The Impact of Music Therapy on Alzheimer's Disease Outcomes

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Abstract

Alzheimer's Disease (AD) is the most common cause of dementia in the United States. Researchers are investigating nonpharmacologic treatment options for AD given that few medications are approved for management of the disease and there remains no cure. As a result, researchers and clinicians in this space are considering non-pharmacological interventions like music therapy. This literature review discusses the potential role for music therapy in the treatment of Alzheimer's and summarizes the current literature on music's impact on cognitive function, including memory. Additionally, it covers the role of music in management of anxiety, depression, and other behavioral disturbances commonly seen in Alzheimer's disease.

Introduction

Approximately 5.2 million Americans today are living with Alzheimer's Disease (AD) and that number is expected to grow to 7 million by 2030. Alzheimer's is the most common cause of dementia and is associated with deterioration of cognitive ability including memory. It can also be associated with neuropsychiatric disturbances like anxiety and depression in older adults (Tang et al., 2020).

Alzheimer's Disease is associated with plaques and tangles in the brain (Tampi et al., 2021). These plaques and tangles, made of amyloid and tau proteins, accumulate in regions like the hippocampus, an area important for encoding memories (Tampi et al., 2021). As the disease progresses, the tangles become more abundant and spread through different brain regions that play a significant role in cognitive and behavioral function (Tampi et al., 2021).

A few drugs have been approved for treatment of Alzheimer's disease. These include acetylcholinesterase inhibitors and the controversial drug, Aducanumab (Aduhelm) (Mehta et al., 2012; Tampi et al., 2021) . A new drug named lecanemab has shown some promise and is currently in phase 3 of the clinical trials, but it is yet to be seen whether it will be approved by the FDA and be used in the market (Prillaman, 2022).

As a result, researchers have decided to investigate whether non-pharmacological interventions, such as music, can help alleviate symptoms and improve quality of life for older adults with Alzheimer's Disease. This literature review summarizes current evidence for use of music therapy in management of Alzheimer's and explores the possibility for its integration in treatment of memory loss and behavioral disturbances associated with the neurodegenerative disease.

Impact of Music on Cognition in Alzheimer's Disease

Music activates several brain areas including the hippocampus, a major structure for long-term memory encoding (Raglio et al., 2015). Additionally, musical activities such as singing

have proven to strengthen neural connections in the brain and improve cognition, making it a potentially valuable tool for older adults with dementia, particularly Alzheimer's disease (Särkämö et al., 2014). Older adults with Alzheimer's disease often have attention, language, and orientation deficits in addition to memory impairment . Researchers are now investigating whether music therapy can address these cognitive deficits.

For instance, Gallego et al. had older adults undergo music therapy with an occupational therapist and cognitive testing with a neurologist prior to and after receiving music therapy (Gómez Gallego & Gómez García, 2017). Study participants had improvement in language ($p=0.047$) and memory ($p=0.000$) on the Mini-Mental State Examination (MMSE) (Gómez Gallego & Gómez García, 2017). In another study, Simmons-Stern et al. had participants with dementia work with a professional vocalist, who modified the lyrics of certain songs to be more relatable to their day-to-day activities (Simmons-Stern et al., 2012). For example, one song had lyrics such as "fill the pillbox with your pills." Participants were then asked questions based on each song, which helped test their episodic memory (Simmons-Stern et al., 2012). Researchers found that the lyrics helped improve participants' memory of general content, but not of more specific content.

In a third study that took place in Taiwan, participants with Alzheimer's disease sat in a room where music from classical composers Mozart and Pachelbel was playing over headphones (Li et al., 2015). Similar to other studies, a receptive musical therapy method was used. In some ways, this study was applying the "Mozart Effect" to participants with Alzheimer's. This is a phenomenon in which piano concertos by Mozart have been proven to improve spatial reasoning skills in individuals that listen to them (Jenkins, 2001). Although there was a significant improvement in abstraction in the music therapy group as opposed to the control group, there were no significant differences in memory and other cognitive domains, meaning that the Mozart Effect was not completely proven to work on patients with Alzheimer's. However, further research could be done on this phenomenon and its applications to AD.

Sarkamo et al. conducted a randomized controlled study of 89 older adults with mild-to-moderate dementia to observe the effect of music therapy not just on cognition but also emotion (Särkämö et al., 2014) . Participants were split into 3 groups: a music listening group, a singing group, and a control group (Särkämö et al., 2014). Over the 10-week coaching program, music therapy helped improve this aspect in both the listening and singing groups ($p=.041$) as opposed to the control group. Furthermore, there were major improvements seen in attention and executive function in music interventions as opposed to the control group ($p=.039$) (Särkämö et al., 2014). Unfortunately, 15 participants dropped from the study over the course of the 10 weeks, which was a limiting factor in drawing any conclusions.

