

Original Article

# Impact of Music on Short-Term Memory in Elderly in Delhi NCR, India

Anushka Raj

*The Shri Ram School Aravali, Gurgaon, India.*

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**Abstract** - Elderly population is increasing in every country, including India. As cognitive function declines with age, the elderly find it difficult to cope with activities of daily living, taking care of finances etc. Music has been shown to significantly enhance mood, improve cognitive function, including memory, and decrease stress. We decided to study the impact of music on short-term memory, heart rate and blood pressure in a prospective manner in the elderly. We studied elderly men and women over 60 years old in 2 elder care homes. Short-term memory was tested using a validated Digit span test. Heart rate and BP were recorded. Curated music was played for 30 minutes. Heart rate, BP recording and Short-term memory test were again recorded. In our analysis, we found that short-term memory improved significantly. Systolic BP decreased (Statistically significant), and heart rate increased marginally. The elderly also enjoyed the experience, and their mood improved. We conclude from the study that music can help improve short-term memory and help in decreasing Blood Pressure. Music can be used as a nonpharmacological intervention to help improve cognitive function in the elderly.

**Keywords** - Blood pressure, Elderlies, Heart rate, Music, Short-term memory.

## 1. Introduction

“Music gives a soul to the universe, wings to the mind, flight to the imagination, and life to everything.” —Plato.

In India, the number of senior citizens (>60 years) has increased from 5.6% in 1961 to 10.1% in 2021 and is further expected to increase to 13% by 2031 (“Senior Citizens - status in India — Vikaspedia”). Hence, with increasing age, there is a decline in memory and cognitive functions that further increases the incidence of dementia (Murman, 2015). However, as age increases, older adults must maintain cognitive function to live independently and reduce the burden on society (*Understanding the Impact of an Aging Society* / NIA, n.d.).

Music has been shown to enhance mood, cognitive function, and memory. Music significantly impacts the brain’s psychological, cognitive, and physiological aspects (Levitin, 2006), further impacting physical and mental health. It further reduces stress positively and benefits health’s emotional, physiological, and cognitive aspects (Joel, 2022). In an extensive study in California Nursing homes, 4107 inmates were studied over three years. Curated music was played at least twice a week. The study results were a significant decrease in the use of antipsychotic medication, anti-anxiety medication, and antidepressant medication (by 9 – 17%). There was also a substantial improvement in mood, decrease in pain, decrease in falls, decrease in aggressive behaviour and depressive moods (Bakerjian et al., 2020).

According to a review on the impact of music on memory and emotion, which stated the impact of music on memory and emotion, it was concluded that “because emotions enhance memory processes and music evokes strong emotions, music could be involved in forming memories, either about pieces of music or episodes and information associated with a particular music” (Jancke, 2008). Studies have also shown that short musical pieces with characteristics could prime semantic language memory systems yielding faster and more efficient recognition of specific words (Koelsch, Kasper et al., 2004).

One of the studies investigated whether musical pieces that induced high arousal and positive feelings are remembered better by non-musicians than non-musical or emotionally neutral musical pieces. They concluded that musical works that were very positive were recognised and were recognised significantly better than those rated as less favourable, thus showing a relation between emotional arousal by music and better memory (Eschrich & Munte, 2008).

Another elegant study examined whether everyday music listening can facilitate cognitive function after a stroke. The study revealed that recovery of verbal memory and focused attention improved significantly in patients who listened to their favourite music daily compared to those who listened to audiobooks or received no listening material.



There was also a significant mood improvement in the former (Sarkamo, Tarvaniemi M et al.,2008).

Music helps improve mood and memory. Seeing elders in a family with declining memory and, at the same time, enjoying music resulted in the idea of exploring music as a means to improve memory. Music therapy can help improve short-term memory in the elderly age group. A pre & post-study was done to see if music improved short-term memory in the elderly. If it did, music therapy could improve memory, cognitive skills, and mood in elderly age groups. Hence, the present research is based on music therapy on elders 60 and above to test their short-term memory, heart rate and blood pressure before and after music.

## 2. Methodology

### 2.1. Research Aim

The study aimed to assess the impact of music on short-term memory and hemodynamic parameters in elderly individuals (>60 years). A secondary objective was to see if it improved their mood.

### 2.2. Research Design

The present experimental study involves an intervention, and the results are analysed in the sample group. Our study involved a cohort of elderly living in elder care homes where the pre and post-data for the music intervention were compared. The same group acted as their control.

### 2.3. Variables

Music was the independent variable. The dependent variables were the change in memory test results in response to music, heart rate, and BP.

