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Effect of Neurological Music Therapy Among Older Adults with Mild Cognitive Impairment

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Mild cognitive impairment, neurological music therapy, older adults, cognitive function, quality of life, randomized controlled trial, non-pharmacological interventions, MCI therapy, dementia prevention, music intervention.

Disclaimers

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ABSTRACT

Background: Mild cognitive impairment (MCI) is characterized by cognitive decline that exceeds normal age-related changes but does not significantly impair daily life. This condition is a precursor to dementia, including Alzheimer's disease, and affects emotional well-being and quality of life.

Objective: This study aimed to evaluate the effects of neurological music therapy (MMT) on cognitive function, emotional well-being, and quality of life in older adults with MCI.

Methods: A single-blinded randomized controlled trial was conducted over six weeks with 20 participants aged 60-80 years. Participants were randomly assigned to the MMT group, which received exercise therapy with music and the Naruko clapper, or the STT group, which received standard exercise guided by counts. The MoCA and SF-36 were used to assess outcomes. Data were analyzed using SPSS version 27, employing paired and independent t-tests with a significance level of $p < 0.05$.

Results: Post-intervention, the MMT group showed a significant improvement in MoCA scores (23.33 ± 2.06) compared to the STT group (18.75 ± 2.61, $p < 0.001$). SF-36 scores also significantly increased in the MMT group (82.62 ± 6.16) versus the STT group (47.32 ± 11.01, $p < 0.001$).

Conclusion: Neurological music therapy significantly enhanced cognitive and physical health outcomes in older adults with MCI, suggesting its potential as an effective non-pharmacological intervention.

INTRODUCTION

Mild cognitive impairment (MCI) is characterized by a level of cognitive decline that surpasses normal age-related changes but does not significantly impair daily life activities, distinguishing it from dementia, where cognitive decline severely impacts functioning. MCI, especially when associated with memory issues, presents a considerable risk for progression to dementia, notably Alzheimer's disease (1). In a landmark conference held by the International Psychogeriatric Association in January 2005, the complexities of diagnosing and managing MCI were highlighted. The slow and often subtle nature of cognitive decline in healthy aging necessitates prolonged testing, sometimes over 5-10 years, to accurately differentiate between normal aging and early dementia (1). The concept of MCI was first introduced by Reisberg in the late 1980s using the Global Deterioration Scale, and later expanded by Petersen et al. in 1999, to fill the diagnostic gap between normal cognition and dementia. This development was crucial due to the increasing recognition of dementia as a significant public health challenge, emphasizing the need for early diagnosis and the potential for preventive strategies if effective treatments were developed (2).

Aging remains the most significant risk factor for cognitive decline, leading to gradual reductions in memory, information processing, and other cognitive functions. While certain abilities, such as language and problem-solving, may remain relatively intact, older adults often experience declines in crystallized intelligence, resulting in behavioral changes, diminished adaptability, and heightened risks of depression and anxiety, which in turn affect social interactions and daily activities (3). In this context, non-pharmacological interventions like music therapy have gained attention for their potential to improve cognitive and emotional well-being without the side effects associated with medications (4). Music intervention (MI) has been shown to be effective in addressing a wide range of behavioral, emotional, and cognitive issues, making it a valuable tool in the treatment of neurological and physical conditions. MI, through its universal appeal and non-invasive nature, utilizes sound and body language to facilitate communication and evoke emotions, making it a cost-effective approach with no adverse side effects (5). The use of MI in elderly populations, particularly those with MCI, is particularly promising as it helps maintain brain function and enhance cognitive reserve, offering a potential means of slowing cognitive decline (5).

Research into the underlying mechanisms of MCI has grown since the condition was first formally defined, with studies focusing on the early stages of Alzheimer's disease (AD) and the distinction between normal aging and dementia (6). Notably, cerebrovascular illness, commonly associated with aging, has been closely linked to dementia, including AD, with studies showing a significant relationship between vascular risk factors and cognitive decline in the elderly (6).