A few systematic reviews have been done on the topic of music therapy and Alhzeimer's disease. One review conducted at The Federal University of Juiz de Fora in Brazil analyzed 24 articles but ended up excluding 20 of them. In the 4 studies included, the authors reached the conclusion that there are too few studies to evaluate whether it is possible to be used as a treatment. However, they noted that in the articles analyzed music was effective in improving

symptoms (Moreira et al., 2018). Another review conducted by a team of researchers at the University of Toronto analyzed 13 publications, and finally used 6 publications to reach their conclusion that individualized music regimens worked best to improve cognitive and behavioral outcomes (Leggieri et al., 2019).

Impact of Music on Behavioral Disturbances in Alzheimer's Disease

The previous section focused on the impact of music therapy on cognitive function in older adults with Alzheimer's disease. In addition to cognitive decline, most Alzheimer's patients also exhibit changes in their behavior. Some researchers have also investigated the impact of music on anxiety and depression in the patient population. In one study, participants were found to have a significant improvement in anxiety levels ($p<0.01$) after sitting and listening to music through headphones in a controlled environment (Guétin et al., 2009). Another study looked at whether music had a significant impact on participants' anxiety, depression, and cortisol levels, a marker of stress. 25 older adults aged 65 years and above participated and underwent 60-minute music therapy sessions (de la Rubia Ortí et al., 2018). These welcome songs had different themes that challenged their recall memory. At the end of the experiment, researchers found that music therapy significantly reduced salivary cortisol levels, suggesting music reduced participants' stress. They also found a linear correlation between decrease in cortisol and improvement in anxiety and depressive symptoms (de la Rubia Ortí et al., 2018).

The previously mentioned study by Gallego et al also found that music therapy that incorporated dance led to significant improvement in participants' delusions, hallucinations, and irritability ($p<0.005$). Furthermore, the therapy was also associated with improved therapy and anxiety and depression scores on the Hospital Anxiety and Depression Scale (HADS) was not statistically significant. (11).

Discussion

This paper summarizes various research studies evaluating the impact of music on cognitive and behavioral outcomes in Alzheimer's disease. While there is insufficient evidence to conclusively prove that music improves Alzheimer's outcomes, music therapy may have promise for management of the disorder in conjunction with medications and supportive services. Additionally, more music therapy-related dementia research is needed.

For example, one aspect of music therapy that has not been explored enough in the research literature is the relationship between the degree of therapy interactivity and dementia outcomes. For instance, two of the studies discussed in this paper that were more interactive yielded statistically significant results. Gallego et. al had study participants dance and clap to songs while Sarkamo et al had participants perform in a singing group alongside a pianist (Gómez Gallego & Gómez García, 2017; Särkämö et al., 2014). Both study groups showed a significant improvement in their memory and other cognitive domains like language following music therapy. These results contrast with other studies discussed in this paper that had participants sitting in rooms and listening to music passively through headphones.

It is also worth noting that there are limitations in many of these studies. A previously mentioned study that took place in Taiwan involved older adults with Alzheimer's undergoing home-based music therapy (Li et al., 2015). Their results on the impact of therapy on cognition were not significant, possibly due to them not having complete control over the home therapy environment. Additionally, some participants dropped out of the study, which may have skewed their results. Participants dropping out of studies can have a big impact on results, considering that many of these music therapy experiments have small sample sizes. Studies with larger sample sizes are necessary in order for these interventions to be successfully applied to the larger dementia population.

There are several ongoing studies and clinical trials being conducted to apply music therapy for AD on larger patient cohorts to enable researchers to study the effects at a larger scale. One ongoing study NCT03444181 has a participant size of 130 (Flo et al., 2022). The goal of the study is to determine whether music therapy has the potential to be applied to the clinical setting. The study is being done at the University of Bergen in Norway, and they are using fMRIs to look at morphological changes in the brain as a response to music therapy, and its effect on cognitive, behavioral and social outcomes. Another study NCT04666077 being conducted at Mount Sinai compares the effect of home-based music therapy through Supervised Supportive Singing (H3S) versus Individualized Music Therapy (IMT), and both of these are evaluated against a control arm with no music therapy interventions.

In conclusion, while there is not sufficient evidence to concretely prove that music therapy improves cognition and behavioral disturbances in Alzheimer's disease, music therapy, a relatively safe intervention, has much promise in the field. With additional research, music therapy has the potential to revolutionize the medical field and advance the treatment of Alzheimer's-associated dementia.

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