MUSIC THERAPY: ITS IMPACT ON MEMORY FUNCTIONS AMONG NON – CLINICAL ELDERLY POPULATION

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Abstract

Background: The global rise in ageing population necessitates enhanced healthcare services for older adults. Music has long been acknowledged for its therapeutic potential in addressing psychological and physiological challenges. This study aims to investigate how music can be utilised as a therapeutic tool to enhance memory functions in elderly individuals who do not have cognitive impairments.

Methods: For the present study, a Randomized Controlled Pre-post design was employed, involving a sample of 80 non – clinical or community older adults aged between 60 and 80 years. The Mini – Mental State Examination (MMSE) was utilised as a screening test to exclude individuals with cognitive impairments. The participants were randomly divided into two groups: the Intervention Group and the Control Group. The Intervention Group received individual biweekly Music Therapy interventions for a duration of three months. The measures assessed in this study were Working Memory and Episodic Memory. Baseline assessments were conducted before the start of the Music Therapy intervention, and Post – Intervention assessments were carried out after the completion of the intervention.

Results: The findings of the study indicate that Music Therapy has shown improvement in various aspects of memory functions in older individuals. These results suggest that Music Therapy could be a feasible and effective complementary tool for enhancing memory functions in healthy older adults. However, further extensive research with larger sample sizes and exploration of different modes of Music Therapy interventions is needed to provide additional support for these findings.

Keywords: Music Therapy, community elderly population, memory functions.

Introduction

Ageing is a natural process characterised by a decline in mental and physical capabilities, leading to disability. The World Health Organization (2022) reports a significant increase in the global ageing rate, projected to nearly double from 12% to 22% by 2050. Alarmingly, approximately 6.6% of this ageing population suffer from mental and neurological disorders. Cognitive decline is a prominent feature of old age, with memory functions being particularly adversely affected and/or deteriorated. The loss of brain connections with age contributes to the degeneration of working memory (Verhaegen et al., 2019) and episodic memory (Levine et al., 2002; Friedman, 2013) in older individuals, who keep forgetting information such as, names, phone numbers, dates or recent events, old faces and the like. Episodic memory, the most vulnerable system, generally begins to decline around the age of 60 years (Nyberg, 2017). Furthermore, visuo – spatial working memory exhibits a higher decline rate compared to verbal working memory, with individuals above 65 years of age experiencing a sharper decline (Klencklen et al., 2017). The environment in which individuals reside also plays a

crucial role in this decline in memory functioning. Rapid urbanisation and complex socio – economic systems have failed to provide a sense of psychological safety and security to the elderly population, resulting in feelings of neglect, unwantedness, and lack of care. Approximately half of the global population now resides in densely populated urban areas with advanced industrial and transportation facilities (Alig et al., 2004; Jiang and O'Neill, 2017). This urbanisation process, coupled with ambient environmental pollutants such as air pollution, traffic – related pollutants and noise pollution, have been identified as the contributing factors to the increased symptoms of cognitive and memory impairments, including Dementia and Alzheimer's Disease (Paul et al., 2019; Chandra et al., 2022). However, a large section of the elderly populace also comprises a host of elderly people without any such clinical disorders. The concerns and requirements of the clinical geriatric population receive relatively more attention compared to their counterparts who are experiencing healthy ageing. However, it is important to emphasize that the problems and needs of the non – clinical segment of the elderly population, those who are experiencing healthy ageing and usual age – related decline in memory functions, often remain unaddressed. This neglect puts them at a risk of deteriorating memorising capacity and mental health. It is crucial to recognise the urgency of addressing these issues, as failure to do so may lead to the development of severe memory dysfunctions and impairments, eventually pushing them into the clinical geriatric population. To prevent this escalating situation, Music Therapy can be employed to delay the onset of chronic mental illnesses and/or mitigate their severity.

