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# SCIENTIFIC BASIS OF MUSIC THERAPY FOR COGNITIVE DECLINE AND DEMENTIA

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## ABSTRACT

The review comprehensively examines dementia's multifaceted nature, its prevalence, etiology, and global impact, highlighting Alzheimer's disease as a significant contributor. It delves into the therapeutic potential of music therapy, outlining its varied applications across neurological disorders and broader healthcare contexts. Additionally, it elucidates the relationship between music and cognitive decline, exploring the cognitive and emotional benefits of music in dementia care. The abstract summarizes the mechanisms through which music triggers emotions and outlines assessment methods for evaluating music therapy's impact on dementia management. Acknowledging the limitations, the abstract emphasizes the need for more robust clinical trials and longitudinal studies to validate and enhance the effectiveness of music therapy. In conclusion, the abstract underscores music therapy's pivotal role in addressing cognitive challenges, improving emotional well-being, and offering a holistic approach to dementia care.

**KEYWORDS:** Dementia, Alzheimer's disease, Music Therapy, Emotions and Neurological Disorders.

## INTRODUCTION

Dementia impacts memory, cognition, and daily function, often linked to age, high blood pressure, elevated sugar, obesity, smoking, alcohol, and inactivity. Primarily Alzheimer's (60-70%), it stems from nerve cell diseases, including vascular or frontotemporal dementia caused by strokes, infections, injuries, or deficiencies. Early signs involve memory loss, confusion, and mood changes. Recognizing diverse causes and early signs is crucial for managing this complex condition.[1]

Dementia, linked to various causes like vitamin deficiencies, injuries, and health conditions, affects 47 million worldwide, projected to hit 131 million by 2050. Alzheimer's disease, a major contributor, impacts over 5 million now, predicted to reach 13.8 million by 2050. It ranks sixth in overall causes of death and fifth among those over 65.[2]

Music therapy aids mood, self-expression, and stress reduction, offering memory enhancement, improved social skills, pain management, metacognition, and motor skills. Activities like dancing, singing, music listening, playing instruments, creating music, and discussing lyrics benefit around 1.6 million annually with neurological disorders.[3]

Music therapy, a recognized healthcare practice, uses music to address physical, emotional, cognitive, and social needs. It soothes and improves mental well-being, impacting physical measures like oxygen, heart rate, and breathing. Across neurological conditions, it stabilizes rehabilitation. Post-stroke, independent music listening aids cognitive recovery and eases emotional distress. It shows promise in boosting memory test performance for those with autobiographical memory challenges, including dementia patients.[4]

### Comprehending Dementia and Cognitive Decline

#### Dementia: Definition and its types

Dementia is a medical condition marked by a gradual deterioration in cognitive functions, impacting self-reliance. This decline impacts cognition and behaviour, with variations among individuals. Cognitive effects include memory loss, communication difficulties, challenges in object recognition (agnosia), issues in task performance (apraxia), and impaired executive functions related to reasoning, judgment, and planning. Dementia is a comprehensive term for a syndrome involving gradual cognitive deterioration, with types categorized by underlying causes. The four primary types—Alzheimer's disease, vascular dementia, Lewy body dementia, and frontotemporal dementia—are briefly summarized in Figure 1.[5]

