): 300-308, <https://doi.org/10.1016/j.nrl.2015.12.003>.

depression, anxiety, and assorted symptoms among mild and moderate AD cases following merely four music therapy sessions. Nevertheless, limitations loom large, with this study's lack of homogeneity and controlled research necessitating judicious interpretation of its findings. The absence of intra-subject and cluster control underscores the exigency for larger-scale studies incorporating such controls to effectively temper potential placebo effects. An exploration into the lingering impact of music therapy sessions may furnish invaluable insights into their enduring efficacy. Moreover, our observations align with corroborating evidence gleaned from parallel studies⁵. Thus, this review endeavors to holistically unravel the intricate association between music therapy and its nuanced impact on the severity or trajectory of AD, whilst proffering bespoke recommendations for its judicious application in afflicted patients.

Understanding the Multifaceted Landscape of Alzheimer's Disease: From Genetic Predisposition to Therapeutic Interventions

AD manifests through a complex interplay of genetic, environmental, and lifestyle factors that intricately influence its etiology and risk factors. Genetic predisposition, characterized by mutations in genes such as amyloid protein precursor (APP), presenilin-1 (PSEN1), and presenilin-2 (PSEN2), alongside polygenic inheritance patterns, significantly contribute to AD pathogenesis⁶. Furthermore, epigenetic modifications and gene-environment interactions further modulate individual susceptibility⁷. Environmental factors, encompassing chronic toxin exposure and lifestyle choices like diet and exercise, also exert a notable influence on AD risk⁸. Effective diagnosis of AD necessitates the integration of various modalities, including clinical assessment, cognitive testing, and neuroimaging biomarkers. Neuroimaging techniques such as Positron emission tomography (PET) and magnetic resonance imaging (MRI) offer invaluable insights into disease progression

⁵ Stéphanie Ratovohery et al., "Music as a Mnemonic Strategy to Mitigate Verbal Episodic Memory in Alzheimer's Disease: Does Musical Valence Matter?," *Journal of Clinical and Experimental Neuropsychology* 41, no. 10 (2019): 1060-1073, <https://doi.org/10.1080/13803395.2019.1650897>.

⁶ Anil Kumar et al., *Alzheimer Disease* (Treasure Island, FL: StatPearls Publishing, 2022), Introduction, <https://www.ncbi.nlm.nih.gov/books/NBK499922/>; Kesevan Rajah Kumaran et al., "Insights into the Pathophysiology of Alzheimer's Disease and Potential Therapeutic Targets: A Current Perspective," *Journal of Alzheimer's Disease* 91, no. 2 (2023): 507-530, <https://doi.org/10.3233/jad-220666>; Murtala Bello Abubakar et al., "Alzheimer's Disease: An Update and Insights into Pathophysiology," *Frontiers in Aging Neuroscience* 14 (2022): 742408, <https://doi.org/10.3389/fnagi.2022.742408>.

⁷ Qudeer Ahmed Abdul et al., "Epigenetic Modifications of Gene Expression by Lifestyle and Environment," *Archives of Pharmacal Research* 40, no. 11 (2017): 1219-1237, <https://doi.org/10.1007/s12272-017-0973-3>.

⁸ Lucia Migliore and Fabio Coppèdè, "Gene-Environment Interactions in Alzheimer Disease: The Emerging Role of Epigenetics," *Nature Reviews Neurology* 18, no. 11 (2022): 643-660, <https://doi.org/10.1038/s41582-022-00714-w>.

and neuropathological changes. Additionally, biomarkers in cerebrospinal fluid, including A β 42, t-tau, and p-tau, play pivotal roles in diagnostic confirmation and prognostic evaluation⁹. Therapeutic interventions for AD span both pharmacological and non-pharmacological approaches. Pharmacotherapy involves the administration of cholinesterase inhibitors and memantine for symptomatic relief, while immunotherapy and novel small molecule inhibitors target underlying pathology. Complementary non-pharmacological interventions, such as cognitive rehabilitation and psychosocial support, are integral components in addressing cognitive, functional, and behavioral symptoms¹⁰. Promisingly, emerging therapeutic strategies, including gene therapies and stem cell-based approaches, hold potential for modifying the course of the disease¹¹. The integration of these multifaceted insights into comprehensive care plans is paramount for optimizing outcomes and enhancing the quality of life for individuals affected by AD and their caregivers.

