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The Effectiveness Of Music Therapy As A Non-Pharmacological Tool On Cognitive Functions Among Geriatric Community Population

By

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Abstract

Background: The increasing rate of ageing worldwide gives rise to the need of improved health care services for the community geriatric population. Therapeutic ability of music to address psychological and physiological issues have been well recognised for ages. The present study aims at exploring the scope of music as a therapeutic tool to improve selected cognitive abilities of elderly individuals without cognitive impairments.

Methods: A Randomised Control Pre-post design was adopted for the present study with a sample size of 80 community geriatrics within the age group of 60 and 80 years. Mini-Mental State Examination (MMSE) was used as the screening test to exclude geriatrics with cognitive impairments. The participants were randomly assigned into two groups, viz., Intervention and Control Groups. The Intervention Group was given individual biweekly Music Therapy intervention for three months and the measures assessed were Attention, Memory and Executive Functions. Assessments were done at the baseline level and three months after the completion of Music Therapy Intervention.

Results: The study reveals that music therapy has improved all the three parameters of the Cognitive Functions, viz., attention capacity, working memory functions and executive functions of the elderly individuals. Thus, Music Therapy may be considered as a non-pharmacological tool for facilitating healthy cognitive ageing. Further extensive research is necessary with larger sample and different other modes of Music Therapy Interventions to support the present findings.

Keywords: Music Therapy, geriatric population, attention, memory, executive functions.

Introduction

Ageing is a natural phenomenon that has been observed as a process of disabling – a phase of life of "mere oblivion/ Sans teeth, sans eyes, sans taste, sans everything." (*As You Like It,* William Shakespeare) – a stage when individuals lose their mental and physical ability to function (Covey, 2000). According to World Health Organisation (2022), the steep spurt in the worldwide ageing rate will nearly double from 12% to 22% by 2050 and even more alarming is the fact that about 6.6% of the degeneration of this population accounts for mental and neurological disorder. Naturally, degenerations in the cognitive faculties are a stark

characteristic of old age. Attention process, memory functioning, processing speed and reaction time and executive functions such as, reasoning, planning, problem solving, decision making and the like are some of the most common forms of cognitive ageing, the process of which begins gradually from middle age or even earlier, though the degree of cognitive ageing differs from individual to individual (Park and Reuter-Lorenz, 2009; Deary et al., 2009). The environment within which an individual lives also plays an important role in this cognitive degeneration process. The complex socio-economic system and increasing urbanisation over the recent years fail to provide the sense of psychological safety and security among the elderly population, for which they feel neglected, unwanted and uncared for. About half of the global population now live in urban environment which is often densely populated with better industrial and/or transport facilities (Alig et al., 2004; Jiang et al., 2017). This urbanisation process coupled with high rates of poverty, alarmingly poor environmental conditions (such as, air pollution and traffic related pollutants, water contamination, noise pollution and the like), lack of quality time with the family members lead to poorer health, which in turn negatively impacts healthy cognitive ageing (Vlahov et al., 2007; Moore et al., 2003). According to the reports of United Nations projects, about 19.6% of the total Indian population accounts for the geriatric population. Research studies have revealed an alarming degenerative scenario with regards to the mental health and wellbeing among the elderly population in India with West Bengal reporting the highest percentage (72%) of elderly with psychological distress (Alam et al., 2012) and reduced cognitive abilities (United Nations Population Fund, 2014). The reduced mortality rate can be considered an important trigger for an increase in the cognitive and neurological health hazards among this population, which in itself is a toll on public health. This, in turn, poses a threat on the wellbeing and quality of life, not only of the elderly but also of their caregivers. This vicious cycle therefore, calls for an urgent need for designing and implementing non-pharmacological interventions as a complement to the conventional pharmacological treatment to maintain sangfroid in the wellbeing and mental health of both the elderly and of the community at large.

Among the various forms of decline in Cognitive Functions, changes in aspects of Attention are quite common. Decline in the immediate attention span, selective attention and the ability to inhibit the intrusion of irrelevant stimuli jeopardise the speed of performing complex tasks (Commodari and Guarnera, 2008). In general, Memory functions, especially working (Verhaegen et al., 2019) and episodic memories (Friedman, 2013) undergo a sharp decline in old age where the elderly individuals keep forgetting information, such as, names, phone numbers, dates or recent events. However, this highly common symptom may become a matter of grave concern in case of Dementia or other forms of memory impairments. The higher order Executive Functions, such as, reasoning, planning, problem solving, judgement, verbal fluency and the like (Collins and Koechlin, 2012) also witness degeneration in old age which cumulatively hamper the wellbeing of this population (Lacreuse et al., 2020). Degenerations in these crucial domains of Cognitive Functions are among the greatest challenges to improving the overall wellbeing of the older people.