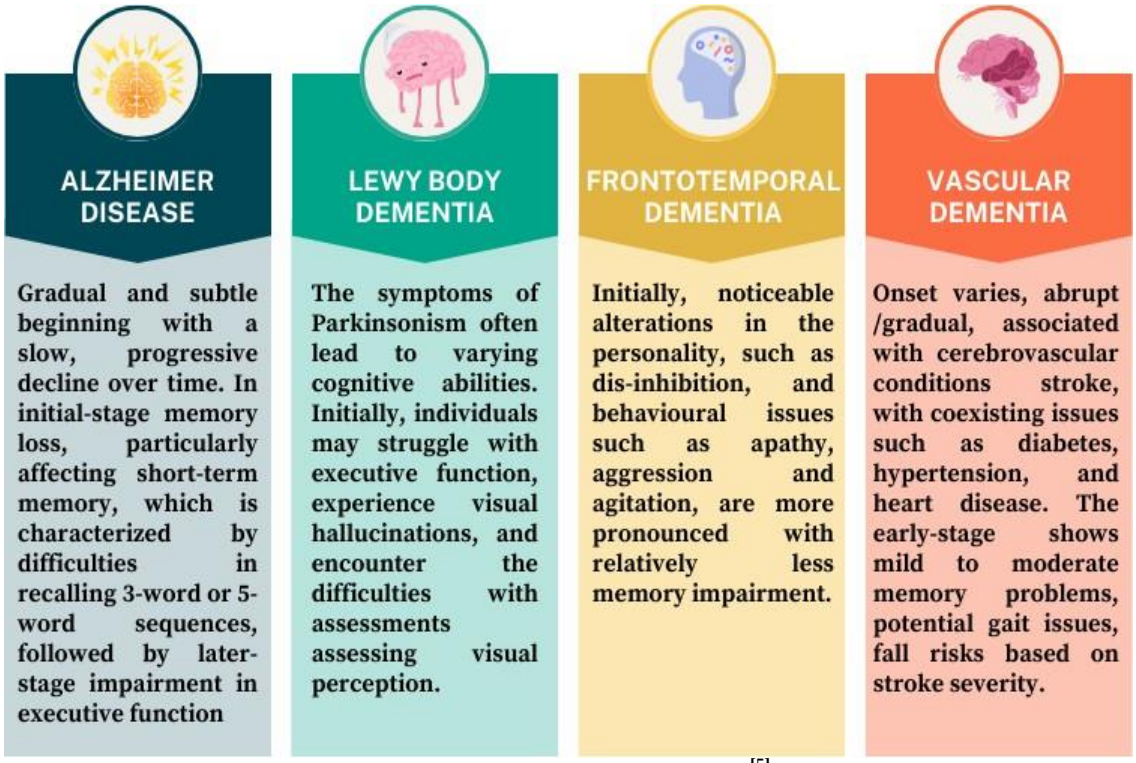


**Fig. 1: Various types of Dementia.**[5]

**Current challenges in Dementia management**

Addressing the multifaceted challenges associated with dementia entails navigating a multitude of complex issues. A critical concern is the frequent absence of early diagnosis, often resulting in identification only during advanced stages, which impedes timely intervention. As no cure currently exists for most types of dementia, the primary emphasis lies in offering care and effectively managing symptoms. The intricate challenge arises in managing the behavioural and psychological signs, like restlessness and perceptions, associated with this condition. Moreover, dementia is heavily burdened by pervasive societal stigma, significantly impacting the well-being of those affected. Access to specialized healthcare services remains limited in numerous regions, and dementia introduces intricate legal and ethical dilemmas, particularly concerning decision-making capacity and end-of-life care. While further research is imperative for developing effective treatments, financial constraints present a significant obstacle. Moreover, the availability of support services for both patients and caregivers tends to be inconsistent. Compounding these challenges is the global trend of an aging population, which exacerbates the prevalence of dementia, thereby straining healthcare systems and resources. Addressing these complex and interwoven challenges demands a multifaceted approach and concerted efforts across healthcare, societal, and research domains.[6]

**Music Therapy: Overview**

**History of Music Therapy**

Music therapy is a healthcare profession grounded in both evidence and artistic expression, utilizing musical experiences within a therapeutic connection to address the physical, emotional, cognitive, and social needs of clients. In alignment with the definition provided by the American Music Therapy Association, music therapy is a structured intervention process where therapists aid clients in promoting health through music experiences, leveraging the relationships formed during these encounters as catalysts for transformation.