### 2.4. Sample

A total of 27 subjects, all aged over 60, residing in 2 elder care homes, were studied. Both old age homes were in Gurgaon, Haryana, India. In one old age home, most people were from lower socio-economic groups, while the other was a paid facility, and most subjects were from Upper middle-class backgrounds. The mean age was 74.15 years. M: F ratio was 2:1 (18 M., 9 F).

### 2.5. Informed Consent

We approached the in charge of elder care homes and obtained permission from them to conduct the study. Before starting the survey, we explained the purpose and method of the study to the group of elders collected in a recreation hall. We explained the process of checking heart rate and Blood Pressure and conducting memory tests before and after music to the group. Those who were interested in the study gave verbal consent. We also asked anyone not interested in participating in the study to stay back and watch or to leave. However, all took the former option and participated in the fun activity.

### 2.6. Tools Used

The digit span test, a validated test for short-term memory, was used to assess Working memory. In the test, the examiner reads a set of numbers, and the subject then repeats the set of numbers. First, forward recall and then backward recall is tested. A total of 8 sets of numbers with a gradually increasing span of numbers in each set are tested forwards and eight sets backwards. (e.g., at level 4, the numbers were read slowly by the investigator forwards as 4-2-7-3-1, subjects were asked to recall forwards, followed by 1-5-2-8-6, and subjects were asked to recall backwards) Positive points are awarded for correct recall.

The last set recalled fully in increasing order is the points awarded to the individual. Forward recall and backward recall were scored separately. Scores ranged from 0 to 28. Demographic data, including age, sex, hemodynamic data, heart rate, and BP, was recorded on a proforma. Heart rate was measured by standard manual pulse rate measurement using a watch. Blood Pressure was recorded using a standard Omron Sphygmomanometer.

### 2.7. Data Collection Procedure

All subjects were seated in a hall in the elderly homes and explained the purpose, process, and STM test. Data were recorded on a proforma for each individual. For each individual, the pulse rate and BP were recorded. STM was tested through the digit span test on each individual, and the results were recorded. Then around 9-10, different songs (popular old Bollywood songs 1960s and 1970s) were played for the elders for 30 minutes. Some of them started dancing and singing along with the songs. After 30 minutes, the music stopped. Finally, pulse rate and BP were re-recorded for each individual. Memory was tested again using the same STM test, and the result was recorded.

## 3. Results

**Table 1. Summary of dependent sample T-test analysis between respondents on short-short-term memory before and after music intervention (N= 27)**

Source	Before	After	t	p
	M SD	M SD		
Short-term memory	12.37 4.49	15.96 5.6	2.055	0.004

The T-test for dependent samples between Short-term memory before (M=12.37, SD=4.49) and after (M=15.96 and SD=5.6) was carried out (t=2.055, p<0.05). It shows a significant impact on short-term memory with music intervention (Table 1). The group showed improvement in short-term memory after listening to music as compared to STM before listening to music.

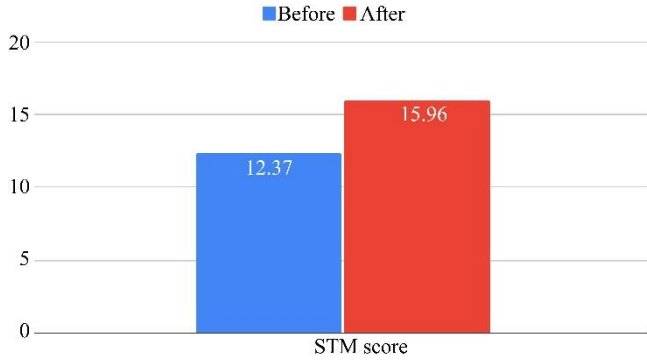


Fig. 1 The bar graph compares respondents' STM before and after music intervention. (N=27)

Figure 1 shows the mean score of STM before and after playing the music. There was a significant improvement in STM after subjects listened to music (From a mean score of 12.37 to 15.96, i.e. 29.02 %). Hence, this further implies that music positively impacts the short-term memory of elderly individuals.

Table 2. Summary of dependent T-test analysis between respondents on systolic blood pressure before and after music intervention (N=27)

Source	Before	After	t	p
	M SD	M SD		
Blood Pressure	144.07 0.55	138.03 .50	2.05	0.01

Summary of T-test analysis comparing systolic Blood pressure in the elderly individuals before (Mean 144.07, SD 0.55) and after listening to music (Mean 138.03, SD 0.50) showed there was a significant decrease in BP after listening to music (t 2.64, p<0.01). Table 2 shows that listening to music calms people down and decreases their systolic BP.

