The effects of music therapy on reducing symptoms of Alzheimer's disease: A meta-analysis

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Abstract

Alzheimer's disease (AD) is a neurological degenerative disease that is highly prevalent with no effective cure. Music therapy has emerged as a way to reduce stress and disruptive behavior. This study reviews and synthesizes the literature on the effects of music therapy on reducing symptoms of AD. Eleven studies were extracted from Google Scholar and included in a meta-analysis. Overall, music therapy had a large effect on reducing various AD symptoms (mean effect size: -2.35 ± .27). Three studies were analyzed to look at the specific effects of depression, which also was reduced by music therapy (mean effect size: -3.41± .68)). Our results suggest that music therapy may be an effective treatment for AD.

Introduction

Alzheimer's disease (AD) is one of the most lethal forms of dementia (a disease where your cognition declines). It is ranked the fifth leading cause of death among individuals above the age of 65 years old (PharmD, 2020). AD affects an individual's behavior, motor skills, and memory. (Alzheimer's awareness (n.d.). Green Shoot Media). Some symptoms that AD patients have include, increased agitation behavior and anxiety; mood swings; losing objects, and putting them in unusual places; getting lost, and then being confused; incapable of making good decisions; forgetting information, dates and plans. AD is one of the leading forms of dementia, with 24 million people currently suffering from dementia, the majority of whom have AD. In addition to all the symptoms, AD is extremely expensive as the global cost is predicted to reach 2 trillion US dollars in 2030 with caregiving costing up to 67.3% of the economic burden (Tay et al., n.d.). As the disease deteriorates the cost increases by 36477.2%.

Despite the high prevalence of AD, there are no efficient treatments or cures to date. The medications currently available can only slow down progression rather than reverse the effects or symptoms, making it a pressing issue and a global concern (Ballard et al., 2011). Further, research investigating pharmaceutical and non-pharmacological treatments for symptoms of AD, particularly neuropsychiatric symptoms, is lacking (Ballard et al., 2011)

Music therapy is now clinically known to use music as a way to promote relaxation and improve wellbeing (Professional, 2024). The history of 'Music therapy' beginning as a treatment came from the end of World War 2 when soldiers who were traumatized used music as a way to cope and navigate. Subsequently, the therapeutic potential of music was recognized. Research has shown that listening to music can promote the release of neurotransmitters such as dopamine and endorphins, which are associated with feelings of happiness, joy, satisfaction, and analgesia in pain-specific contexts (Professional, 2024b). Further, listening to music has also been shown to help the body produce an increasing amount of Immunoglobulin A, which attacks

pathogens, having a positive effect on the immune system. Additionally, it decreases levels of the stress hormone cortisol. Having decreased cortisol leads to mitigation of anxiety and lower blood pressure, leading to a relaxation effect on the body (Montgomery, 2016). Music therapy has been used for a spectrum of neurological and psychiatric disorders including depression, anxiety, Parkinson's disease, cancer, mood disorders, autism, dementia, and chronic pain (Professional, 2024b). A wide array of studies have shown music therapy to be effective at treating diseases such as AD, but some findings remain controversial. This study aims to synthesize findings on music therapy to assess its efficacy in improving cognitive abilities and behavioral symptoms in AD.

Method:

Study Selection

Studies relating to music therapy and AD were searched for using Google Scholar. The search string input in the database was: (Alzheimer's disease, Music therapy, and Music). The search results yielded a total of 142,000 studies, of which 150 were reviewed for inclusion in the study (Table 1). A total of 47 studies were extracted for further screening. The inclusion and exclusion criteria used are listed in Table 1. Pertaining to the Inclusion criteria, this review included observational studies and clinical trials. The studies included in this meta-analysis review are published in peer-reviewed journals and they are exclusive to only Alzheimer's patients and music therapy. These studies also included adults aged 18 and above, and they examined patients who have participated in music therapy and to what extent has it affected them. The included studies are also all in English. For the Exclusion criteria, this review excluded animal studies, other meta-analysis reviews, editorials, and commentaries. Additionally, it excluded case reports, conference abstracts, dissertations and studies that did not focus on Alzheimer's patients specifically. This review also excluded studies with insufficient methodological quality or a high risk of bias based on the quality of assessment tools. Based on these inclusion and exclusion criteria, a total of 11 studies were included in the final meta-analysis.