Listening to musical pieces and other forms of musical exposures prove to reap noticeable but short-term benefits on different forms of cognitive tests, which strikes a contrast to the relatively trivial yet more long-lasting intellectual developments among young children (Schellenberg, 2016). The use of Music as a therapeutic intervention in neonatology has gained popularity as it has proved to have positive effects on brain development, autonomic nervous system, language, behavioural and psychosocial developments among the neonates and also

strengthen their bonds with their mother (Parmar and Sundar, 2015). Music Therapy is an effective complementary intervention to improve global cognition, memory functions, language ability and executive functions among patients suffering from mild Alzheimer's Disease, other forms of Dementia and cognitive impairments (Lam, Li, Laher and Wong, 2020; Kim and Yoo, 2019; Lyu *et al*., 2018; Fusar-Poli *et al*., 2017). However, Music Therapy along with Recognition Test had better efficacy to improve Cognitive Functions among the elderly population (Sawami, Kitamura and Suishu, 2018).

In India, Music serves as an integral part in its socio-cultural scenario. The Therapeutic value of Music not only in elevating mood, wellbeing and quality of life, but also to aid Cognitive Functions, Emotional Regulation and maintaining prenatal and neonatal health and wellbeing has long been recognized. In recent years, Indian researchers from different disciplines have been studying the effectiveness of Music as a non-pharmacological tool on various domains of life – both physiological and psychological. Indian studies have shown beneficial effects of music to elevate mood, improve Emotion Regulation, Cognitive Functions and also to maintain healthy growth and development among the neonates (Varma and Saxena, 2022; Jayamala et al., 2021; Parmar and Sundar, 2015). Music Therapy has been found to effectively deal with cognitive and affective deficits among individuals with different forms of mental disorders and impairments (Hedge, 2018; Reddy et al., 2017). However, further research is needed to determine the effectiveness of Music as a complementary Therapeutic tool to aid maintenance of psychological health among the non-clinical population of India across different age groups.

The effect of Music Therapy on the cognitive, emotional and other behavioural functions among elderly individuals with different forms and levels of Dementia, cognitive impairments and mood disorders including late-life Depression have been widely studied. But, quite less evidence for the Therapeutic effects of Music and its components on normal ageing population is found. The rapidly increasing rate of geriatric population with their physiological and psychological health hazards demands an immediate attention on strengthening health care services for the geriatrics, which in turn influences public health. The present study therefore, focuses on exploring how listening to music as a Music Therapy Module influences and/or affects the Cognitive Functioning, especially, Attention Functions, Memory and Executive Functions of geriatric community.

Methodology

Trial Design

The present study deploys Randomised Control Pre and Post Test Design to discern whether Music Therapy has any impact on the selected cognitive domains of the elderly community population. For the purpose of investigating into the research problem, a total of 80 elderly people living in both Old Age Homes and within family were selected. Individuals with no neurological impairments, aged between 60 and 80 years and having the ability to read, comprehend and write Bengali and/or English were kept as the Inclusion Criteria for sample selection. Individuals with any psychiatric disorders, neuro-cognitive disorders and major

visual or motor impairments were excluded. Mini-Mental State Examination (MMSE) was used to screen participants with neurological impairments, where anyone scoring below 24 was excluded from the sample. The participants were then randomly assigned either to Intervention (receiving Music Therapy) or Control (only measured variables were tested) Group, using randomised table. Attention, Memory and Executive Function parameters of the cognitive domain were the chosen measure variables. The participants in both the groups were assessed at the baseline and 3 months after the completion of Music Therapy Intervention on the selected Cognitive Domains.

Participants

The total sample consisted of eighty elderly individuals (N=80) within the age range of 60 and 80 years (Mean = 70.75 years; SD = 6.028), the number of female and male participants being 71 and 09 respectively. Among them, 40 geriatrics were chosen from Old Age Homes, while the rest 40 were those who lived with their families. All the participants were under medication for one or more of the following symptoms: hypertension, low and fluctuating blood pressure, thyroid, diabetes, minor gastroenterological problems and knee and back pain. One participant had undergone Total Knee Replacement surgery four months back and was still undergoing physiotherapy sessions.