Music Therapy is a complementary therapeutic approach that utilises various elements of music, including sound, rhythm, melody, and harmony, to address the physical, psychological, emotional, intellectual, cognitive, and social needs of clients. By harnessing the power of music, Music Therapy aims to enhance communication skills, foster interpersonal connections, improve learning abilities, facilitate mobilisation, and promote the expression and organisation of thoughts and emotions. Ultimately, the goal is to enhance the overall quality of life for individuals receiving Music Therapy (World Federation of Music Therapy, 1996; American Music Therapy Association, 2005). The neuronal memory traces established through music are found to be deeply embedded and demonstrate greater resilience against neurodegenerative effects. For Alzheimer's patients, music serves as a valuable modality for accessing and enhancing memory function and their retention of musical information has been observed to be better than any other form of information, despite experiencing memory loss (Thaut, 2006). Research studies have further demonstrated that the inherent temporal structure of musical stimuli serves as a metrical template which aids in chunking a large amount of information into manageable units, thereby ensuring more effective declarative and verbal learning and recall among a wide range of populations – from healthy individuals to patients with memory impairments or even children with learning disabilities (Thaut, 2010; Gfeller, 1983; Wallace, 1994). Music Therapy has been found to possess the capacity to facilitate the reintegration of the information retrieval process from stored memory, even in individuals who are affected by Dementia or other Brain Injuries (Tomaino, 2002). Music Therapy, thus, increases neuroplasticity of the hippocampal area of the Brain, thereby facilitating memory functions (James et al., 2020).

Extensive research has been conducted on the impact of Music Therapy on memory functions among elderly individuals with various forms and degrees of Dementia, as well as other types of memory impairments and cognitive dysfunctions. However, there is relatively limited evidence regarding the therapeutic effects of music and its components on the normal ageing population. Given the rapidly increasing rate of the geriatric population and the associated physiological and psychological health risks, there is a pressing need to strengthen healthcare

services for older adults, which ultimately has implications for public health. Therefore, the objective of the present study is to investigate the influence and/or effects of listening to music, as a module of Music Therapy, on the memory functions of the geriatric community population.

Methodology

Trial Design

The present study employed a Randomised Controlled Pre and Post Test Design in order to examine the impact of Music Therapy on the memory functions of the elderly community population. A total of 80 elderly individuals from Kolkata and its surrounding areas were selected to investigate the research problem. The inclusion criteria for sample selection included individuals between the age of 60 and 80 years with no neurological impairments, who were able to read, comprehend, and write in both Bengali and English. Participants with psychiatric disorders, neuro-cognitive disorders, major visual impairments, or significant motor impairments were excluded from the study. The Mini – Mental State Examination (MMSE: Folstein et al., 1975) was used as a screening tool to identify participants with neurological impairments, and those scoring below 24 were excluded from the sample. Using a random number table, the participants were then randomly assigned to either the Intervention Group (receiving Music Therapy) or the Control Group (where only measured variables were tested). The outcome measures selected for the study included Working Memory, List Learning Immediate and Delayed Recall, and Recognition under the Memory Module. The Intervention Group received biweekly Music Therapy sessions, and their assessments were conducted at both the Baseline and Post – Intervention phases. On the other hand, the Control Group did not receive any alternative therapeutic treatment and underwent assessments twice, with a three – month interval between them.

Participants

The study included a total sample of eighty elderly individuals (N = 80) aged between 60 and 80 years, with a mean age of 70.75 years (SD = 6.028). Among the participants, 71 were female and 09 were male. All participants were taking medication to manage one or more of the following symptoms: hypertension, low and fluctuating blood pressure, thyroid issues, diabetes, minor gastroenterological problems, knee pain, and back pain. Additionally, one participant had undergone Total Knee Replacement surgery four months prior and was still undergoing physiotherapy sessions.

Treatment

The Music Therapy module consisted of individual sessions lasting for about 30 minutes, which took place biweekly over a period of 03months, resulting in a total of 24 sessions. Musical strains from the Indian Raga System were pre – recorded using two musical instruments, namely the Sitar and Flute, employing the Musical Improvisation Technique. Each musical piece had an approximate duration of 10 minutes. The sessions commenced with deep breathing and meditation exercises aimed at promoting relaxation among the participants. Subsequently, the participants were exposed to the pre – recorded music. Interactive sessions were conducted following each session to encourage interpersonal communication between the participants and the researcher.

Treatment Outcome Measures

Working Memory and Recall and Recognition of Lists were chosen as the measures for the study and were assessed using the Neurological Assessment Battery (NAB: Stern and White,

2003). The NAB measures included the Backward Digits under Attention domain and List Learning under Memory domain.

Results

Table 1: Comparison of Age (in Years) of the Participants Across Groups (N = 80)

Variables	**Intervention Group**		**Control Group**		**Mann - Whitney**	**p – value**
	Mean	**SD**	**Mean**	**SD**		
Age (In Years)	71.20	6.52	70.30	5.54	722.50	0.455

As seen in Table 1, a comparison of the age (in years) of the participants of the two groups revealed no significant differences.