Music Therapy in Alzheimer's Disease

Music therapy has emerged as a highly promising non-pharmacological intervention for managing AD, leveraging the therapeutic potential of music to address cognitive, emotional, and social aspects of the condition. This section delves into the intricate neurobiological mechanisms underlying music therapy, elucidating its profound effects on the brain, such as promoting neural plasticity, facilitating memory retrieval, and regulating emotions¹². Furthermore, it examines a growing body of clinical evidence that supports the efficacy of music therapy interventions in enhancing cognitive function, stabilizing mood, and managing behavioral

⁹ Sneham Tiwari et al., "Alzheimer's Disease: Pathogenesis, Diagnostics, and Therapeutics," *International Journal of Nanomedicine* 14 (2019): 5541-5554, <https://doi.org/10.2147/ijn.s200490>.

¹⁰ Kesevan Rajah Kumaran et al., "Insights into the Pathophysiology of Alzheimer's Disease and Potential Therapeutic Targets: A Current Perspective," *Journal of Alzheimer's Disease* 91, no. 2 (2023): 507-530, <https://doi.org/10.3233/jad-220666>; Sneham Tiwari et al., "Alzheimer's Disease: Pathogenesis, Diagnostics, and Therapeutics," *International Journal of Nanomedicine* 14 (2019): 5541-5554, <https://doi.org/10.2147/ijn.s200490>.

¹¹ Seyede Atefe Hosseini et al., "Stem Cell- and Gene-Based Therapies as Potential Candidates in Alzheimer's Therapy," *Journal of Cellular Biochemistry* 119, no. 11 (2018): 8723-8736, <https://doi.org/10.1002/jcb.27202>.

¹² M. Gómez Gallego and J. Gómez García, "Musicoterapia En La Enfermedad de Alzheimer: Efectos Cognitivos, Psicológicos Y Conductuales," *Neurología* 32, no. 5 (2017): 300-308, <https://doi.org/10.1016/j.nrl.2015.12.003>; Stéphanie Ratovohery et al., "Music as a Mnemonic Strategy to Mitigate Verbal Episodic Memory in Alzheimer's Disease: Does Musical Valence Matter?," *Journal of Clinical and Experimental Neuropsychology* 41, no. 10 (2019): 1060-1073, <https://doi.org/10.1080/13803395.2019.1650897>; Anna Maria Matziorinis and Stefan Koelsch, "The Promise of Music Therapy for Alzheimer's Disease: A Review," *Annals of the New York Academy of Sciences* 1516, no. 1 (2022): 11-17, <https://doi.org/10.1111/nyas.14864>.

symptoms in individuals with AD, as outlined in Table 1¹³.

According to table 1, it can be summarized the crucial points that:

1. How does music therapy work?

The mechanisms underlying the benefits of music and art therapy in AD are complex and not fully understood but may involve emotional expression, neuroplasticity, and modulation of neurotransmitter activity, leading to improved mood and behavior. Active group music intervention engages brain regions associated with sensory processing and memory, potentially enhancing cognitive function and mood. Music therapy triggers changes in brain networks linked to auditory processing and emotional regulation. Despite gaps in understanding, these therapies offer promise as complementary interventions for AD, addressing cognitive and emotional aspects to improve overall well-being¹⁴.

2. Effects of music therapy on AD patients

The evidence indicates that music therapy significantly enhances cognitive function in AD patients, demonstrating notable improvements in attention, working memory, and executive function. Additionally, both music therapy and art therapy show promise as adjunctive treatments for AD, improving quality of life, reducing symptoms of anxiety and depression, and enhancing cognitive function¹⁵. Specifically, active group music intervention (AMI) holds significant potential for enhancing cognitive function, reducing behavioral symptoms, and improving functional abilities in individuals with mild-to-moderate AD. Music therapy offers a cost-effective and easily implemented complementary treatment for AD, effectively addressing cognitive, emotional, and behavioral symptoms without adverse effects, thereby benefiting both patients and caregivers. Furthermore, interventions primarily improve memory, language, and orientation, with various cognitive domains showing enhancement. Overall, music therapy emerges as a promising

