



Music Therapy for Cognitive Deficits of Neuropsychiatric Disorders

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Abstract

Music therapy has evolved as a supplementary treatment for a diverse range of mental and physical conditions. In recent years, the application of music therapy in addressing cognitive deficits has garnered growing interest. It has demonstrated the capacity to enhance memory, focus, and emotional expression in individuals. Furthermore, it contributes to positive outcomes in social interaction, psychological and physical well-being, and overall quality of life for patients. As a result, there is a compelling rationale for further exploration and investigation into the effectiveness of this therapeutic approach.

Keywords: Music therapy; Cognition; Neuropsychiatric Disorders

Introduction

Music therapy is an evolving discipline that can be integrated into the therapeutic process. It has demonstrated reliable therapeutic effects and has been widely applied in the field of mental health treatment [1]. Cognitive deficits generally denote abnormalities in learning, memory, and cognitive judgment. In recent years, as the scope of music therapy continues to expand, an increasing number of cases involving cognitive deficits have been treated with supplemental music therapy, resulting in positive outcomes. This article aims to research and analyze the current status of music therapy in addressing cognitive deficits, with the intention of exploring its practicality and sustainability. It serves as a reference for the future development and application of music therapy in clinical settings.

Development of Music Therapy

Music therapy has a rich history, with ancient Greeks and Romans using music in their gatherings to alleviate stress and enhance emotions. In ancient Chinese medical theory, the correspondence between the body's five viscera and the five musical tones led to the invention of Five Elements music therapy. Its purpose was to nourish the body and mind, addressing conditions such as anxiety, depression, and fear [2]. In modern times, music therapy has been consistently passed down and refined, widely employed to tackle various mental health issues, including depression, anxiety, autism, and cognitive deficits. Over the past few decades, thanks to abundant scientific research confirming the efficacy of music therapy, its application in clinical settings has become increasingly widespread. In summary, music therapy is an interdisciplinary approach that transcends cultural differences and can positively impact human health.

Music Therapy in the Treatment of Various Cognitive Deficits

Alzheimer's Disease (AD)

AD is a neurodegenerative disorder characterized by the decline or loss of cognitive functions, thinking abilities, and emotional capacities. Telomere Length (TL), Telomerase Activity (TA), and plasma Amyloid-Beta ($A\beta$) levels are predictive factors for cognitive decline and dementia. Research has indicated that music therapy can alter plasma $A\beta$, TL, and TA levels, thereby positively impacting the cognitive functions and emotions of AD patients [3]. Lyu et al. [4], reported that after 3 months of music and poetry training, AD patients demonstrated improved language fluency, enhanced memory, and language abilities, leading to the amelioration of mental symptoms. Wu et al. [5], further confirmed that music therapy could enhance memory function in AD patients, and exposure to familiar music could trigger passive recollection of emotions and emotional memories from the past in AD patients. Matziorinis et al. reported a significant increase in patients' scores on the Rivermead Behavioral Memory Test following music therapy intervention.

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Parkinson's Disease (PD)

PD is a prevalent neurodegenerative disorder characterized by cognitive decline, usually preceding the onset of motor symptoms. Literature suggests that non-pharmacological training through music therapy can ameliorate the Montreal Cognitive Assessment (MoCA) scores and Hamilton Anxiety and Depression Scale scores of PD patients, including those with PD-related mild cognitive impairments. This, in turn, improves the cognitive function and emotional well-being of individuals with PD [6,7]. Pohl et al. [8], also utilized group-based music intervention, employing MoCA and the Parkinson Disease Questionnaire-39 items to evaluate cognitive and symptomatic enhancements in PD patients. The findings demonstrated that music therapy enhanced the emotional states and alertness of individuals with Parkinson's disease and boosted their cognitive abilities. The underlying mechanism is attributed to the rhythmic stimulation provided by music, which may activate extensive motor areas in PD patients, influencing cognition, sensation, and movement within cortical and subcortical motor regions [9].

Vascular dementia

Vascular dementia primarily refers to cognitive impairment resulting from damage to the central nervous system due to cerebrovascular diseases, such as ischemic strokes. Some studies propose that supplementary music therapy could be an effective intervention for alleviating symptoms in patients with vascular dementia. Kondo et al. [10] observed an 88-year-old individual with severe vascular dementia, providing music intervention twice a week for 15 min per session, over a total period exceeding 18 months. The ultimate results indicated that although the Mini-Mental State Examination (MMSE) scores of patients with vascular dementia continued to worsen, during music therapy intervention, the patient could still concentrate on playing digital instruments, focus on performances, or suggest that music therapy might decelerate the cognitive decline in memory, time, and place orientation. Nevertheless, this conclusion still requires additional research samples for validation.

Whole-body chronic disease-related cognitive impairment

Multiple studies suggest that diabetes, hypertension, hyperlipidemia, and chronic obstructive pulmonary disease may contribute to cognitive functional impairments, characterized by structural changes in the central nervous system, brain tissue atrophy, reduced hippocampal volume, alterations in neural tissue electrophysiology, decreased neurogenesis in the hippocampus, and the differentiation and proliferation of neural precursor cells [11]. Diabetes, hypertension, and chronic obstructive pulmonary disease are recognized triggers for vascular cognitive impairment. Simultaneously, in-depth investigations into cognitive impairments identify factors like gender, age, education, BMI, diabetes, depression, serum cholesterol, history of head injury, smoking, social activities, pesticide exposure history, etc., as potential risk factors [12]. Numerous studies indicate that music therapy significantly enhances concentration, auditory perception, and executive function. Music therapy's influence on the hypothalamus, limbic system, brainstem reticular structure, and the right temporal lobe music activity center of the cerebral cortex, combined with movement and auditory information, leads to improved motor function, enhanced sensory perception, and the facilitation of motor perception and emotional expression [13].