Table 2: Comparison of Baseline Outcome Variable Scores Across Groups

Outcome Measures	**Intervention Group**	**Control Group**	**Mann - Whitney**	**p – Value**
	Mean ± SD	**Mean ± SD**		
Digits Backwards	7.20 ± 1.56	7.10 ± 1.82	781.50	0.855
Digit Span	6.08 ± 0.97	6.95 ± 0.99	800.00	1.000
Immediate Recall	19.92 ± 4.99	21.70 ± 4.60	641.50	0.126
Short Delayed Recall	7.80 ± 2.40	8.30 ± 2.36	702.00	0.342
Long Delayed Recall	5.73 ± 2.36	6.60 ± 2.63	655.00	0.159
Long Delayed Recall % Retention	72.13 ± 15.43	77.68 ± 14.02	639.00	0.120
Long Delayed Forced - Choice Recognition	9.10 ± 2.47	9.58 ± 2.33	711.50	0.388
Long Delayed Forced - Choice Recognition False Alarms	3.33 ± 1.42	3.05 ± 2.44	725.00	0.464
Long Delayed Forced - Choice Recall vs. Recognition Index	61.35 ± 14.01	70.65 ± 27.16	641.50	0.126

Table 2 presents an analysis of whether there were significant differences between the Intervention Group and Control Group in terms of their selected memory functions prior to the beginning of the Therapy sessions (at Baseline Level). The data indicates that there were no significant variations in the baseline data between the two groups.

Table 3: Comparison of the Post-Intervention Outcome Variable Scores Across Groups

Outcome Measures	**Intervention Group**	**Control Group**	**t – Test**	**Mann - Whitney**	**p – Value**
	Mean ± SD	**Mean ± SD**			
Digits Backwards	8.84 ± 1.39	7.37 ± 1.61	-	377.50	0.000***
Digit Span	6.76 ± 0.91	6.15 ± 0.92	-	493.00	0.005**
Immediate Recall	25.58 ± 4.28	21.50 ± 3.69	4.51	-	0.000***

Short Delayed Recall	10.16 ± 1.73	8.15 ± 2.02	-	336.50	0.000***
Long Delayed Recall	8.87 ± 2.17	6.25 ± 2.17	-	296.00	0.000***
Long Delayed Recall % Retention	86.58 ± 10.97	76.18 ± 13.01	-	406.00	0.000***
Long Delayed Forced - Choice Recognition	11.13 ± 1.19	10.63 ± 1.90	-	660.50	0.280
Long Delayed Forced - Choice Recognition False Alarms	1.08 ± 1.08	1.35 ± 1.49	-	706.50	0.577
Long Delayed Forced - Choice Recall vs. Recognition Index	78.98 ± 13.99	74.93 ± 17.20	-	664.50	0.337

*** $p < 0.001$, ** $p < 0.01$

Table 3 displays the comparison between the Intervention Group and the Control Group regarding their changes in the Post – Intervention scores on the Outcome Variables. The results indicate that the Intervention Group demonstrated significantly greater improvement compared to the Control Group in the following areas: Digit Backwards ($p < 0.001$), Digit Span ($p < 0.01$), Immediate Recall ($p < 0.001$), Short Delayed Recall ($p < 0.001$), Long Delayed Recall ($p < 0.001$), and Long Delayed Recall Percentage Retention ($p < 0.001$). However, there were no significant differences between the two groups in terms of the Post – Intervention scores on Long – Delayed Forced Choice Recognition and False Alarms.

Table 4: Changes in the Outcome Measure from Baseline to Post – Intervention Scores of the Intervention Group

Outcome Measures	**Baseline**	**Post – Intervention**	**Paired t**	**Wilcoxon Signed Rank**	**p - Value**
	Mean ± SD	**Mean ± SD**			
Digits Backwards	7.20 ± 1.56	8.84 ± 1.39	-	- 5.36	0.000***
Digit Span	6.08 ± 0.97	6.76 ± 0.91	-	- 4.15	0.000***
Immediate Recall	19.92 ± 4.99	25.58 ± 4.28	- 19.86	-	0.000***
Short Delayed Recall	7.80 ± 2.40	10.16 ± 1.73	- 11.53	-	0.000***
Long Delayed Recall	5.73 ± 2.36	8.87 ± 2.17	-	- 4.57	0.000***
Long Delayed Recall % Retention	72.13 ± 15.43	86.58 ± 10.97	- 4.74	-	0.000***
Long Delayed Forced - Choice Recognition	9.10 ± 2.47	11.13 ± 1.19	-	- 4.57	0.000***
Long Delayed Forced - Choice Recognition False Alarms	3.33 ± 1.42	1.08 ± 1.08	-	- 5.21	0.000***
Long Delayed Forced - Choice Recall vs. Recognition Index	61.35 ± 14.01	78.98 ± 13.99	- 7.35	-	0.000***