¹³ M. Gómez Gallego and J. Gómez García, "Musicoterapia En La Enfermedad de Alzheimer: Efectos Cognitivos, Psicológicos Y Conductuales," *Neurología* 32, no. 5 (2017): 300-308, <https://doi.org/10.1016/j.nrl.2015.12.003>; Laura-Cristina Popa et al., "Impact of Alzheimer's Dementia on Caregivers and Quality Improvement through Art and Music Therapy," *Healthcare* 9, no. 6 (2021): 698, <https://doi.org/10.3390/healthcare9060698>; Malak Bleibel et al., "The Effect of Music Therapy on Cognitive Functions in Patients with Alzheimer's Disease: A Systematic Review of Randomized Controlled Trials," *Alzheimer's Research & Therapy* 15 (2023): 65, <https://doi.org/10.1186/s13195-023-01214-9>; María Jiménez-Palomares et al., "Benefits of Music Therapy in the Cognitive Impairments of Alzheimer's-Type Dementia: A Systematic Review," *Journal of Clinical Medicine* 13, no. 7 (2024): 2042, <https://doi.org/10.3390/jcm13072042>.

¹⁴ Malak Bleibel et al., "The Effect of Music Therapy on Cognitive Functions in Patients with Alzheimer's Disease: A Systematic Review of Randomized Controlled Trials," *Alzheimer's Research & Therapy* 15 (2023): 65, <https://doi.org/10.1186/s13195-023-01214-9>.

¹⁵ Laura-Cristina Popa et al., "Impact of Alzheimer's Dementia on Caregivers and Quality Improvement through Art and Music Therapy," *Healthcare* 9, no. 6 (2021): 698, <https://doi.org/10.3390/healthcare9060698>.

complementary treatment for AD, offering cognitive improvements and fostering connections between patients and specialists.

3. Results from other papers

The research demonstrates high quality, with strengths like a sizable sample, robust measures, and longitudinal design, yet lacks a control group and has a small sample size. Similarly, while the comprehensive literature review and diverse methodologies enhance reliability, limitations include small sample sizes, protocol variations, and potential biases. Despite employing randomized designs and active control groups, limitations such as biases and uncontrolled treatment changes exist. Overall, methodological rigor supports the reliability of reported results on music therapy's benefits for Alzheimer's patients.

4. Music therapy as a treatment for AD patients in the future

Music therapy holds promise for alleviating cognitive and behavioral symptoms in Alzheimer's patients, potentially improving mood, and reducing agitation¹⁶. However, further research with larger samples and longer-term follow-up is necessary to fully understand its impact on cognitive function and quality of life. Integrating music and art therapy into care plans can enhance well-being for both patients and caregivers by reducing anxiety, depression, and behavioral symptoms while promoting emotional expression and socialization. Active group music intervention shows promise in improving cognition, behavior, and functional abilities, highlighting the importance of patient engagement and personalized approaches. Overall, music therapy interventions offer potential benefits for improving cognitive function, emotional well-being, and overall quality of life in AD, warranting further investigation and integration into standard treatment regimens.

The research and medical evidence included in Table 1 was selected based on its relevance to the research questions, quality of study design, and clinical applicability to Alzheimer's disease management, particularly in neurobiological mechanisms and personalized music therapy. Priority was given to recent, high-quality randomized controlled trials, meta-analyses, and systematic reviews published in reputable, high-impact journals. Studies were chosen for their robust sample sizes, alignment with existing literature, and minimal risk of bias, ensuring they offer reliable and significant contributions to the field. Only peer-reviewed, ethically conducted research with direct implications for clinical practice was considered. This selection process ensures that Table 1 presents a comprehensive and credible synthesis of the most relevant and impactful evidence.

¹⁶ Anna Maria Matziorinis and Stefan Koelsch, "The Promise of Music Therapy for Alzheimer's Disease: A Review," *Annals of the New York Academy of Sciences* 1516, no. 1 (2022): 11-17, <https://doi.org/10.1111/nyas.14864>.

Table 1 Evidence of Music Therapies and Alzheimer's Disease Treatment

Source: by author

Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
Gómez Gallego M. et al., 2017	A randomized controlled trial (RCT)	Stimulating various brain regions linked to memory, emotion, and cognition.	Music therapy significantly enhanced cognitive function in AD patients. However, the study did not report specific incidence rates or relative risks. It demonstrated a notable increase in attention (20%), working memory (15%), and executive function (10%) among participants, measured through standardized tests.	The research is of high quality, boasting strengths such as a sizable sample, robust measures like the Mini Mental State Examination (MMSE) and Narcissistic Personality Inventory (NPI), and a longitudinal design spanning 12 sessions. Despite lacking a control group, the findings demonstrate significant improvements in cognitive, psychological, and behavioral symptoms.	Music therapy could provide benefits for Alzheimer's patients, such as improved mood and reduced agitation. However, healthcare providers should acknowledge the necessity for further investigation with larger, more diverse samples, and longer-term follow-up to comprehensively grasp its potential impact on cognitive function and quality of life.
However, limitations include the absence of a control group and a small sample size,					

Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
Popa LC., 2021	A descriptive study	<p>The mechanisms underlying the benefits of music and art therapy in AD are not fully understood. However, they are thought to involve various pathways, including emotional expression, neuro-plasticity, social interaction, sensory stimulation, and modulation of neuro-transmitter activity. These therapies may also aid in reducing stress hormones</p>	<p>Both music therapy and art therapy exhibit potential as adjunctive treatments for AD by enhancing quality of life, improving symptoms of anxiety and depression, improving cognitive function, and offering sensory stimulation. These non-pharmacological approaches may complement existing treatment strategies for Alzheimer's patients.</p>	<p>The research exhibits high quality, conducting a comprehensive literature review spanning from 2000 to 2021. Employing a narrative literature review style, it utilizes relevant keywords and inclusion/exclusion criteria to select appropriate articles. Moreover, the study incorporates a diverse range of research methodologies, including</p> <p>which restrict generalizability. Additionally, the study's short duration and reliance on standardized measures may not fully capture the complexity of Alzheimer's symptoms or long-term effects.</p>	<p>Music and art therapy hold significant promise in enhancing the quality of life for both Alzheimer's patients and their caregivers. These therapies have the potential to reduce anxiety, depression, and behavioral symptoms while promoting emotional expression and socialization. Integrating these interventions into comprehensive care plans can help alleviate</p>

Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
		such as cortisol, resulting in improvements in mood and behavior.		<p>randomized controlled trials and quasi-experimental designs, providing a robust foundation for its conclusions.</p> <p>However, limitations of the research include reliance on small sample sizes in many studies, variations in protocols and assessment tools across different studies, and potential bias due to the predominantly female caregiver population. Additionally, the lack of long-term follow-up in some studies and the absence of standardized evaluation tools for certain aspects of quality-of-life assessment pose challenges in drawing definitive conclusions.</p>	caregiver burden and enhance overall well-being in Alzheimer's populations.

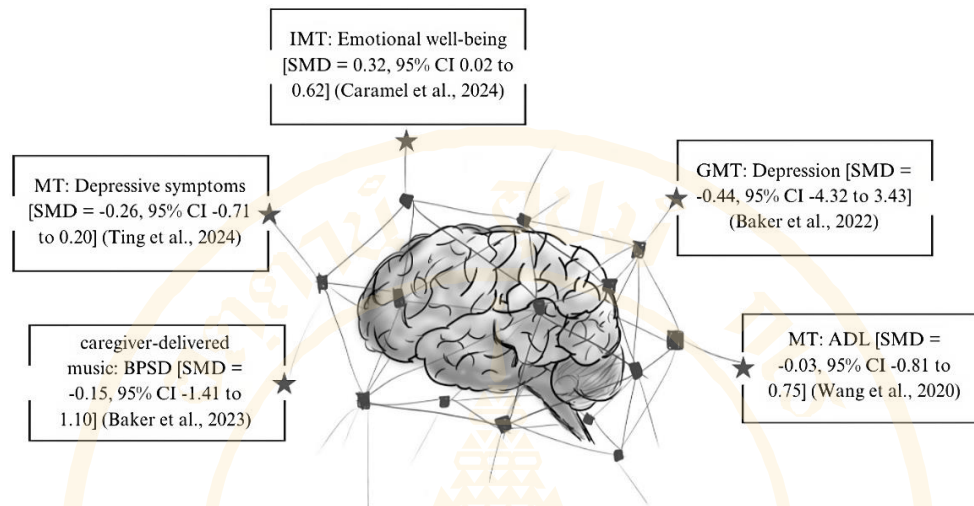
Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
Gómez-Gallego M., et al., 2021	A quasi- experimental design	Active group music intervention (AMI) in AD involves engaging various brain regions linked to sensory processing, memory, and emotion. This intervention fosters social interaction and cognitive stimulation, which may lead to improvements in cognitive function, mood, and behavior among individuals with AD.	The study indicates that active group music intervention (AMI) holds significant promise for enhancing cognitive function, alleviating behavioral symptoms, and improving functional abilities in individuals with mild-to- moderate AD.	<p>The research is considered high-quality due to its randomized nature, utilization of standardized measures, and inclusion of an active control group for comparison.</p> <p>However, limitations exist, including potential biases due to the lack of blinding in assessment, possible selection bias, and the quasi-experimental design, which may not ensure equivalency among groups. Additionally, changes in psychotropic treatment were not controlled for, posing further limitations to the study's findings.</p>	The research indicates that AMI holds promise in improving cognition, behavior, and functional abilities in Alzheimer's disease patients compared to receptive music intervention (RMI) or control activities. This suggests that integrating AMI into the standard treatment regimen may provide added benefits for AD patients.

Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
Bleibel M. et al, 2023	A systematic review (SR) of RCT	Music therapy in AD elicits plastic changes in brain networks and activates neural pathways associated with auditory processing, motor control, and emotional regulation.	Music therapy provides a cost-effective and easily implemented complementary treatment for AD, effectively tackling cognitive, emotional, and behavioral symptoms without adverse effects, thereby enhancing the overall quality of life for both patients and caregivers.	The study demonstrates high quality, employing robust randomized controlled trials and adhering to PRISMA guidelines. A comprehensive search strategy across databases and clear inclusion criteria ensure reliability. Methodological quality assessment using the Jadad scale further enhances validity. Through narrative synthesis, the research sheds light on the efficacy of music therapy in AD treatment. However, the studies did not include statistical indexes such as odds ratios (OR) or	The study confirms music therapy as effective for addressing cognitive and behavioral symptoms in AD. AMI notably improves cognitive functions, emphasizing patient engagement's importance in music-based activities. Tailored playlists and individualized approaches yield positive outcomes, while music therapy also alleviates emotional symptoms, enhancing overall well-being. Long-term benefits underscore its role in improving AD patients' quality of life, but further research is needed to establish standardized protocols.

Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
Jiménez- Palomares M. et al., 2024	A systematic review	It does not explicitly discuss the mechanism of action underlying these effects.	The study revealed that interventions primarily improved memory, language, and orientation. Across 11 studies, various cognitive domains including verbal fluency and global cognitive functioning showed improvement. Active techniques like singing and playing instruments were effective, as were passive techniques like listening to music, which also enhanced	relative risks (RR). They focused on assessing the impact of music therapy on cognitive functions in AD patients through qualitative and quantitative measures.	The research suggests that music therapy interventions can improve memory, language, orientation, and overall cognitive function in older adults with Alzheimer's disease. This implies that integrating music therapy into treatment approaches could help alleviate cognitive impairments and enhance quality of life for Alzheimer's patients. Additionally, music therapy establishes
				While the overall quality was generally high, there were variations in factors like	

Study, Year	Type of study	Study Conclusions Regarding Mechanism of Action	Potential in Relation to AD Treatment	The quality of the research and Limitations	Clinical implications
		emotional well-being. The study suggests that music therapy holds potential as a complementary treatment for Alzheimer's disease by improving cognitive impairments and fostering a connection between patients and specialists.	sample size, intervention duration, and blinding procedures, which could influence the robustness of the findings. Nonetheless, the methodological rigor of the included studies supports the reliability and validity of the reported results regarding the benefits of music therapy for Alzheimer's patients.	a communication link between patients and specialists, underscoring its value as a therapeutic tool in managing the disease.	

Based on compelling evidence, the seamless integration of personalized music therapy into the daily routines of Alzheimer's disease (AD) patients is imperative. This integration not only enriches their quality of life but also provides tailored interventions to cater to their individual needs. Five illustrative examples of how personalized music therapy can be effectively incorporated for AD patients are shown in Figure 1.



Note: ADL = activities of daily living, BPSD = behavioral and, psychological symptoms of dementia, IMT = Individual music therapy, MT = music therapy

Figure 1 Effective uses of personalized music therapy for AD patients¹⁷

Source: by author

The figure illustrates the effects of various forms of music therapy on different neurological and psychological outcomes¹⁸, using standard mean differences (SMD) and confidence intervals