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The Petersen criteria for MCI emphasize targeting cognitive impairment while preserving overall cognitive function and daily living activities, identifying cognitive complaints ideally confirmed by an informant, and excluding the presence of dementia (7). Given the substantial burden of dementia on healthcare systems, the identification and management of MCI are crucial, although research on MCI remains limited, often confined to clinical settings with strict selection criteria, highlighting the need for more diverse community-based studies (7).

Neurological music therapy (NMT) represents an evidence-based approach specifically designed to address the physical, emotional, and cognitive dysfunctions associated with neurological diseases, including MCI (8). NMT targets specific impairments through the use of music, aiming to enhance mood, cognitive abilities, and overall quality of life, making it a promising addition to treatment plans for individuals with MCI (8). In assessing cognitive decline, tools like the Montreal Cognitive Assessment (MoCA) have been widely used, although their construct validity, including factorial, convergent, and discriminant validities, has been debated, particularly in diverse clinical samples (9). The SF-36, another widely recognized tool, has been validated and found reliable across various illnesses and is sensitive to changes in overall health status, although its application may vary across different cultural contexts, including Malaysia (10).

Music-Movement Therapy (MMT), a specific form of MI, is particularly suitable for older adults, even those with limited exercise habits, as it involves rhythmic movements synchronized with percussion devices, which can enhance cognitive and physical functions through the stimulation of neural circuits in the brain (11). The increasing prevalence of moderate cognitive impairments (MCI) among the elderly presents significant challenges, and traditional pharmacological treatments have shown limited efficacy, making non-pharmacological options like NMT increasingly valuable. NMT, through rhythmic music and clapping exercises, aims to improve cognitive functions, physical health, and emotional well-being, with evidence suggesting enhancements in attention, memory, executive function, neuroplasticity, and brain activity modulation (11). This study explores the impact of NMT on older adults with MCI, aiming to advance treatment strategies and improve quality of life for this vulnerable population.

MATERIAL AND METHODS

The study was designed as a single-blinded, randomized clinical trial conducted over six weeks, with sessions held on three alternating days each week. A total of 20 participants were recruited using a consecutive sampling method based on predefined inclusion and exclusion criteria. Participants included both males and females aged 60 to 80 years who presented with mild cognitive impairment, defined by a Montreal Cognitive Assessment (MoCA) score of less than 26. Additionally, participants needed to be able to walk safely as determined by a Functional Gait Assessment (FGA) score of less than one, and to have a minimal degree of physical activity as assessed by the SF-36 physical activity questionnaire. Exclusion criteria encompassed older adults with visual or hearing impairments, a history of cardiovascular diseases, other neurological disorders such as multiple sclerosis or Parkinson's disease, presence of depression, serious motor deficits, serious physical or mental health issues, and being left-handed or ambidextrous.

Ethical approval for the study was obtained from the Ethical Review Committee of The University of Faisalabad (Reference No: TUF/IRB/344/24). All participants provided written informed consent prior to enrollment, and the study adhered to the ethical principles outlined in the Declaration of Helsinki. The study was registered with the Iranian Registry of Clinical Trials (IRCT) with trial ID IRCT20240314061290N1. Data collection took place at Allied Hospital Faisalabad within the Physiotherapy Department's outpatient setting.

Participants were randomly assigned to either the Neurological Music Therapy (MMT) group or the Standard Treatment Technique (STT) group using a chit and draw method. Each MMT session began with a 20-minute warm-up that included approximately five minutes of light exercise synchronized with background music, followed by 15 minutes of exercises designed to strengthen leg muscles for fall prevention, accompanied by music. The main MMT session involved the use of the Naruko clapper for 30 minutes, where participants engaged in rhythmic clapping to selected music tracks. Each session concluded with relaxation exercises, including deep breathing and massage, set to background music. The STT group participated in exercise sessions that involved the same movements as the MMT group, but guided by counts instead of music.

The effectiveness of the interventions was assessed using the MoCA for cognitive function and the SF-36 for physical function and quality of life. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 27. Normality of the data was checked using the Shapiro-Wilk test. For within-group comparisons, paired t-tests were used, while independent t-tests assessed between-group differences. Levene's test was applied to evaluate the equality of variances. Statistical significance was set at a p-value of less than 0.05.