Impact of music therapy on immune inflammation

With the continual expansion of the clinical application scope of music therapy, it has been confirmed to contribute to improving the body's immune and inflammatory responses. Orff music therapy, incorporating active physical movement, sound expression, resonance, and emotionally integrated musical activities, engages participants in creative games and performances with various musical elements like rhythm, melody, harmony, and beats, tailored to their interests and emotional needs. In a study by Tang et al. [14], on Schizophrenia patients using Orff music rehabilitation therapy, results revealed that this therapy not only helped restore neurological and social functions but also improved levels of inflammatory factors, alleviating the inflammatory response and promoting positive recovery outcomes. Similarly, Xiao et al. [15], reported that digital music contributed to the downregulation of serum inflammatory factors, such as Interleukin-6 (IL-6), Interleukin-8 (IL-8), and Interleukin-10 (IL-10), in esophageal cancer patients, thereby reducing oxidative stress levels.

Application of music therapy in the treatment of mental disorders

Music therapy, as a therapeutic approach utilizing music to enhance mental and physical health, has proven beneficial for various types of mental disorders in the field of psychotherapy. It can help soothe emotions, alleviate anxiety, and address insomnia. Music therapy is also effective in managing aggressive behavior, improving self-esteem, and enhancing behavioral self-control. Guo et al. [16], reported that music therapy could improve pain and relieve anxiety and depression. Another study demonstrated that applying music therapy interventions at least five times for elderly dementia patients in nursing facilities helped alleviate depressive symptoms, address behavioral issues, and enhance overall quality of life [17]. Mao et al. [18], suggested that music promoted the secretion of glutamate in the mouse hippocampus, leading to the activation of various proteins and neurotransmitters, ultimately improving mood and reducing negative emotions. Additionally, music can influence the neuroendocrine stress response and regulate the release of immune system cytokines, mitigating the damage to the brain caused by sustained inflammatory reactions.

Main Approaches of Music Therapy

The music used in therapy currently lacks a fixed style and category. In recent years, based on clinical methods and types, it can be categorized into Active Music Therapy, Passive Music Therapy, and Sound Therapy.

Active music therapy

Active Music Therapy involves communication between a music therapist and the participant. With the therapist's assistance, information is gathered through scales, disease reports, and collaborative selection of music tracks and rhythms with the participant. A treatment plan is formulated to maximize participant cooperation, fostering active engagement in singing while simultaneously adjusting breathing frequency and relaxing the body. The aim is to synchronize body rhythm with musical rhythm, achieving holistic coordination. Abundant research indicates that positive active music therapy significantly improves emotions, increases happiness, facilitates adaptation, and enhances social relationships. However, there is limited evidence of its effectiveness in improving sleep and daily life abilities. In this therapy, the music therapist plays a crucial role as a variable influencing the outcomes.

Music therapists customize interventions based on patients' direct physiological and psychological needs. In many countries, music therapists are recognized as qualified professionals in health management and promotion.

Passive music therapy

Passive Music Therapy involves participants passively listening to music. The key difference from active therapy lies in the emphasis on perceiving rhythmic movements in music. Active Music Therapy places more emphasis on participant engagement with the rhythmic movements accompanying the music. In contrast, Passive Music Therapy focuses on passive listening, prioritizing the selection of personalized music. Emphasizing familiar music over unfamiliar tunes appears more effective. Currently, focused listening in passive music therapy is believed to be effective in relieving anxiety and tension. Passive music therapy achieves relaxation and the alleviation of anxiety and tension by creating a virtual space through listening to music, meditation, and focused attention.

Sound therapy

Beyond music therapy, there is a form of treatment known as Sound Therapy. In recent years, it has gained increasing attention and research, with white noise being one of the most well-known sound therapy approaches. Existing studies suggest that sound can alleviate pain, and further research indicates a significant relationship between the analgesic effect of sound and the signal-to-noise ratio. However, more research is needed to understand the neural pathways and related mechanisms.

Conclusion

With the increasing prevalence of diseases such as Alzheimer's Disease (AD), Parkinson's Disease (PD), and vascular dementia, there is a growing concern for the quality of life of affected individuals. Slowing down the progression of cognitive impairments is crucial to improving their quality of life. Existing research has confirmed that music therapy can enhance cognitive function, delay the development of cognitive impairments, and subsequently improve the quality of life for patients. Music therapy, as an emerging discipline that encompasses theories from music, medicine, and psychology, has received positive feedback in clinical settings and the field of psychotherapy due to its non-invasiveness, minimal adverse reactions, and cost-effectiveness. However, the mechanisms underlying the effects of music therapy on cognitive improvement remain unclear, and the efficacy requires further clarification. Presently, most studies use assessment tools such as scales and scores, and there is a lack of standardized criteria for intervention time, frequency, musical forms, and duration in music therapy. Consequently, the scientific and systematic aspects of music therapy in medical treatment are currently lacking, and more rigorous clinical trials are needed to provide more comprehensive and authentic evidence to determine its precise role in different populations.

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