This tailored approach, facilitated by certified music therapists, distinguishes music therapy from other interventions. For instance, 'music medicine' involves passive listening to pre- recorded music provided by medical staff, particularly before, during, or after medical procedures. Additionally, other music-based activities, such as choir singing or drumming sessions led by musicians or healthcare professionals other than certified music therapists, fall outside the scope of formal music therapy practices.[7]

A concise overview of the history of music therapy is presented in Figure 2.[8]


**Fig. 2: History of Music Therapy.[8]**

**Definition and ISO Principle in Music therapy**

Music therapy harnesses the mood-enhancing properties of music to support mental health and overall well-being through various goal-oriented activities. These activities include creating music, song writing, singing, dancing, listening to music, and engaging in discussions about musical experiences. There are different approaches to music therapy, such as analytical music therapy, which encourages self-expression through spontaneous musical interactions; Benenzon music therapy, which integrates psychoanalysis with music to explore an individual's "musical sound identity"; cognitive-behavioural music therapy, which combines cognitive-behavioural therapy with music; community music therapy, which emphasizes communal change through group participation. Nordoff-Robbins music therapy engages in spontaneous musical expression for self-expression; the Bonny method of guided imagery and music utilizes classical music to spark imagination, while vocal psychotherapy involves vocal exercises and natural sounds to enhance emotional bonding and self-awareness.[9] The ISO principle, a scientific approach in music therapy since 1948, is applied by music therapists to influence a patient's emotional state, according to Music Therapy Time. "The ISO principle involves aligning music with a client's emotional state and gradually adjusting it to induce the intended emotional state.[10]

The different categories or forms of music therapy modalities has been displayed in Table 1.[11]

**Table 1: Types of Modalities.**

| Modalities | Description |
|---|---|
| Song writing | Typically, in a group session led by a music therapist, individuals compose lyrics to accompany a melody. |
| Directed music listening | Individualized sessions with patients often involveplaying music, occasionally tailored to their personal preferences. |
| Music and relaxation exercises | Patients engage in stretching and breathing exercises synchronized with the music's rhythm. |
| Lyric discussion | In a group setting, patients engage in discussions about song lyrics, often with the guidance of a musictherapist. |
| Singing/ Toning | Patients participate in singing alongside a provided melody that includes lyrics. |
| Kinetic engagement with music | Patients engage in movements or dancing synchronized to music. |
| Audiovisual Creation | Patients actively engage in creating either a musical recording or a video involving music. |
| Tailored Instrumental Instruction | Patients receive instruction in playing musical instruments, tailored to accommodate their unique abilities and current condition, adjusting the difficulty level accordingly. |

**Applications of music therapy in healthcare**

Music therapy shows great promise in neurology, supporting individuals with various neurological conditions. It aids stroke survivors' recovery by using rhythmic auditory cues for motor skills and speech rehabilitation. In Parkinson's disease, it enhances motor coordination through rhythmic musical prompts. Addressing Alzheimer's and dementia, it improves quality of life by reviving memories and alleviating agitation. In instances of traumatic brain injury (TBI), music therapy plays a crucial part in the recovery of cognitive and emotional functions, aiding memory and speech rehabilitation. For multiple sclerosis (MS), it elevates mood, serving as a creative outlet for depression and fatigue. In epilepsy, it assists in managing stress and anxiety, potentially reducing stress-triggered seizures. These applications highlight music therapy's adaptability and effectiveness in enhancing overall welfare and life satisfaction for those with neurological disorders.[12]

Music therapy extends beyond neurological disorders, finding diverse applications in healthcare. In paediatric settings, it aids children in coping with stress, anxiety, and medical challenges, addressing developmental and speech-related issues. In palliative care, it provides comfort, assistance and aid concerning emotions for both individuals receiving care and their families in the final stages of life. For the elderly, it enhances cognitive function, reduces isolation, and promotes social interactions. In physical rehabilitation, music therapy inspires patients during exercises, refines motor skills, and contributes to overall well-being. Within oncology, it proves invaluable in managing pain, alleviating anxiety, and enhancing emotional well-being during cancer treatments. These applications highlight the broad and effective role of music-based interventions in meeting the physiological, affective, and cognitive needs across diverse healthcare contexts.[13,14]