Table 1

Inclusion criteria	Exclusion criteria
Include peer reviewed studies	Exclude animal studies
Studies involving AD and music therapy	Exclude meta analysis reviews
Include studies published in English	Exclude case reports

Include observational studies and clinical trials	Exclude studies with no AD patients
Include studies that assess cognitive impairment validated neuropsychological tests	Exclude studied with insufficient using methodological quality or risk of bias

Data Extraction

The data that was extracted out from all these individual reviews were age; sample size; p value; effect size; the intervention mean before, during, and after; the control mean before and after; the SD mean before, during, and after; the age range; the number of females and males in the study; the mean age; the AD diagnosis and its measures; the instrument to measure the AD; the intervention and its frequency per week, its number of sessions and how long per session; the statistical test used.

Table 2

STUDY	INTERVENTION	DURATION	PRIMARY DIAGNOSIS	MEASUREMENT OF DIAGNOSIS
Melissa Brotons et al. (1996)	Music therapy	5 sessions (30 minutes)	Alzheimer's disease	Agitation Behavior Scale of the Disruptive Behavior Rating Scales (DBRS)
Anna-Eva J.C Prick et al. (2024)	Music therapy	9 sessions (45 minutes)	Alzheimer's disease	Neuropsychiatric Inventory Nursing Home version (NPI-NH)
S. Guétin, F. Portet et al. (2009)	Music therapy	24 sessions (20 minutes)	Alzheimer's disease	Geriatric Depression Scale
Kendra D. Ray et al. (2018)	Music therapy	6 sessions (30-60 minutes)	Alzheimer's disease	Cornell Scale for Depression

Juan José Meilán García et al. (2011)	Music therapy	5 sessions (30 minutes)	Alzheimer's disease	Mini-Mental State Examination (MMSE)
James C. Gardiner et al. (2000)	Music therapy	8-10 sessions (10 minutes)	Alzheimer's disease	DBRS
Alison J. Ledger et al. (2007)	Music therapy	42 sessions (30-45 minutes)	Alzheimer's disease	Cohen-Mansfield Agitation Inventory
Zengmian Wang et al. (2018)	Music therapy	Everyday for 3 months (30-50 minutes)	Alzheimer's disease	MMSE
Jose´ Enrique de la Rubia Ort et al. (2017)	Music therapy	Once a week (60 minutes)	Alzheimer's disease	MMSE

