ISSN: 2167-7182
Gerontology & Geriatric Research

OPEN ACCESS Freely available online

Research Article

Nostalgic Music Stimulation and Five-sense Activities: A Cognitive Enhancement Intervention for Mild Cognitive Impairment

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ABSTRACT

Objective: This study examines the impact of structured nostalgic music coupled with sensory activities on cognition, depression, emotion, and daily living abilities in mild cognitive impairment (MCI) individuals.

Method: A total of 49 MCI participants were divided into experimental (n=25, mean age ± SD= 73.1 ± 4.8) and control (n=24, mean age ± SD= 71.7 ± 3.9) groups across two sites. The experimental group underwent ten 2-hour sessions of nostalgic music stimulation twice weekly, with pre- and post-assessments utilizing cognitive, emotional, and functional scales.

Results: Significant improvements in cognition and depression were observed in the experimental group. Mixed ANOVA indicated a noteworthy time * group interaction in cognition.

Conclusion: Integrating nostalgic music and sensory activities effectively enhances cognitive abilities in MCI individuals.

Keywords: Nostalgic music; Cognitive training; Cognitive function; GDS

INTRODUCTION

Population aging is a global public health concern, and maintaining the autonomy and well-being of older adults is a major challenge [1]. Cognitive function decline is a significant worry for the elderly during the aging process [2]. Aging is associated with an increased risk of physical and cognitive impairments, which can lead to disability and loss of independence [3]. Cognitive functions, such as information processing speed, working memory, and executive functions, gradually decline with age [4-6]. Mild Cognitive Impairment (MCI) is a stage with a high risk of progressing to dementia, and individuals in this stage may experience challenging cognitive conditions that significantly impact their quality of life [7].

Timely cognitive training programs can help older adults maintain cognitive function and prevent further decline before the onset of MCI or dementia [8]. Cognitive training has shown positive effects in various health conditions, including MCI and brain injury [9]. Engaging in regular physical, mental, and social activities can reduce the risk of dementia by up to 47% [10].

Cognitive training, whether short-term or long-term, can enhance cognitive abilities in healthy middle-aged and older adults [11-16]. Music, as a cognitive training tool, has been associated with positive effects on neural plasticity, cognitive task performance, and brain health [17-23].

Nostalgic music for cognition and emotion improvement

Music has been a significant source of emotional expression throughout human history [24]. It activates the whole brain, positively influencing memory, attention, semantic processing, motor function, sleep quality, pain reduction, anxiety reduction, and blood pressure regulation [25-27]. Nostalgic music associated with past experiences enhances episodic memory [28]. Listening to favorite music has neurological benefits and enhances cognitive functions [25]. Special songs can evoke memories [29-31]. Music engages multiple senses, stimulates memory and attention, and provides emotional and cognitive benefits [32,33]. Music training can delay cognitive decline in older adults and improve visual ability and working memory [21]. Music interventions have positive effects on depressive mood, cognitive function, and emotional conditions in older adults [34-36].

Purpose of the study

Previous research suggests that music stimulation improves cognition, depression, positive mood, and activities of daily living in older adults [19,21,37-39]. However, there is limited research on

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Received: 28-September -2023, Manuscript No. jggr-23-23203; **Editor assigned:** 30-September -2023, Pre QC No. P-23203; **Reviewed:** 12-October-2023, QC No. Q-23203; **Revised:** 17-October-2023, Manuscript No. R-23203; **Published:** 24-October -2023, DOI: 10.35248/2167-7182.23.12.691

Citation: Lee PL, Chang HH, Huang CK (2023). Nostalgic Music Stimulation and Five-sense Activities: A Cognitive Enhancement Intervention for Mild Cognitive Impairment. J Gerontol Geriatr Res.12: 691.

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applying five-sense activities to older adults' learning processes, despite its significance in early childhood education. This study aims to explore the effects of structured nostalgic music with five-sense activities on cognition, depression, emotion, and Instrumental Activities of Daily Living (IADL). Using measures such as the Montreal Cognitive Assessment (MoCA), Geriatric Depression Scale (GDS), Positive Emotion (PE) scale, and IADL scale, the study examines the differences between and within the experimental and control groups.