Treatment

The Music Therapy module consisted of thirty – minutes biweekly individual sessions, spanning over three months. The total number of Music Therapy sessions was therefore, twenty-four. Musical strains from Indian Raga System were pre-recorded on two musical instruments, viz., Sitar and Flute following the Musical Improvisation Technique, with the duration of each musical piece being around 10 minutes. The sessions began with deep breathing and meditation exercises for relaxation of the participants, followed by the pre-recorded musical exposure. Interactive session was kept after each session for inter-personal communication between the participants and the researcher.

Treatment Outcome Measures

Attention, Memory Function and Executive Functions, selected for the study were assessed using Neurological Assessment Battery (NAB: Stern and White, 2003): Attention (Backward Digits), Memory (List Learning) and Executive Functions (Maze, Judgement and Word Generation).

Results

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

Intervention Group		Control Group		t – value	p – value
Mean	SD	Mean	SD		
71.20	6.517	70.30	5.543	0.665	0.51

Source: *Primary Survey, 2022*

Table 1 indicates that there is no significant difference between the participants in the Intervention Group and Control Group with regards to their age.

Table 2: *Comparison of Baseline Outcome Variable Scores Across Groups (N = 80)*

Categories		Intervention Group		Control Group		t – value	p – value
		Mean	SD	Mean	SD		
Attention	**Digit Backward**	7.200	1.556	7.100	1.823	0.264	0.79
Memory	**Immediate Recall**	19.925	4.999	21.700	4.597	1.653	0.10
	Short Delayed Recall	7.800	2.398	8.300	2.355	0.941	0.35
	Long Delayed Recall	5.725	2.364	6.600	2.629	1.565	0.12
	Long Delayed Retention Percentage (%)	72.125	15.429	77.675	14.022	1.684	0.09
Executive Functions	**Maze**	5.075	2.654	6.100	4.087	1.330	0.19
	Judgement	12.525	2.038	12.650	1.748	0.294	0.76
	Word Generation	7.150	3.945	8.275	5.458	1.056	0.29

Source: *Primary Survey, 2022*

Table 2 describes whether the two groups, viz., Intervention Group and Control Group differ significantly in terms of the selected cognitive parameters before the inception of the Therapy sessions. The data reveals that the baseline data of two groups do not vary significantly.

Table 3: *Comparison of the Post-Intervention Outcome Variable Scores Across Groups (N = 80)*

Categories		Intervention Group		Control Group		t – value	p – value
		Mean	SD	Mean	SD		
Attention	**Digit Backward**	8.842	1.386	7.375	1.612	4.300	0.00***
Memory	**Immediate Recall**	25.579	4.278	21.500	3.693	4.514	0.00***
	Short Delayed Recall	10.158	4.278	8.150	2.019	4.701	0.00***
	Long Delayed Recall	8.868	2.170	6.250	2.169	5.327	0.00***
	Long Delayed Retention Percentage (%)	86.579	10.973	76.175	13.007	3.808	0.00***
Executive Functions	**Maze**	8.895	2.892	6.375	3.814	3.275	0.00***

	Judgement	10.394	5.011	12.500	1.895	2.478	0.01**
	Word Generation	10.395	5.011	8.050	4.804	2.110	0.03*

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$
Source: *Primary Data, 2022*

Table 3 reveals that Music Therapy did have highly significant positive effect on the selected cognitive parameters of the participants in the Intervention Group. The Attention and Memory Functions were the most significantly benefitted from the Therapy. However, the Judgement ability has not been benefitted by the Music Therapy and Control Group has scored more on this sub-test than the Intervention Group.

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

Categories		**Baseline**		**Post Intervention**		**t – value**	**p – value**
		Mean	**SD**	**Mean**	**SD**		
Attention	**Digit Backward**	7.210	1.527	8.842	1.386	8.939	0.00***
Memory	**Immediate Recall**	19.842	4.890	25.579	4.278	19.856	0.00***
	Short Delayed Recall	7.711	2.359	10.158	1.732	11.526	0.00***
	Long Delayed Recall	5.658	2.304	8.868	2.170	14.783	0.00***
	Long Delayed Retention Percentage (%)	72.237	15.541	86.579	10.973	4.743	0.00***
	Maze	5.000	2.579	8.895	2.893	18.315	0.00***
Executive Functions	**Judgement**	12.553	2.036	10.395	5.011	3.943	0.00***
	Word Generation	7.000	3.742	10.395	5.011	10.030	0.00***

*** $p < 0.001$
Source: *Primary Data, 2022*

Table 4 indicates that the improvement in the selected cognitive parameters has been highly significant after the three months of biweekly Music Therapy sessions. The mean scores reveal that the Memory Functions, especially the ability to retain information and recall them later, have been benefitted the most by the Therapeutic Session, as evident from the differences between the pre and post intervention mean scores on Long Delayed Retention Percentage. However, the post Intervention mean score on Judgement has significantly reduced even after the Therapy Session.