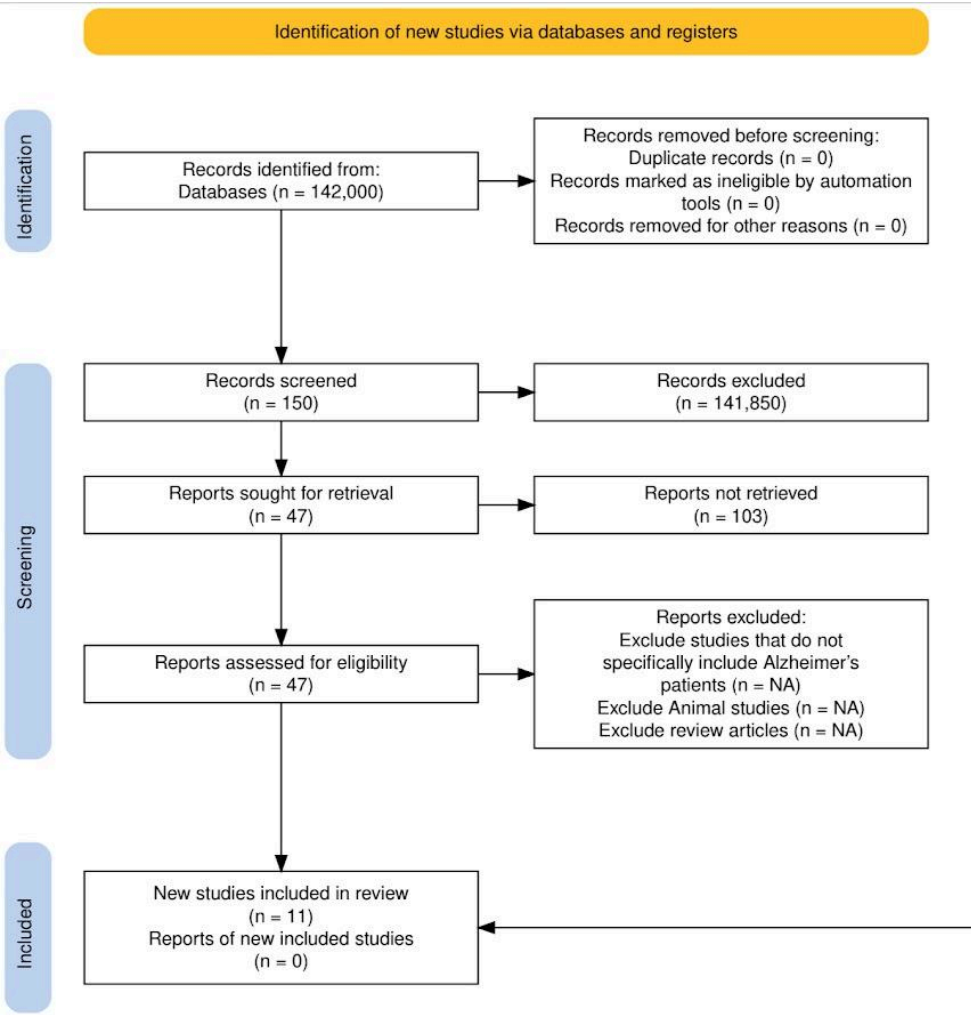
Statistical Analysis

To conduct the meta-analysis, we calculated the effect sizes and variances for each study in our dataset. For each study, the mean difference between pre-and post-intervention measurements was calculated. The pooled standard deviation (SD) was calculated for each study using the standard deviation before and after the intervention and the sample size of the tested group. We then used the pooled SD to derive the standard error (SE) of the mean difference. Each effect size was weighted according to the variance, enhancing the contributions of the studies with lower variance to the overall meta-analysis.

The primary outcome, the weighted mean effect size, was calculated by computing the weights as the inverse of the variance for each study's effect size. The SE of the weighted mean effect size was calculated to derive the overall 95% confidence interval (CI). The calculated effect sizes and their corresponding confidence intervals were visualized in a forest plot.

All analyses were performed using Python, specifically the Pandas and NumPy libraries for data manipulation, and Matplotlib for forest plot visualization.

Figure 1



Results

All measures

Overall, across the 11 studies included in the meta-analysis, music therapy had a large impact on AD symptoms (Figure 3). The weighted mean effect size across the studies was -2.35. The standard error (SE) was 0.27 and the 95% Confidence interval was (-2.88,-1.82).