**The Relationship Between Music and Cognitive Decline**

**Music Processing in the Brain**

The human auditory brain is structured hierarchically in both anatomy and function, with lower stages communicating with higher stages to process progressively intricate auditory information. Music, being a complex form of sound, involves this hierarchical organization. Initially, music goes through a sequence of processing in the initial auditory passage, moving from the cochlea to the primary auditory cortex, deciphering essential sound features. As the information ascends, it involves the cerebral cortex. For instance, pitch is determined by the frequency of an acoustic signal, but its perception is not solely dependent on one physical attribute. While the encoding of pitch-related acoustic features occurs in the ascending auditory pathway, the perception of pitch originates at the cortical level. This perception emerges from the cortical analysis of the entire acoustic signal pattern, formed through various physical mechanisms. This hierarchical processing provides insight into how the brain comprehends the intricate features of musical sound.[15]

**Cortical circuitry**

The human primary auditory cortex is located in Heschl's gyrus within the superior temporal lobe, near the Sylvian fissure, with a specialized area for processing pitch perception. Surrounding Heschl's gyrus is a complex network of upper cortical regions extending across the temporal, parietal, and frontal lobes, responsible for analysing intricate sound characteristics. The planum temporal, posterior to Heschl's gyrus, corresponds to Wernicke's area in the left hemisphere and contributes to analysing complex sound attributes. The superior temporal gyrus, in front of Heschl's gyrus, processes continuous auditory data, including spoken sentences and melodies. Areas in the anterior temporal lobe and insula recognize nonverbal sounds, such as music. The lateral temporal and parietal lobes integrate auditory information with data from other senses, primarily visual. Parietal and frontal circuits support working memory for music and govern behavioural responses to auditory stimuli. Brain imaging studies reveal common neural circuitry, forming a functional hierarchy for music and complex sounds across interconnected brain regions.[16]

**Cognitive and Emotional Benefits of Music in Dementia Care**

In dementia care, incorporating music yields emotional and cognitive benefits. Music's profound emotional impact helps individuals manage emotions, reduces anxiety, and evokes positive memories, particularly valuable in advanced dementia stages. Serving as a non-verbal communication tool, music facilitates interactions, vital when verbal communication is limited. It creates a tranquil care environment, easing restlessness. Music engagement enhances overall quality of life, providing joy, purpose, and fostering social interaction. As a cognitive stimulant, it promotes problem-solving skills and community among individuals with dementia, mitigating challenging behaviors. Music bolster's identity, self-esteem, and strengthens connections between caregivers and patients, ultimately enhancing the quality of life for both.[17-19]