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

Categories		Baseline		Post Intervention		t – value	p - value
		Mean	SD	Mean	SD		
Attention	**Digit Backward**	7.10	1.823	7.375	1.612	2.317	0.02*
Memory	**Immediate Recall**	21.700	4.598	21.500	3.693	0.805	0.42
	Short Delayed Recall	8.300	2.356	8.150	2.020	1.233	0.22
	Long Delayed Recall	6.600	2.629	6.250	2.169	2.156	0.03*
	Long Delayed Retention Percentage (%)	77.675	14.023	76.175	13.007	0.793	0.43
Executive Functions	**Maze**	6.100	4.088	6.375	3.814	2.317	0.02*
	Judgement	12.650	1.748	12.500	1.895	1.637	0.11
	Word Generation	8.275	5.458	8.050	4.804	1.221	0.22

* $p < 0.05$

Source: *Primary Data, 2022*

It is quite evident from Table 5 that daily lifestyle of the participants in the Control Group could not solely improve most of the selected cognitive parameters. Rather, their performances show a downward trend, although not significantly. The mean score on the Long-Delayed Recall is the only sub-test where this decrease in the mean score is significant. However, the scores on Digit Backward and Maze have improved.

Discussion

The present discussion aims at assessing the effect that Music Therapy has on the Attention, Memory and Executive Functions of the elderly population in India. Advancements in medical science and health care sector have been instrumental in decreasing the mortality rate. The rapidly growing elderly population contributes greatly to the increasing physiological and psychological ailments reported worldwide. The highly complex socio-economic structure and urbanisation, growing numbers of nuclear families, lack of family support and such other factors have a massive adverse impact on the cognitive as well as emotional health of this population, due to which their overall health and wellbeing and quality of life are jeopardised. Frailty, cognitive decline due to rapid urbanisation, loneliness and late life depression as a result of lack of adequate family care and support, lack of communication with their social environment and the higher sedentary life are inevitable during old age (Singh and Mishra, 2009; Hays and Minichiello, 2016; Kemppainen et al., 1999; Robins et al., 2019). Music Therapy has been found to effectively complement pharmacological treatments to aid Cognitive Functions, such as, memory functions, orientation, global cognition and the like and in reducing impaired cognitive symptoms such as, delirium and hallucination (Wang et al., 2018; Fusar-Poli et al., 2018; Gallego and Gracia, 2017). Although extensive research has been

done on clinical geriatric population, especially on those with Dementia and other neurological impairments, evidences are required to discern the effectiveness of Music Therapy to facilitate Cognitive Functions among normal ageing population. Moreover, Music forms an integral part of the cultural heritage of every country and influences the different walks of lives of their citizens. India has a rich legacy in different genres of music and has been found to have positively impacted the emotional health, wellbeing and quality of life of its citizens (Varma and Saxena, 2022; Sanivarapu, 2015). This serves as a basis of the present study to utilise Indian Classical Ragas being played on Indian musical instruments to assess their effectiveness in improving cognitive functions among the non-clinical geriatric population.

The findings of the present research reveal a significant difference between the two groups (Intervention and Control Groups) in terms of their Attention, Memory and Executive Functions after the Musical Intervention. This implies that Music has significantly and positively facilitated Cognitive Functions among the participants in the Intervention Group. Music therefore, can be deployed in a Therapeutic framework to aid and facilitate memory functions, higher executive functions (such as, planning and problem-solving) and verbal generativity among the elderly population. The present findings conform to many of the previous research which suggest that music has the ability to stimulate complex cognitive functions of the brain and increases brain connectivity (Wilkins et al., 2012; Thaut, 2005) which is instrumental for memory and higher order executive functions. Siponkoski et al. (2020) in his study with Traumatic Brain Injury patients proved that musical training and music-based rehabilitation have been effective to bring about neuroanatomical changes in the prefrontal cortex and improved Executive Functions. This finding may therefore, indicate that musical exposure increases the neuroplasticity of the Prefrontal Cortex, the Brain area responsible for helping an individual to focus on and select relevant sensory information from among a gamut of stimuli and engage in higher order Executive Functions necessary for their processing in the Brain (Postle, 2006). These serve as the neurological explanation for the present findings. Musical exposure has been recorded to have increased neural responses during intermodal attention tasks (Meltzer et al., 2015). Background music without any lyrics has been proved to have positive effects on the concentration and attention which is necessary for any kind of work in daily life (Shih, Huang and Chiang, 2012). Moreover, McCabe et al. (2010) identified high inter-correlation between working memory and Executive Function. This finding therefore, justifies the highly and significantly improved auditory working memory (measured by Backward Digits of Attention Module) and higher Executive Function constructs (planning, problem-solving, psychomotor speed, impulse control and word generativity as measured by Maze and Word Generation sub-tests of Executive Functions Module) of the Intervention Group. All these previous research findings cumulatively support the findings of the present study where music significantly and positively impacted the Attention, Memory and Executive Functions of the geriatric community population.