*** $p < 0.001$

Table 4 displays the comparison between the Baseline and Post – Intervention scores of the Intervention Group. The results demonstrate that all scores on the outcome variables of the

Intervention Group exhibited a significant improvement ($p < 0.001$) following three months of Musical Intervention.

Table 5: Changes in the Outcome Measure from Baseline to Post – Intervention Scores of the Control Group

Outcome Measures	**Baseline**	**Post – Intervention**	**Paired t**	**Wilcoxon Signed Rank**	**p – Value**
	Mean ± SD	**Mean ± SD**			
Digits Backwards	7.10 ± 1.82	7.37 ± 1.61	-	- 2.18	0.029*
Digit Span	6.95 ± 0.99	6.15 ± 0.92	-	- 1.41	0.157
Immediate Recall	21.70 ± 4.60	21.50 ± 3.69	0.81	-	0.426
Short Delayed Recall	8.30 ± 2.36	8.15 ± 2.02	1.23	-	0.225
Long Delayed Recall	6.60 ± 2.63	6.25 ± 2.17	2.16	-	0.037*
Long Delayed Recall % Retention	77.68 ± 14.02	76.18 ± 13.01	0.79	-	0.432
Long Delayed Forced - Choice Recognition	9.58 ± 2.33	10.63 ± 1.90	-	- 4.66	0.000***
Long Delayed Forced - Choice Recognition False Alarms	3.05 ± 2.44	1.35 ± 1.49	-	- 4.84	0.000***
Long Delayed Forced - Choice Recall vs. Recognition Index	70.65 ± 27.16	74.93 ± 17.20	-	- 2. 95	0.003**

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 5 presents a comparison between the Baseline and Post – Intervention scores of the Control Group. The results indicate that the Control Group exhibited improvements in the Post – Intervention scores of Digit Backwards ($p < 0.05$), Long Delayed Forced-Choice Recognition ($p < 0.001$), and Long Delayed Forced Choice Recognition – False Alarm ($p < 0.001$). However, there was a significant decrease ($p < 0.05$) in the Post – Intervention score on Long Delayed Recall. The Post – Intervention scores on Immediate Recall, Short Delayed Recall, and Long Delayed Recall % Retention decreased compared to the Baseline assessment scores, although the differences were not significant.

Discussion

The objective of this study was to evaluate the impact of Music Therapy on the memory functions of elderly individuals in India. Its findings compared the participants of the two Groups on the basis of their Baseline and Post – Intervention scores on the sub – tests measuring the different memory functions.

The comparison between the baseline scores on the outcome measures (Table 2) reveal that the participants in the Control Group performed better than those in the Intervention group on most of the sub – tests measuring the Working Memory and Recall – Recognition Abilities, although not significantly. The absence of any significant difference between the Baseline scores of the two Groups are indicative of successful randomisation of the participants so as to ensure comparability of the Groups.

The comparison of the Post – Intervention scores on the outcome measures obtained by the two Groups (Table 3) reveal significantly better scores of Intervention Group than their counterparts in the Control Group on Digit Backwards and Digit Span; Immediate, Short and Delayed Recall and Recognition Percentage. However, the scores obtained by the

Intervention Group on Long – Delayed Forced – Choice Recognition, False Alarms and Recall vs. Recognition Index have not been significantly higher than those obtained by the Control Group. Significant improvement in all the parameters measuring working memory functions and retention and recall abilities of the Intervention Group has been revealed when the Baseline and Post – Intervention scores were compared (Table 4). On the other hand, the comparison between the scores obtained by the Control Group at the Baseline phase and after three months (Table 5) reveal significant improvement in Digit Backwards and Long – Delayed Forced – Choice Recognition, False Alarms and Recall vs. Recognition Index. However, the score on Long Delayed Recall decreased significantly, while the deterioration on Immediate and Short Delayed Recall and Long Delayed Percentage Retention were not significant. This finding implies that although their ability to identify previously presented auditory stimuli improved, their ability to retrieve those and the related information without any reference point deteriorated.