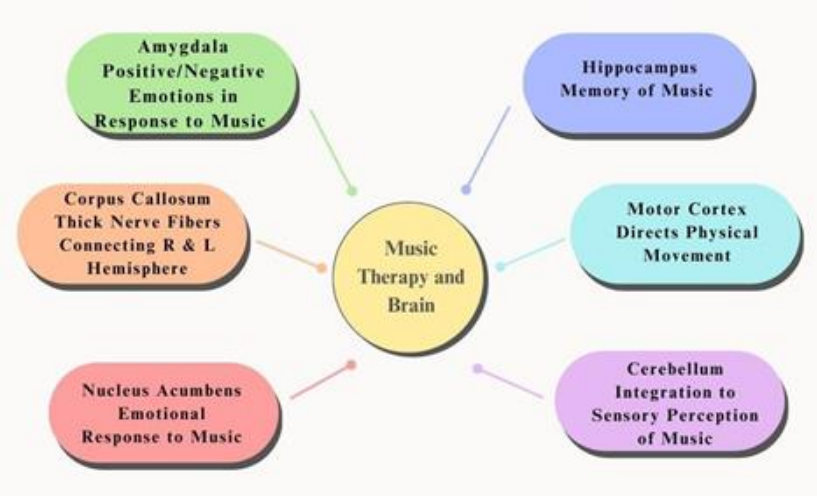


**Fig.3: How Music Therapy Impacts BrainMechanisms Behind How Music Triggers Emotions**

Six psychological mechanisms contribute to the induction of emotions through music, andthese mechanisms are outlined below.

**Brain Stem Reflexes**

The brain's response to music involves reacting to specific acoustical features, inducing emotions. When detecting fundamental acoustic elements, the brain interprets them as potentially significant events. Sudden, loud, dissonant, or rapidly changing sounds can evoke arousal or unpleasant feelings. The perceptual system constantly observes the environment for significant changes. Auditory characteristics like abrupt or intense sounds act as change indicators, stimulating increased central nervous system activity. While the exact physiological mechanisms are not fully understood, evidence suggests involvement of the brain stem's reticular formation and thalamus's intralaminar nuclei, receiving auditory inputs. These brain stem reactions occur early in auditory processing, preceding the primary auditory cortex, following analysis by structures like the superior olivary complex, inferior colliculus, and thalamus.

**Evaluating Conditioning**

This process involves generating emotions through a specific piece of music due to its repeatedassociation with other favorable or unfavorable signals. For example, if a specific musical composition consistently links with a joyful event over time, it will eventually evoke feelings of happiness even when that event is absent. This phenomenon is known by various names, such as evaluative conditioning (EC), affective learning, fear conditioning, emotional conditioning, and preference conditioning. Despite the labels, all describe the same procedure—a unique form of classical conditioning where a neutral conditioned stimulus (CS) pairs with an emotionally charged unconditioned stimulus (US). Through this pairing, the CSgains the ability to elicit the same emotional response in individuals as the US. This process maintains its essential characteristics, whether establishing positive or negative emotional states.

**Emotional Contagion**

This process entails the experience of an emotion when listening to music due to the perception of the music's emotional expression. The listener internally mirrors this expression, which canoccur through peripheral feedback originating in the muscles or direct activation of the corresponding emotional patterns in the brain, ultimately causing the same emotion to be elicited. This mechanism is strongly connected to the extensive body of research on the expression of emotions in music. It has been proposed that musical manifestation acts as an "iconic" cause of emotion because musical structures display formal resemblances to structures associated with expressed or experienced emotions.

**Visual Imagery**

This process involves a listener feeling emotions by mentally conjuring visual images, like envisioning a picturesque landscape, while music plays. The emotional experience results froma significant interplay between the music and these mental visuals. Visual imagery is typicallydescribed as an encounter that closely resembles visually perceiving something, even in the absence of actual sensory input.

**Episodic Memory**

This process involves a listener feeling emotions when music rekindles memories of specific life events. The resurfacing of these memories also brings back the associated emotions. Theseemotions can be exceptionally strong, perhaps due to the fact that the physiological reactions from the initial occurrences are stored in memory along with the experiential elements.

**Musical Expectancy**

This signifies a method wherein a listener feels emotions due to a specific aspect of the music challenging, delaying, or confirming their expectations regarding how the music will unfold.[20]

**Methods to Assess Impact of Music Therapy on Dementia Management Mini – Mental State Examination (MMSE)**

The Mini-Mental State Examination (MMSE) is an 11-question questionnaire designed to assess cognitive function. It evaluates orientation to time and place, attention, short-term memory, language abilities, and visuospatial skills. Tasks include memorization, recalling items, drawing an image, forming a grammatically correct sentence, and identifying the day, date, month, season, and year. Scores range from 0 to 30, with 25 or higher considered normal. A score below 24 suggests potential cognitive impairment, but the MMSE has limitations. A high score doesn't guarantee the absence of cognitive issues, and a low score doesn't always indicate dementia. Factors like physical disabilities, language difficulties, education, or cultural differences can influence test outcomes.[21,22]