Depression

With depression only, there was an even larger effect size (Figure 2). The weight mean effect size across the studies was -3.41 and the SE was 0.68. The 95% Confidence interval was (-4.75,-2.08)

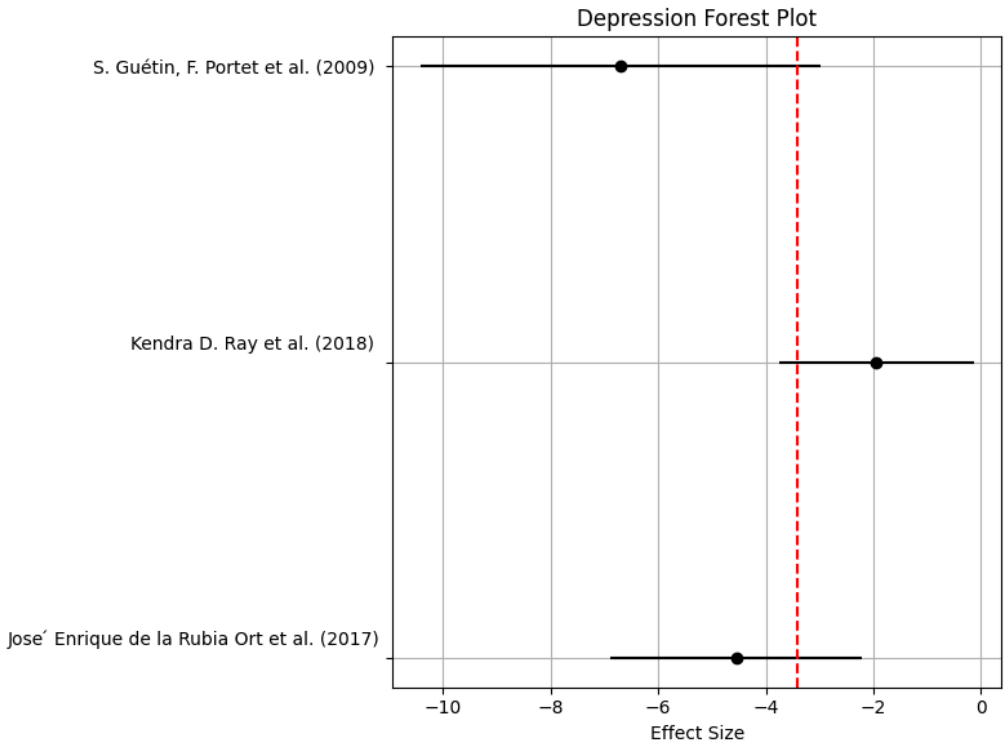


Figure 2

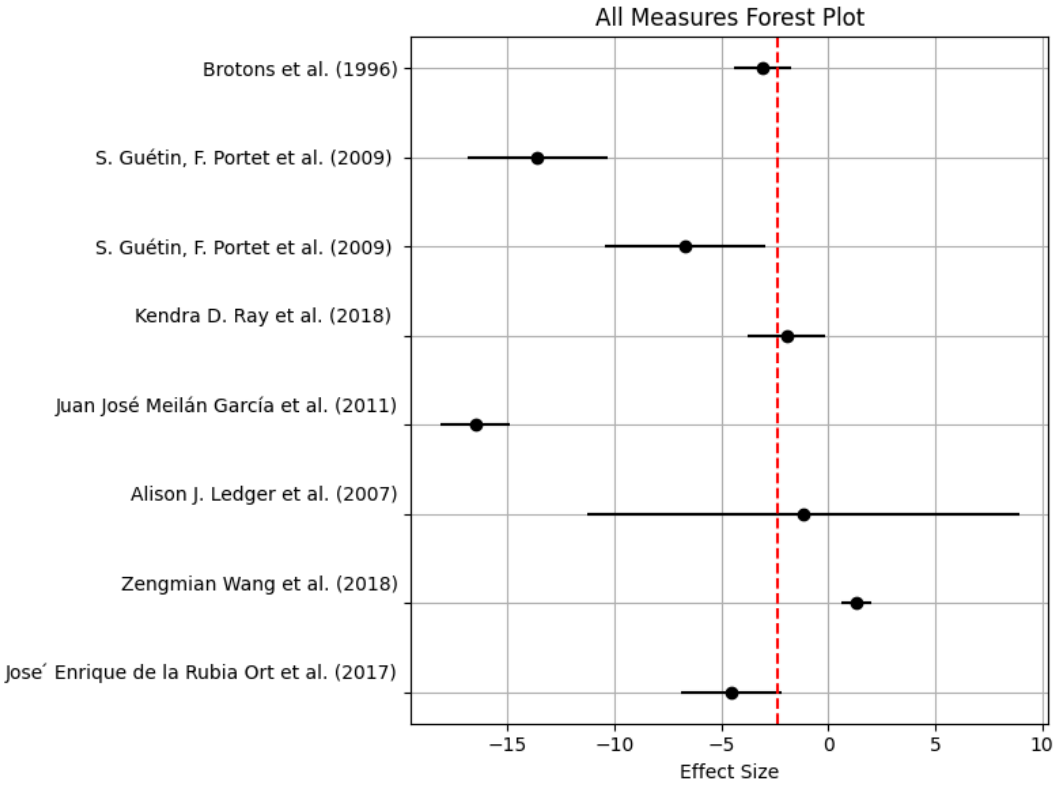


Figure 3

Discussion

This review aimed to analyze the effects of music therapy on depressive symptoms, agitation behaviors and autobiographical memory. AD is a pressing issue and finding out if the application of music therapy on AD is important as there are currently no cures for AD. Our results indicate that music therapy can have a significant impact on reducing AD symptoms with 10 out of the 11 studies having a negative effect size.

The study that had the lowest effect size was García et al. (year). The study suggests that when the stimulus, for example, music is more emotional, it 'evokes autobiographical recall' however it does not work with new memories. The authors suggested that this was due to sad music eliciting more emotional responses, therefore allowing better memory recall. Music therapy helps to better recall semantic memory, which is our 'general knowledge of the world', rather than episodic memory which is recalling unique personal experiences or having the ability to store new memories. It did compare the results of responses due to happy music and sad music, and it presented the biases of the study: the researchers were not focused on the AD patients' responses to happy music however, it was also presented that happy music grabs attention but not necessarily helps with memory retrieval.

The study conducted by Gueitn et al. (year) showed that compared to the control group, the experimental group who were exposed to music therapy had decreased anxiety and depression levels. They also conducted their depression and anxiety levels weeks after music therapy and its effect was maintained for up to 2 months after terminating the sessions. In depressive symptoms, there was a significant difference between baseline and week 16. With Anxiety levels, there was an