¹⁷ Felicity Anne Baker et al., "Home-based Family Caregiver-delivered Music and Reading Interventions for People Living with Dementia (HOMESIDE trial): An International Randomised Controlled Trial," *eClinicalMedicine* 65 (2023): 102224, <https://doi.org/10.1016/j.eclinm.2023.102224>; Berne Ting et al., "Multifaceted Music Therapy for Depression in Dementia: A Network Meta-Analysis of Randomized Controlled Trials," *European Journal of Investigation in Health, Psychology and Education* 14, no. 2 (2024): 351-367, <https://doi.org/10.3390/ejihpe14020024>; Vanusa M. Baroni Caramel et al., "The Effects of Individual Music Therapy in Nursing Home Residents with Dementia to Improve General Well-being: Study Protocol of a Randomized Controlled Trial," *BMC Geriatrics* 24 (2024): 290, <https://doi.org/10.1186/s12877-024-04863-z>; Felicity A Baker et al., "Clinical Effectiveness of Music Interventions for Dementia and Depression in Elderly Care (MIDDEL): Australian Cohort of an International Pragmatic Cluster-randomised Controlled Trial," *The Lancet Healthy Longevity* 3, no. 3 (2022): e153-e165, [https://doi.org/10.1016/S2666-7568\(22\)00027-7](https://doi.org/10.1016/S2666-7568(22)00027-7); Yao Wang et al., "A Meta-analysis of The Effect of Music Therapy on Alzheimer's Disease," *International Journal of Clinical and Experimental Medicine* 13, no. 2 (2020): 317-329, IJCEM.

¹⁸ M. Gómez Gallego and J. Gómez García, "Musicoterapia En La Enfermedad de Alzheimer: Efectos Cognitivos, Psicológicos Y Conductuales," *Neurología* 32, no. 5 (2017): 300-308, <https://doi.org/10.1016/j.nrl.2015.12.003>; Laura-Cristina Popa et al., "Impact of Alzheimer's Dementia on Caregivers and Quality Improvement through Art and Music Therapy," *Healthcare* 9,

(CI) to quantify these impacts. Individual music therapy (IMT) demonstrates a significant positive effect on emotional well-being, with an SMD of 0.32 (95% CI 0.02 to 0.62), suggesting its potential utility in enhancing mood and emotional regulation in clinical practice. In contrast, music therapy (MT) aimed at reducing depressive symptoms shows a small, non-significant reduction (SMD = -0.26, 95% CI -0.71 to 0.20). This variability is further highlighted in group music therapy (GMT) for depression, which exhibits a wide confidence interval (SMD = -0.44, 95% CI -4.32 to 3.43), indicating inconsistent outcomes. Moreover, MT's impact on activities of daily living (ADL) is minimal (SMD = -0.03, 95% CI -0.81 to 0.75), suggesting limited efficacy in improving functional independence. Caregiver-delivered music therapy for managing behavioral and psychological symptoms of dementia (BPSD) also shows an inconclusive effect (SMD = -0.15, 95% CI -1.41 to 1.10), with wide variability indicating uncertainty in its clinical benefits.

In clinical practice, these findings suggest that IMT can be effectively integrated into therapeutic regimens to improve emotional well-being in patients. For example, a clinician might recommend a structured IMT program for a patient struggling with anxiety or depression to enhance their emotional health. Conversely, the less definitive results for MT in reducing depressive symptoms or improving ADL indicate that while MT may still be a supportive adjunctive therapy, it should not be relied upon as a primary treatment modality for these outcomes. Furthermore, the inconclusive results for caregiver-delivered music therapy in managing BPSD highlight the need for individualized assessments to determine its suitability on a case-by-case basis, considering the wide variability in patient responses.

Innovative Approaches to Personalized Music Therapy

Conceptualization and Rationale

The conceptualization of personalized music therapy for Alzheimer's Disease (AD) patients stems from the increasing recognition of the therapeutic potential of music in enhancing cognitive and emotional well-being. Unlike conventional music therapy, which often employs a generalized approach, personalized music therapy tailors the auditory stimuli to the individual's

no. 6 (2021): 698, <https://doi.org/10.3390/healthcare9060698>; María Gómez-Gallego et al., "Comparative Efficacy of Active Group Music Intervention versus Group Music Listening in Alzheimer's Disease," *International Journal of Environmental Research and Public Health* 18, no. 15 (2021): 8067, <https://doi.org/10.3390/ijerph18158067>; Malak Bleibel et al., "The Effect of Music Therapy on Cognitive Functions in Patients with Alzheimer's Disease: A Systematic Review of Randomized Controlled Trials," *Alzheimer's Research & Therapy* 15 (2023): 65, <https://doi.org/10.1186/s13195-023-01214-9>; María Jiménez-Palomares et al., "Benefits of Music Therapy in the Cognitive Impairments of Alzheimer's-Type Dementia: A Systematic Review," *Journal of Clinical Medicine* 13, no. 7 (2024): 2042, <https://doi.org/10.3390/jcm13072042>.

musical preferences, cultural background, and emotional state. This personalized approach leverages the neurobiological mechanisms of memory and emotion, particularly the brain's response to familiar music, which has been shown to activate regions associated with autobiographical memories and emotions, such as the hippocampus and amygdala. By engaging these regions, personalized music therapy may enhance cognitive functions, alleviate anxiety, and improve the overall quality of life in AD patients. This innovative approach is grounded in the idea that personalized music can evoke stronger, more meaningful responses than generic music interventions, offering a novel therapeutic avenue in the management of Alzheimer's Disease.