**Cornell Scale for Depression in Dementia (CSDD)**

Developed in 1988 by Professor George Alexopoulos and colleagues, the Cornell Scale for Depression in Dementia (CSDD) assesses depressive symptom severity in dementia patients. It involves structured interviews with both a patient and an informant. The interviewer initially assigns a score based on informant-provided information, later validating or adjusting it through a patient interview. Unlike many traditional scales, the patient version of CSDD relies less on subjective responses. Both versions take around 20 minutes, evaluating depressive symptoms over a week. With 19 items, each rated on a three-point scale, the total score is thesum of individual item scores from both interviews. A score of 5 or less indicates no clinically significant depression, while scores of 10 or higher suggest clinically significant depression, and scores exceeding 18 indicate more severe episodes.[23]

**Music in Dementia Assessment Scales (MiDAS)**

The Music in Dementia Assessment Scales (MiDAS) is a comprehensive and structured tool designed to assess the impact of music-based interventions on individuals with dementia. Its purpose is to systematically evaluate the effectiveness of various music activities, including singing, playing instruments, and music listening, in improving the well-being of dementia patients. MiDAS incorporates scales tailored to measure different aspects of participants' responses during music sessions, assessing emotional and social engagement. These scales cover factors like mood, communication, interest level, and overall engagement. Notably adaptable, MiDAS can be used in diverse settings such as care facilities, medical institutions, and community centres, making it valuable for caregivers, healthcare practitioners, and music therapists. By quantifying outcomes, MiDAS contributes to the understanding of music as a therapeutic and enjoyable approach in dementia care, offering an evidence-based framework for delivering optimal support.[24-26]

**Montreal Cognitive Assessment (MoCA)**

Developed in 2005, the Montreal Cognitive Assessment (MoCA) is tailored for Mild CognitiveImpairment (MCI) detection. Unlike the Mini-Mental State Examination (MMSE), it's more sensitive to subtle cognitive decline, crucial for pre-dementia identification. This concise, single-page 30-point test takes around 10 minutes, assessing memory, visuospatial skills, orientation, and executive functions through varied tasks. It gauges focus, immediate memory, and language skills with exercises like sustained attention, digit span, and naming unfamiliar animals. Notably, it awards an extra point for 12 years of education. Detailed analysis confirms its efficacy in distinguishing between normal, MCI, and dementia individuals, offering a comprehensive cognitive assessment.[27,28]

**Overstimulation**

Music's elements, volume, and instruments affect physiology. Overwhelming bass or volume can overstimulate, causing discomfort, restlessness, and stress, especially critical in neonatal intensive care units (NICUs).

**Memory Triggers**

Music, like scent, evokes memories swiftly. It aids dementia clarity but may trigger unwanted memories in Post Traumatic Stress Disorder (PTSD) patients, challenging their desire to avoid reliving certain experiences.

**Anxiety**

Music eases anxiety but can also trigger it. In Alzheimer's, inappropriate music heightens distress. Lyrics, especially negative ones, impact mood, worsening sadness, crucial for individuals managing depression.[29]

## CONCLUSION

In the intricate landscape of dementia care, music therapy shines as a beacon of hope, offering profound benefits across cognitive, emotional, and social realms. Its diverse applications underscore adaptability and effectiveness, elevating the quality of life for individuals navigating this challenging terrain. To unlock its full potential, concerted efforts towards standardized assessments and robust longitudinal studies are imperative. Embracing music therapy's transformative power holds promise in illuminating a path towards comprehensive dementia care. As we move forward, harnessing the therapeutic harmony of music stands as a pivotal step in fostering well-being, resilience, and dignity for those affected by dementia.

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