METHODS

Participants

Forty-nine older adults participated in the study, with a mean age of 73.1 ± 4.8 years (range: 65-82) for the experimental group and 71.7 ± 3.9 years (range: 65-78) for the control group. All participants had mild cognitive impairment (MoCA scores between 18 and 26) [40,41] were literate, had verbal communication skills, and were not hard-of-hearing. The mean Montreal Cognitive Assessment (MoCA) score was 22.7 ± 2.2 for the experimental group and 21.7 ± 2.6 for the control group. Participants were recruited through community posters in Kaohsiung, Taiwan. Informed consent was obtained from all participants before participating in the research, and the study was approved by the local ethics committee (Taiwan). Participants did not pay any fees for participation to ensure that motivation was not affected by monetary issues. The demographic information of the participants is shown in (Table 1).

Measures

Four measures were administered to participants before and after the intervention.

MoCA

The Montreal Cognitive Assessment (MoCA), developed by Nasreddine ZS, et al. [40] is an instrument for detecting mild cognitive impairment. It covers different cognitive tasks to assess participants' short-term memory recall, visuospatial abilities, executive functions, attention, concentration, working memory, language, and orientation to time and place. The Taiwanese version of the MoCA was used to explore whether the cognitive function of the experimental group improved after participating in nostalgic music training activities.

IADL

The Instrumental Activities of Daily Living (IADL) Scale is an instrument used to assess the performance of complex daily living tasks. It includes eight domains: using the telephone, shopping, meal preparation, housekeeping, laundry, transportation, medication management, and financial management [42]. This scale is useful for determining a person's current functioning of daily living and whether their functioning has improved or deteriorated over time. Participants are scored across all eight functional domains, with a total score ranging from 0 (low function, dependent) to 8 (high function, independent).

Table 1: Baseline characteristics of the participants.

Characteristics	Cognitive training, n=25	Control, n=24
Age	73.1 ± 4.8 (65-82)	71.7± 3.9 (65-78)
Female, n %	22(88)	24 (100)
Education, mean ± SD (range)	8.6 ± 3.2 (6-15)	7.4 ± 3.2 (0-12)
MoCA	22.7 ± 2.2	21.7 ± 2.6

Note: M= Mean; SD= Standard Deviation

GDS

The Geriatric Depression Scale (GDS), created by Yesavage JA, et al. [43]. Was used to assess depressive symptoms in older adults. The GDS-SF15 version used in this study is a simplified 15-item self-reported scale [44]. Scores range from 1 to 5 for a healthy condition, 6 to 9 for a slight tendency toward depression, and 10 or more for severe depression

Positive emotion

A positive emotion scale consisting of six items was developed based on questionnaires from international scholars [45] and the circular model of emotions proposed by Russell JA [46]. A pilot study was conducted to establish the reliability of the scale (Cronbach's α = .891) and its suitability for factor analysis (KMO value = .861; Bartlett's sphericity test, $\chi 2$ = 779.969, df = 15, p < .01). The scree plot indicated one factor with a Total Variance Explained of 67.055%, indicating good construct validity. The scale included the following items: "My current emotion is: pleasant, depressed, optimistic, calm, relaxed, and unhappy." Note that the second and sixth items are reverse-scored.

Design and statistical analysis

Design: A quasi-experimental clinical trial design was employed, recruiting community residents aged 65 and above from the metropolitan area in southern Taiwan. The intervention involved nostalgic music combined with five-sense activities, including listening to nostalgic songs, oral singing, visual imagination, sign language singing, and other activities targeting the five-senses. The intervention spanned 5 weeks, with 2 sessions per week, each lasting 2 hours. The training sessions focused on memory training, concentration improvement, executive skill strengthening, and enhancing the five-senses in older adults. The intervention group followed the schedule outlined in (Table 2) while the control group did not receive any treatment.

Statistical analysis: Various statistical analyses were employed to examine the effects of the intervention. The Wilcoxon test was used to determine significant changes in mean scores within the experimental and control groups on the measures of MoCA, IADL, GDS, and Positive Emotion. In addition, t-tests and Cohen's d effect size were used to analyze and compare the intervention effects between pre- and post-tests. Mixed Design ANOVA was implemented to compare the mean differences between the experimental group and the control group across the four measure instruments and examine the intervention effect

RESULTS

We conducted a nostalgic music intervention program to examine the pre (Time 1)-post (Time 2) effects on the measurements of MoCA, IADL, GDS, and PE, as shown in Figure 1. A steeper slope indicates a greater improvement in participants. Figure 1 demonstrates that the slopes of MoCA, IADL, GDS, and PE in the experimental group are steeper than those in the control group, indicating significant improvements in cognition, instrumental ac-

tivities of daily living, and positive emotions after the five-week intervention course. Additionally, the depression scores significantly decreased, indicating a positive effect of the intervention.