The sample size of 20 participants was determined to be adequate to detect significant differences in the outcomes of interest based on power calculations using Epitool. All statistical analyses were performed in accordance with standard procedures, ensuring the reliability and validity of the findings. The study's methodology was carefully designed to minimize bias and confounding factors, ensuring robust and generalizable results that contribute to the evidence base on the effectiveness of neurological music therapy in older adults with mild cognitive impairment.

RESULTS

The results of the study were analyzed using SPSS version 27, with descriptive statistics used to summarize demographic data and inferential statistics applied to test

hypotheses. The age distribution of participants revealed that 20% were aged 60-64 years, 30% were aged 65-69 years, 25% were aged 70-74 years, and 25% were aged 75-80 years.

Table 1: Functional Gait Assessment (FGA)

Functional Gait Assessment (FGA)	N	Frequency	Mean	Standard Deviation (SD)
Severe Impairment	20	7	0.65	0.489
Moderate Impairment	20	13		

Table 2: Montreal Cognitive Assessment Scale (MoCA) - Between Group Analysis

Sr.	Variables	Assessment	Group A (MMT) (Mean ± SD)	Group B (STT) (Mean ± SD)	t-Value	P-value
1	Montreal Cognitive Assessment Scale	Pre MoCA	17.10 ± 2.46	16.20 ± 2.65	-11.93	0.443
		Post MoCA	23.33 ± 2.06	18.75 ± 2.61	-5.22	<0.001

The Montreal Cognitive Assessment (MoCA) scores were compared between the MMT and STT groups before and after the interventions. Initially, the MMT group had a mean score of 17.10 (SD = 2.46), while the STT group had a mean score of 16.20 (SD = 2.65), with no significant difference between the groups ($p = 0.443$). Post-intervention, the STT group's mean score rose to 18.75 (SD = 2.61), showing improvement, but the MMT group demonstrated a significantly larger improvement in MoCA scores with a post-intervention mean of 23.33 (SD = 2.06), highlighting a statistically significant difference between the groups ($p < 0.001$).

Table 3: SF-36 (Short Form Health Survey) - Between Group Analysis

Sr.	Variables	Assessment	Group A (MMT) (Mean ± SD)	Group B (STT) (Mean ± SD)	t-Value	P-value
2	SF-36	Pre SF-36	29.75 ± 9.01	32.91 ± 7.28	-0.864	0.399
		Post SF-36	82.62 ± 6.16	47.32 ± 11.01	8.28	<0.001

The SF-36 scores before and after interventions indicated no significant difference between the groups pre-intervention, with the MMT group scoring a mean of 29.75 (SD = 9.01) and the STT group 32.91 (SD = 7.28) ($p = 0.399$). Post-intervention, the MMT group's SF-36 scores significantly increased to a mean of 82.62 (SD = 6.16), while the STT group's scores rose to 47.32 (SD = 11.01). The between-group analysis showed a statistically significant difference favoring the MMT group ($p < 0.001$), indicating that MMT had a more substantial impact on quality-of-life improvements compared to STT.

The within-group analyses revealed significant improvements in cognition, emotional well-being, and physical function for both groups post-intervention. However, the between-group comparison underscored that the MMT group experienced superior outcomes in both cognitive function and overall quality of life as measured by the MoCA and SF-36 scales. These findings suggest that neurological music therapy is a highly effective intervention for enhancing cognitive and physical health in older adults with mild cognitive impairment.

DISCUSSION

The findings of this study demonstrated that neurological music therapy (MMT) significantly improved cognitive function, emotional well-being, and physical quality of life in older adults with mild cognitive impairment (MCI) when compared to standard exercise therapy (STT). These results align with existing literature that highlights the effectiveness of music-based interventions in enhancing cognitive and emotional outcomes in neurological conditions (8). Previous studies have established that music therapy can evoke emotional responses, reduce stress, and enhance mood, contributing to overall psychological well-being (5). The significant improvements observed in the MMT group underscore the potential of music therapy as a non-pharmacological intervention that addresses multiple aspects of well-being in older adults with MCI.