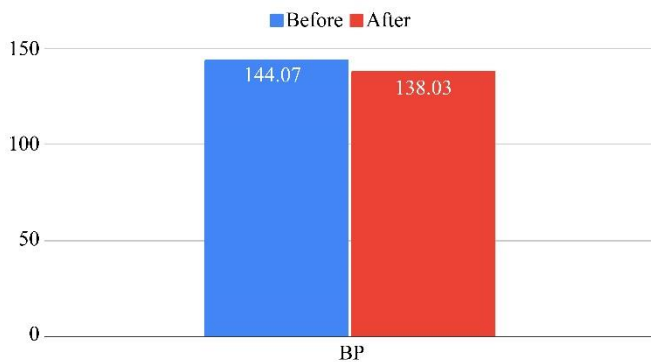


Fig. 2 The bar graph compares respondents' systolic blood pressure before and after music intervention (N=27)

Figure 2 shows the mean systolic BP before (Mean 144.07mm Hg) and after listening to music (Mean 138.03 mm Hg). There was a decrease of 4.19% in systolic BP (p<0.01), which is statistically significant. This suggests that

listening to music can relax elderly subjects and thus result in a decrease in systolic BP.

Table 3. Summary of dependent T-test analysis between respondents on heart rate before and after music intervention (N=27)

Source	Before	After	t	p
	M SD	M SD		
Heart rate	83.77 11.49	87.40 10.84	1.70	0.08

Summary of T-test analysis on music's impact on subjects' heart rate states that the mean heart rate before listening to music (M=83.77, SD=11.49) was lower than after listening to music (M= 87.4, SD=10.84). The increase in heart rate was 4.33% (p<0.08) (Table 3). This showed a mild increase in pulse rate after listening to music, though it did not reach a statistically significant value. This was likely because people started enjoying and getting excited about the music.

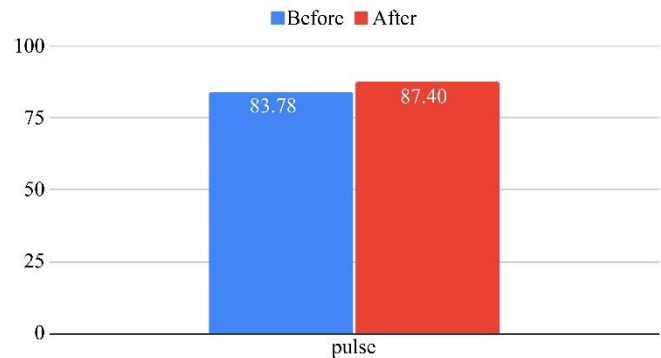


Fig. 3 The bar graph compares respondents' heart rates before and after music intervention (N=27)

Figure 3 shows that the mean pulse rate before listening to music M=83.77 was lower than after listening to music M=87.4. The increase in heart rate was 4.33% (p=0.08). This showed a mild increase in pulse rate after listening to music, though it did not reach a statistically significant value. It could be likely because people started enjoying and getting excited about the music.

#### 4. Discussion

Music has been integral to human culture and civilisation for thousands of years. It significantly affects physiological and psychological aspects as well as cognition, memory, and mood (W G Joel et al., 2022).

We were interested in studying the impact of music on short-term memory and Physiological parameters like Heart rate and BP in individuals (> 60 years). Music gets deeply embedded easily in our conscious and unconscious brains. As we grow, new and diverse information is added to the brain, and new neuronal connections are made. As we age

further, recall of information becomes poorer. This becomes even more important if the brain's functioning is deteriorating, as with age and dementia. Music can awaken the brain and create rich memories associated with familiar songs or music. Playing old favourite songs or songs associated explicitly with personal events or moods can bring back vivid memories of the events or moods from even decades earlier, e.g. when one first fell in love or on a birthday or wedding. Music can thus unlock neuronal activity from the past. It may make the current neuronal activity also better. The current research studied the impact of music on elderly individuals residing in old age homes. A total of 27 subjects were studied, including 18 men and 9 women. The mean age was 74.15 years. We recorded each subject's heart rate, BP and test results of a number-based short-term memory test (digit span test).

Our primary aim was to study the effect of music on short-term memory. As outlined in Table 1, the mean short-term memory test score improved from 12.37 to 15.96. This was statistically significant ( $p= 0.000403$ ). The short-term memory score improved in 17 out of 27 subjects; in the remaining, it either remained the same or decreased.