The two groups have been found to be homogeneous in terms of their rate of cognitive ageing in the areas of Attention, Memory and Executive Functions before any Music Therapy was applied to the Intervention Group. Moreover, the age of the two groups also didn't vary which indicates that the changes have not been influenced due to the difference in age groups. These together strengthen the rationale that the changes in their selected cognitive parameters after three months were solely and primarily influenced by the Music Therapy Intervention, and not determined by any other external factors.

Further analysis reveals that the attention, memorisation capacity, planning, problem-solving and word generativity functions of Executive Functioning have improved significantly among the participants in the Intervention Group after three months of the Music Therapy. The

pre and post intervention comparison in the Control Group reveals lesser improvement in most of the selected cognitive parameters. Their scores in immediate and short delayed recall and percentage of retention sub-tests of Memory Module, Judgement and Word Generation sub-tests of the Executive Functions Module have reduced, although not significantly, whereas, long-delayed recall score has deteriorated significantly which may have led to the decrease in the percentage of retention of this Group. This within group comparison between the pre and post intervention phases of the two groups further justify the significant effectiveness of Music Therapy to improve the elderly population's attention, memory and executive functions. The present findings are in sync with the results of the previously conducted research where Musical Intervention has been found to have benefitted the clinical elderly population with regards to their Cognitive Functions (Kim and Yoo, 2019; Wang et al., 2018; Jihui et al., 2018; Fusar-Poli et al., 2017).

However, the post intervention mean score of the Intervention Group on Judgement sub-test of Executive Functions Module has reduced highly significantly. The Judgement was expected to improve as well as it is a component of planning and problem-solving process. But, Judgement refers to the acknowledgement, decision on the final selection and execution parts of a particular course of action, whereas, Planning refers to the analysis of a situation and identifying the future course of actions to reach to the solution. The Music Therapy session conducted over a period of three months may have been too brief a span of Intervention to improve their ability to judge and take a decision to execute a plan to reach the goal, despite its effectiveness to facilitate the other aspects of the entire planning and problem-solving capacity. Moreover, communication with others and discussion play a significant role in judgement and decision-making, which can be achieved through Talk Therapy. But in this case, maximum focus was given on the musical exposure, conversation has played minimum role which may have failed to improve their judgement and decision-making abilities. On the other hand, the mean scores of the Control Group on the Attention Module and Maze sub-test of the Executive Functions Module have increased significantly from the baseline data. The mean score on the Maze sub-test was higher for the Control Group even at the baseline level, which indicates that their planning and problem-solving abilities, psychomotor speed and impulse control measured by the sub-test were better than the Intervention Group. The high inter-correlation between Working Memory and Executive Functions found by McCabe et al. (2010) justifies this improvement among the participants in the Control Group as well.

However, further extensive research is necessary with longer span of Music Therapy sessions and larger sample size with different sub-categories of socio-demographic characteristics to find stronger evidences of the effectiveness of Music as a non-pharmacological tool on cognition. Moreover, only directed music listening module has been employed for the present research. Other modules of the therapy and mixed method approach need to be compared with other forms of non-pharmacological and relaxation therapy to elucidate their effects on cognitive ageing.

Conclusion

The findings of the present study reveal that Music Therapy employing Indian Classical Raga has been found to be significantly effective to improve cognitive functions among the non-clinical geriatric population of India, especially, their Attention, aspects of Memory and Executive Functions. With reduced mortality rate and increased life expectancy, the global ageing has seen a sharp rise in the last few years. General health deterioration among the elderly population, especially higher rates of cognitive degeneration, apart from the clinical geriatric

population, is a matter of grave concern and calls for immediate attention of the health care services. Therefore, contemporary non-pharmacological treatments and therapeutic interventions are also necessary for improving and/or maintaining health and wellbeing. The present study is an endeavour to throw light on incorporating Music and its elements into a Therapeutic Module to aid healthy cognitive ageing, thereby improving their wellbeing and quality of life.

Conflict Of Interest:

NIL

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