Although the scores on Digit Backwards and Long – Delayed Forced – Choice Recognition, False Alarms and Recall vs. Recognition Index improved for the Control Group, the Between Group Analysis of the Post – Intervention scores reveal significantly higher scores of the Intervention Group than the Control Group on those parameters. Moreover, the Control Group performed better than the Intervention Group, although not significantly, on the Long – Delayed Forced Choice Recognition, False Alarms and Recall vs. Recognition Index at the Baseline Assessment Phase. The Intervention Group exhibited significantly greater improvements in all outcome measures during the Post – Intervention phase compared to the Control Group. Conversely, the Control Group showed a decline in Post – Intervention scores on measures such as Immediate, Short, and Long Delayed Recall, as well as Retention Percentage. These findings suggest that Music Therapy is effective in enhancing and/or preserving memory functions among the non – clinical elderly population. It is important to note that despite the Control Group showing improved scores on measures such as Digit Backwards, Long Delayed Forced – Choice Recognition, False Alarms, and Recall vs. Recognition Index, the overall trend indicates the superiority of Music Therapy in memory improvement.

In line with research findings, cognitive abilities and functions tend to remain relatively stable until the late fifties and sixties, with a subsequent acceleration in the rate of decline during the seventies (Aartsen et al., 2002; Plassman et al., 1995; Schaie, 1989). The mean age of the participants in both the Intervention and Control Groups was found to be 71.20 years and 70.30 years, respectively. Consistent with these findings, the Control Group demonstrated a decline in scores across most parameters measuring memory functions during the final assessment, three months after the baseline measurement. Conversely, the Intervention Group showed significant improvement in all parameters following the intervention.

The current findings align with previous research that has indicated the capacity of music to stimulate complex cognitive functions in the brain and enhance brain connectivity (Wilkins et al., 2012; Thaut, 2005), crucial for memory processes and higher – order executive functions. Studies have provided evidence that listening to vocal music can lead to increase in grey matter volumes and induce structural and functional changes in the neuroplasticity of specific temporoparietal networks in the brain, thereby enhancing the ability of stroke patients to recall verbal memory more effectively (Leo, 2020; Sihvonen, 2020). The research findings also provide substantial evidence that exposure to musical training, music – based interventions, and rehabilitation can induce neuroanatomical changes by increasing brain connectivity and neuroplasticity in the Prefrontal Cortex (Sjponski et al., 2020). These changes have been found to stimulate complex cognitive functions, including attention,

memory, and higher – order executive functions (Wilkins et al., 2012; Postle, 2006; Thaut, 2005). Musical exposure has also been shown to stimulate the secretion of dopamine, a neurotransmitter in the brain involved in motivation, reward – seeking behaviours (Morita et al., 2013; Salamone and Correa, 2002), and working memory (Sawaguchi and Goldman-Rakic, 1991). Furthermore, favourable evidence supporting the effectiveness of Music Therapy on various cognitive functions, particularly general cognition, episodic memory, and executive functions (Ito et al., 2022), further strengthens the findings of the present study. Music Therapy has been proved to be a significantly beneficial and non – invasive intervention for delaying cognitive deterioration among elderly individuals, particularly with a profound impact on slowing down the degeneration of short – term recall in individuals with mild and moderate dementia (Chu et al., 2014).

The findings of the present study, thus, highlight the potential of Music Therapy to enhance memory functions, specifically working memory and episodic memory, as evidenced by the positive impact on scores related to digit backwards, list learning recall, and recognition sub – tests among non – clinical elderly individuals. By promoting healthy ageing and overall wellbeing, Music Therapy thus, may be thought of as a promising means for maintaining cognitive functions, thereby promoting healthy ageing and overall wellbeing for older individuals.

Conclusion

The present study explored the potential of Music Therapy, particularly using Indian Classical Raga, to improve memory functions among the community elderly population. The findings revealed significant effectiveness in improving working memory and episodic memory in otherwise healthy elderly individuals in India. With the global ageing rate on the rise and increased life expectancy, addressing the deterioration of general health and cognitive functions among the elderly population has become crucial. This study highlights the integration of music and its elements into a therapeutic module as a valuable approach to support healthy cognitive ageing, enhance wellbeing, and improve the overall quality of life for older individuals.

Conflict of Interest:

Nil

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