Many studies have shown that music can improve short-term and long-term memory, including patients with dementia. A systematic review found that music benefits cognition (memory, attention, language), emotion and behaviour (Sotomayor et al., 2021) in another large, comprehensive, prospective study in California nursing homes involving 4107 residents in 265 nursing homes over 3 years. Bakerjian et al. showed that music therapy improved subjects' cognitive function, decreased anxiety and depression, decreased the use of anti-anxiety and antidepressant medication and decreased the no of falls. (Bakerjian D et al. J med Dir assn 2020). However, another study by Kirweg et al. showed no impact of music on memory (Cronk, 2001).

In a recent review article on the use of music in patients with Alzheimer's disease, Anna Matziorinis et al. reviewed published literature on the use of music in Alzheimer's disease. They state that musical memory is better preserved in patients with dementia and that when music is used as a therapeutic intervention, autobiographical memory and short-term memory can show improvement. They also concluded that since Cognitive decline begins early in these patients, early music intervention can delay and decrease the rate of neurocognitive decline (Matziorinis & Koelsch, 2022).

In our review of published literature, we found that many of the studies on the impact of music were in patients with dementia or Alzheimer's disease. In these patients, since neurocognitive decline has already set in and the potential for response to therapy is lower, one may not see as much improvement in short-term memory. On the other hand, our

study was conducted in an unselected group of adults over 60 and may therefore be more generalisable in the general elderly population. Music can be a valuable nonpharmacological tool for improving memory, cognitive function, and mood in the elderly.

Based on our results, we have demonstrated that even half an hour of music can improve short-term memory. Our secondary objective was to assess the impact of music on heart rate and BP. Many studies have shown improved heart rate and BP in response to music.

In a large meta-analysis, which analysed 11 studies and 311 subjects, Loomba et al. showed that music therapy significantly decreased systolic BP, Diastolic BP and heart rate. Their patient population was, however, very diverse, including some ICU patients, some pre-operative patients, and some community patients. (Loomba et al., 2012).

In another study, Suguna et al. studied the impact of different types of music on heart rate and BP. They found a significant reduction in pulse rate and BP after listening to slow music. In contrast, there was an increase in pulse rate and BP after listening to fast music (Suguna & Deepak, 2017)

In the current study, the BP decreased from a mean of 144 mmHg to 138 mm Hg after listening to music for a half hour (Table 2, Fig 2). This was a statistically significant improvement ( $p = 0.01$ ).

In our study, the Heart rate increased from a mean heart rate of 83.7 to 87.4 after the subjects listened to music for 30 minutes. ( $p=0.08$ ). This differed from what was observed in the meta-analysis by Loomba et al. mentioned above. This may be because the patient population we studied differed from those in Dr Lomba's study (Elder care homes vs hospital patients, including some in ICU). Also, we played popular Hindi music, while in some other studies, different music was played.

In a detailed review and perspective article, Raglio et al. analysed the impact of different types of music interventions in patients with dementia and concluded that music could be a very good nonpharmacological intervention in patients with dementia to improve cognitive, behavioural and psychological symptoms and improve quality of life (Alfredo Raglio et al., 2014).

Although assessment of mood was not a part of our study and is difficult to quantify and measure, it was observed in the current study that once the elderly subjects got comfortable with music, the overall mood became happy, and some even started dancing and singing along. A few were agitated before music was played and became calm after that music session.

## 5. Conclusion and Limitations

### 5.1. Conclusion

The current study examined the impact of music on short-term memory in elderly individuals. The results showed that music had a statistically significant positive effect on short-term memory and blood pressure. The heart rate showed a mild increase, though this was not statistically significant ( $p < 0.08$ ). Other research articles have shown a reduction in the heart rate and increased blood pressure in response to different types of music (fast and slow). On the other hand, our results showed a slight increase in heart rate and a decrease in blood pressure. We saw a positive outcome on short-term memory by the music intervention and a positive impact on the mood and behaviour of the elders on clinical observation.

Can music be a therapy tool for elderly members suffering from short-term memory loss? If yes, what type of music, for how long and how frequently can it be used? These could be some of the future research ideas. Further research and exploration of various music genres and

interventions are warranted to harness music's full potential in improving the lives of older individuals.

### 5.2. Limitations

The sample population under study was too small ( $N=27$ ). Further studies can include more subjects to improve the scope & credibility of the results obtained. The current study focused on the impact of 30-minute music played once. We feel a regular daily music intervention may improve outcomes and can work as a therapeutic intervention.

Our study group was real-life, unselected elderly, which was a strength of the study in generalizability. However, the same study done with more selected groups like 10-year age bands or people with psychiatric or neurological problems may be able to identify the people who can benefit most. In the current study, we used popular Hindi music as an intervention. However, the impact of different types of music, such as classical, jazz, popular English music, and calming music, may have on cognitive function can be investigated.

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