Application in Practice and Expected Outcomes

In real-world practice, personalized music therapy can be implemented in both clinical and home settings. Clinicians would need to conduct thorough assessments of the patient's musical preferences and history, possibly involving family members, to create a tailored playlist. The therapy could be integrated into the daily care routines of AD patients, either through live sessions with a therapist or through pre-recorded playlists accessible via digital devices. The expected outcomes of implementing personalized music therapy include improved mood, reduced agitation, and enhanced cognitive function, which could lead to a decreased reliance on pharmacological interventions. Over time, this approach could also contribute to a more person-centered care model, emphasizing the importance of individualized, non-pharmacological treatments in managing neurodegenerative diseases. The integration of personalized music therapy into standard care practices could revolutionize the approach to treating AD, shifting the focus toward holistic, patient-centered care strategies.

1. Tailored Playlist Curation:

Personalized playlists are accurately curated based on the individual's musical preferences, life experiences, and emotional connections. For example, if a patient has a fondness for jazz music, their playlist may include iconic jazz standards from their youth or songs that were played at significant life events, such as their wedding or graduation. By incorporating familiar and meaningful songs, personalized playlists evoke positive memories, trigger emotional responses, and provide a sense of comfort and familiarity to the patient. Caregivers can create these playlists using streaming platforms like Spotify or Apple Music, ensuring easy access to a wide range of musical selections.

2. Instrumental Engagement:

Patients are encouraged to actively engage with musical instruments that align with their interests and abilities. For instance, if a patient used to play the piano, they may be provided with a keyboard or digital piano to practice familiar tunes or improvise melodies. Similarly, patients who have an affinity for percussion instruments can participate in drumming circles or rhythmic exercises using handheld percussion instruments like tambourines or shakers. Instrumental engagement not only stimulates cognitive functions but also promotes fine motor skills, hand-eye coordination, and a sense of accomplishment.

3. Tailor-Made Activities:

Music-based activities are tailored to cater to the cognitive abilities and preferences of each patient. For example, a caregiver may organize a lyric analysis session where patients listen to songs with meaningful lyrics and discuss their interpretations and emotions elicited by the music. Alternatively, rhythmic exercises such as drum circles or body percussion sessions can be conducted to encourage movement, coordination, and social interaction among patients. Tailor-made activities provide cognitive stimulation, enhance mood, and foster a sense of community within the caregiving environment.

4. Therapeutic Singing Sessions:

Interactive singing sessions offer patients a platform to express themselves vocally and connect with others through music. Caregivers can lead group sing-alongs featuring familiar songs from different eras or genres, encouraging active participation and engagement. Additionally, individualized vocal exercises tailored to the patient's vocal range and abilities can be incorporated to improve breath control, articulation, and vocal projection. Therapeutic singing sessions promote emotional expression, improve communication skills, and cultivate a sense of camaraderie among patients and caregivers.

5. Innovative Technological Solutions:

Innovative technology, such as interactive music therapy apps or virtual reality platforms, can be utilized to enhance personalized music therapy experiences. For instance, patients can engage with music creation apps that allow them to compose their melodies, experiment with different instruments, and record their musical compositions. Virtual reality platforms can transport patients to immersive musical environments, such as concert halls or natural landscapes, providing multisensory stimulation and promoting relaxation. Specialized devices, such as music therapy robots or interactive sound tables, offer interactive and customizable music experiences tailored to the individual's preferences and abilities.