The results of the Wilcoxon test examining intragroup differences are presented in (Table 3). MoCA showed a statistically significant improvement in the pre-post tests for the experimental group, but not for the control group. The effect size, measured by Cohen's d, indicated a large intervention effect for MoCA (effect size = 1.259) and a near-medium effect for GDS (effect size = 0.476), approaching the medium effect size threshold of 0.50 [47]. The statistical results for the intra-group pre-test, post-test, and mean gain of the four measurement instruments are displayed in (Table 3).

MoCA: The pre-test (M = 22.680, *SD* = 2.212) and post-test (M = 25.760, *SD* = 2.619) results showed a significant increase of 3.080 points (SD = 0.406) in MoCA scores for the experimental group ($p < .001$), indicating a significant improvement.

IADL: The pre-test (M= 7.360, *SD*= 1.221) and post-test (M= 7.440, *SD*= 1.044) results in IADL showed a slight increase of 0.080 points (*SD*= 1.28) for the experimental group.

GDS: The pre-test (M= 3.240, *SD*= 2.990) and post-test (M= 2.000, *SD*= 1.658) results showed a significant decrease of -1.240 points (*SD*= 1.332) in GDS scores for the experimental group (p= .031), indicating a significant improvement.

PE: The pre-test (M= 3.807, *SD*= 0.587) and post-test (M = 3.913, *SD*= 0.297) results in PE showed a slight increase of 0.107 points (*SD*= 0.290) for the experimental group.

Furthermore, mixed design ANOVA tests were conducted to examine intergroup differences and interaction effects. The results indicated significant group main effects on MoCA and GDS, indicating that the intervention (experimental) group performed better on these measurements (Table 4). Moreover, there was an interaction between the time factor (within-subject) and the group factor (between-subject) on the dependent variable of MoCA, suggesting that the intervention group showed significant improvement in cognition (MoCA) from Time 1 to Time 2 compared to the control group.

Table 2: The content and objective of the intervention schedule for the experimental group.

Wk.	Content	Objective
1	Pretest	Baseline characteristics
2	Listening to and singing nostalgic songs	Memory training, concentration, executive ability
3	Nostalgic music and sign language singing	Memory training, executive ability, visual space
4	Arranging nostalgic songs	Memory training, executive ability
5	Memorizing nostalgic music and lyrics	Concentration, executive ability, visual space
6	Nostalgic music and five sense associations	Memory training, concentration, executive ability
7	Creating stories for nostalgic songs	Memory training, concentration, executive ability
8	Dancing with nostalgic music	Memory training, concentration, executive ability
9	Nostalgic music and food associations	Memory training, concentration, executive ability
10	Collective creation of nostalgic songs	Memory training, concentration, executive ability,
11	Performances of nostalgic songs	Review
12	Post-test	Collect data for pre-post test comparisons and intervention effects determination

Table 3: Pre-post test intervention gains (mean) within group comparisons.

		Cognitive Training	Control	Intragroup Differences p Value c	
				Cognitive Training	Control
MoCA	Mean gains (SD)	3.080 (.406)	1.500 (.539)	.000***	.007**
	Effect size d[a]	1.259	0.509	-	-
	At or above baseline level, %b	92	67	-	-
IADL	Mean gains (SD)	.080 (-.177)	-.292 (.424)	0.715	.034*
	Effect size d[a]	0.07	0.334	-	-
	At or above baseline level, %b	57	75	-	-
GDS	Mean gains (SD)	-1.240 (-1.332)	-.458 (-.205)	.031*	0.083
	Effect size d[a]	0.476	0.317	-	-
	At or below baseline level, %[b]	80	71	-	-
PE	Mean gains (SD)	.107 (-.290)	-.007 (-.052)	0.221	0.887
	Effect size d[a]	0.21	0.013	-	-
	At or above baseline level, %[b]	40	46	-	-

Notes: *: $p < .05$; **: $p < .01$; *** $p < .001$ Within group mean differences were evaluated by Wilcoxon test.
a Effect size defined as training improvement from pretest to posttest minus control improvement from pretest to posttest divided by the intrasubject Standard Deviation (SD) of the composite score. Positive effect sizes indicate improvement.