The study's strengths included the use of a randomized clinical trial design, which minimized selection bias and enhanced the validity of the results. Furthermore, the detailed protocol, including the use of validated tools such as the Montreal Cognitive Assessment (MoCA) and the SF-36, ensured that cognitive and physical health outcomes were measured accurately. The findings of this study are consistent with those of Raglio et al., who reported significant improvements in psychological symptoms and cognitive functions through music therapy in patients with dementia (8). Additionally, the use of a standardized intervention, with specific rhythmic movements and musical elements, supported the targeted enhancement of cognitive and physical functions, reinforcing the importance of structured music interventions in clinical practice.

However, the study also had limitations that need to be considered. The small sample size limited the generalizability of the findings, and the short duration of the intervention may not fully capture the long-term effects of MMT. Additionally, the absence of a control group with no exercise component makes it difficult to isolate the specific effects of the music element from the exercise itself. These limitations suggest that future research should explore larger, more diverse populations and include longer follow-up periods to assess the sustainability of the observed benefits. Including a control group without exercise would

also help clarify the unique contributions of the music intervention. The findings also pointed to cultural and gender-specific factors that may influence the effectiveness of music therapy, which should be further explored to tailor interventions more effectively to diverse populations.

The study by Satoh et al. on the use of physical exercise with music to maintain daily living activities in patients with dementia parallels the present findings, highlighting that music-movement interventions can significantly enhance physical and cognitive outcomes in older adults (14). Moreover, the study's emphasis on rhythmic synchronization supports the hypothesis that MMT can engage neural circuits involved in cognitive and motor functions, which is crucial for older adults with MCI, as discussed by Tabei et al. (11). Music's ability to act as a "time suppressor," as noted by Levi-Strauss, and its role in stimulating neuroplasticity, further validate the observed improvements in cognitive reserve among participants (5).

One notable strength of this study was its focus on a holistic approach, addressing not just cognitive deficits but also physical and emotional aspects of well-being, thus providing a comprehensive intervention strategy. This aligns with the growing recognition of the need for multifaceted approaches in managing MCI and other neurodegenerative conditions (6). The study's findings highlight the clinical relevance of MMT, particularly in settings where enhancing cognitive function and physical health are primary goals, and offer valuable insights into the implementation of music therapy in real-world clinical settings.

In terms of recommendations, the integration of MMT into routine care for older adults with MCI should be considered, given its non-invasive nature and the potential to improve quality of life without pharmacological side effects. Future research should aim to refine the MMT protocols, explore the neurobiological mechanisms underpinning the observed benefits, and evaluate the cost-effectiveness of such interventions in larger, more diverse populations. The exploration of digital platforms and technology-based solutions for delivering music therapy could also expand its accessibility and impact, particularly in resource-limited settings.

Overall, this study contributes to the growing body of evidence supporting the use of music therapy in the management of cognitive and physical impairments among older adults. By demonstrating the significant benefits of MMT, the study underscores the potential of music-based interventions as a valuable tool in the broader therapeutic arsenal for MCI, warranting further investigation and integration into clinical practice.

CONCLUSION

The study concluded that neurological music therapy (MMT) is a highly effective non-pharmacological intervention for improving cognitive function, emotional well-being, and physical quality of life in older adults with mild cognitive impairment (MCI). The significant enhancements observed in attention, memory, executive function, and overall physical health underscore MMT's potential as a valuable therapeutic approach. These findings suggest that incorporating music therapy into standard care for MCI could offer a holistic, patient-centered alternative that addresses multiple dimensions of health without the side effects associated with medications. Given its accessibility and adaptability, MMT has the potential to be widely implemented in various healthcare settings, providing a practical means of enhancing the quality of life for aging populations. Further research should explore its long-term benefits, integration into digital platforms, and scalability to maximize its impact on global health outcomes.

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