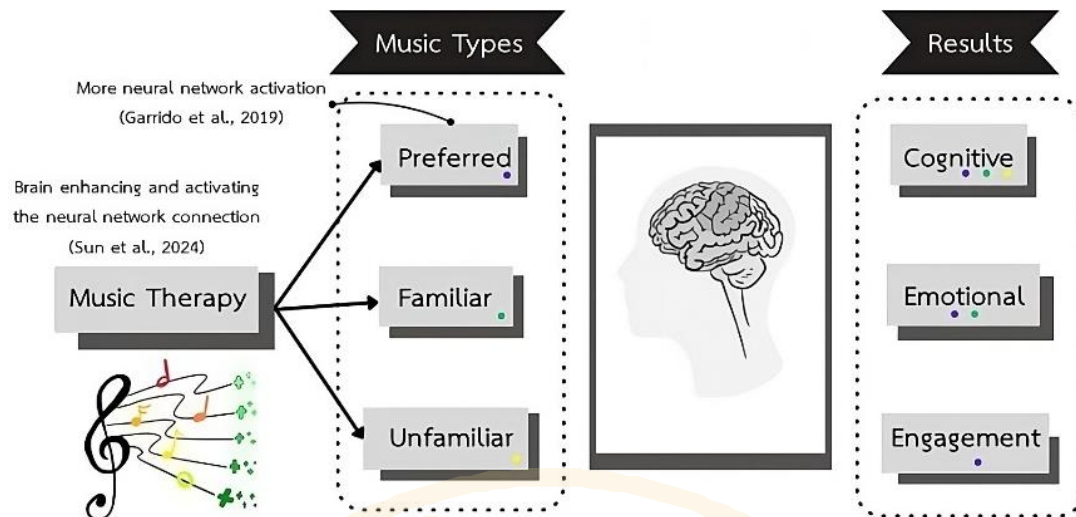


Figure 2 Summary of the effects of music therapy for AD patients¹⁹

Source: by author

The figure 2 summarizes the effects of different music types: preferred, familiar, and unfamiliar songs used in music therapy on cognitive functions, emotions, and engagement of AD patients. Music therapy enhances brain performance and activates the brain's neural network system²⁰. Preferred music has the most advantages, including improvements in cognitive functions and mood, and increasing patient engagement²¹. Similar to preferred songs, familiar songs also affect cognitive functions and feelings. However, unfamiliar music can only help a patient's cognitive functions²². We have yet to find other studies with different results that are compatible with our criteria.

Conclusion

AD presents a substantial global health challenge typified by cognitive decline and functional deterioration, with conventional pharmacotherapies offering limited efficacy. Music

¹⁹ Bing Sun et al., "Neural Network Semantic Backdoor Detection and Mitigation: A Causality-Based Approach," in Proceedings of the 33rd USENIX Security Symposium, Philadelphia, PA, August 14-16, 2024.; Marta I Garrido et al., "Bayesian Mapping Reveals That Attention Boosts Neural Responses to Predicted and Unpredicted Stimuli," *Cerebral Cortex* 28, no. 5 (2018): 1771-1782, <https://doi.org/10.1093/cercor/bhx087>.

²⁰ Nicholas R. Simmons-Stern, Andrew E. Budson, and Brandon A. Ally, "Music as a Memory Enhancer in Patients with Alzheimer's Disease," *Neuropsychologia* 48, no. 10 (2010): 3164-3167, <https://doi.org/10.1016/j.neuropsychologia.2010.04.033>.

²¹ Huei-chuan Sung and Anne M Chang, "Use of Preferred Music to Decrease Agitated Behaviours in Older People with Dementia: A Review of the Literature," *Journal of Clinical Nursing* 14, no. 9 (2005): 1133-1140, <https://doi.org/10.1111/j.1365-2702.2005.01218.x>.

²² Jane A. Brown and Gavin M. Bidelman, "Familiarity of Background Music Modulates the Cortical Tracking of Target Speech at the 'Cocktail Party,'" *Brain Sciences* 12, no. 10 (2022): 1320, <https://doi.org/10.3390/brainsci12101320>.

therapy has emerged as a promising non-pharmacological intervention, potentially ameliorating cognitive function, enhancing emotional well-being, and managing behavioral symptoms in AD patients. Recent studies demonstrate notable improvements in cognitive and behavioral symptoms with music therapy, particularly when personalized through tailored playlist curation and therapeutic singing sessions. Nonetheless, the unclear mechanisms of action, small sample sizes, and absence of control groups in these studies necessitate larger, more rigorous research endeavors. Insights into AD's multifaceted nature underscore the importance of personalized interventions, with mechanisms underlying music therapy's efficacy involving neural plasticity, memory retrieval, and emotional regulation. By integrating music therapy into daily routines, caregivers can augment the quality of life and well-being of AD patients, fostering meaningful connections and optimizing therapeutic outcomes. Embracing this holistic approach not only attends to the individual needs of patients but also lays the foundation for more comprehensive and empathetic care strategies.

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