even more significant difference between baseline and week 16. This study confirms the efficacy of music therapy on AD patients with their depressive symptoms and their anxiety. It also added that personalized music for AD patients is more efficient than neutral relaxation music—personalized music can help recall past memories as the music reminds them, however,this indicates long-term memory recall rather than help with memory processing.

In Orti et al (year), the authors suggested that increased cortisol (stress hormone) levels are associated with the progression of AD. When a neurologist conducted the music therapy, it showed a difference in cortisol levels before and after music therapy which then in turn decreased anxiety and depression. This study shows a positive linear relationship between decreased levels of anxiety and depression and decreased levels of cortisol.

Although these studies show the promise of music therapy in helping individuals with AD, there are some limitations. First, none of the studies considered the cultural influences and the individual's background that can significantly change the response to music therapy. Further, most of the studies did not have a long-term follow-up after the music therapy sessions to see if the effect was maintained. These studies were also single-blinded studies because the music therapists were aware of this experiment however this might affect the research findings' objectivity. Additionally, the 'standardization of music intervention' and being able to accurately replicate interventions are needed because every study has a different way of conducting music therapy. The last limitation was that there were no biological measures such as neuroimaging before and after the interventions, so we were not able to see the impacts of music therapy specifically on the brain.

This study supports the use of cost-effective and unburdensome treatment for promoting well-being in patients with AD and indicates improvement in agitation behaviors, depression, and anxiety levels.

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