Table 4: Mixed design anova results for inter-group differences in each measure.

	Cognitive Training		Control		
	Pre-training	Post-training	Pre-training	Post-training	
	M (SD)	M (SD)	M (SD)	M (SD)	
MoCA	22.680 (2.212)	25.760 (2.619)	21.667 (2.632)	23.167 (3.171)	
IADL	7.360 (1.221)	7.440 (1.044)	7.793 (.509)	7.500 (.933)	
GDS	3.240 (2.990)	2.000 (1.658)	1.750 (1.539)	1.292 (1.334)	
PE	3.807 (.587)	3.913 (.297)	3.868 (.547)	3.861(.496)	
Source	**SS**	**df**	**MS**	**F(p)**	$\hat{w}^2$
MoCA	128.427	1	128.427	40.806(.000***)	0.465
group	79.641	1	79.641	7.133(.010*)	0.132
MoCA *group	15.284	1	15.284	4.856(.032*)	0.094
IADL	0.274	1	0.274	0.471(.496)	0.01
group	1.48	1	1.48	1.150(.289)	0.024
IADL *group	0.846	1	0.846	1.451(.234)	0.03
GDS	17.659	1	17.659	7.667(.008**)	0.14
group	29.588	1	29.588	5.194(.027*)	0.1
GDS *group	3.741	1	3.741	1.624(.209)	0.033
PE	0.061	1	0.061	.322(.573)	0.007
group	0.001	1	0.001	.002(.967)	0
PE *group	0.079	1	0.079	.417(.521)	0.009

Note: *:p < .05; **: p < .01; *** p <.001

DISCUSSION

This study explored the effect of nostalgic music with five-sense activities on cognition, positive emotion depression, and instrumental ability of daily living. The uniqueness of this study lies in the following reasons: (a) The nostalgic music intervention program combine with five-sense activities are evidence-based practice, such approaches are rare in literature. (b) the intervention program. Population aging is a world trend, so the results will be of great significance for many aging areas or countries; (c) The participants were reside in the community with MCI, and the findings might be applied to general similar community residents with MCI to improve their quality of life in the future. The key findings of the study and the results are:

Intragroup change

Statistics indicated that nostalgic music training programs could improve the measure of MoCA and GDS of the elderly. The average score of the experimental group in MoCA increased greatly, while the average score of GDS decreased significantly. The reasons might be: Through the nostalgic music intervention program, the elderly could reconnect themselves with their youth. As people grow older, people prefer old songs and melodies they used to be familiar with [48]. As suggested by the Hebbian theory [49]. The neural connections of the participants are reactivated, and their brains become neuroplastic when they listen to and sing music that they are familiar with. Thus, engaging in musical activities enhances memory and cognition. However, the statistical results did not show any significant differences in IADL and PE resulting from the music stimulation program. The reasons might be: In the pre-test of IADL, the elderly of the experimental group got a high score, 7.36 out of 8 points. According to Lawton MP [42], if the participants are scored close to 8, it means they have a better functioning of daily living and are more independent. Even though the elderly improved somewhat to 7.44 on the post-test, there was no significant difference, probably due to the ceiling effect, which parallels the finding of Lam LC, et al. [50]. Nevertheless, some literature reported that cognitive stimulating improves IADL [51,52]. Additionally, the score of PE slightly non-significantly improved by .106 points, from 3.807 to 3.913, It may be due to that positive emotion recognition is more difficult for those with MCI [53]. In addition, the average age of the experimental group is 73, and as individuals age, they might get more physical problems, which might negatively affect their positive emotions.

Intergroup difference and interaction effects

Our results demonstrated a statistically significant improvement in MoCA scores between the experimental group and the control group. The cognitive intervention program proved beneficial to the participants in the experimental group as the nostalgic music stimulation aimed to enhance cognitive functions such as memory, concentration, and executive function. These findings are consistent with previous studies by Bernini S, et al. [54] and Han E, et al. [55] which also reported significant improvements in MoCA and GDS scores within their respective experimental groups.

However, the control group exhibited better GDS scores in the pre-test compared to the experimental group. Therefore, even though the experimental group showed improvement, it was challenging to surpass the performance of the control group, thereby explaining the difficulty in achieving a significant difference.

Interaction effect

Based on our study findings, we observed a significant interac-

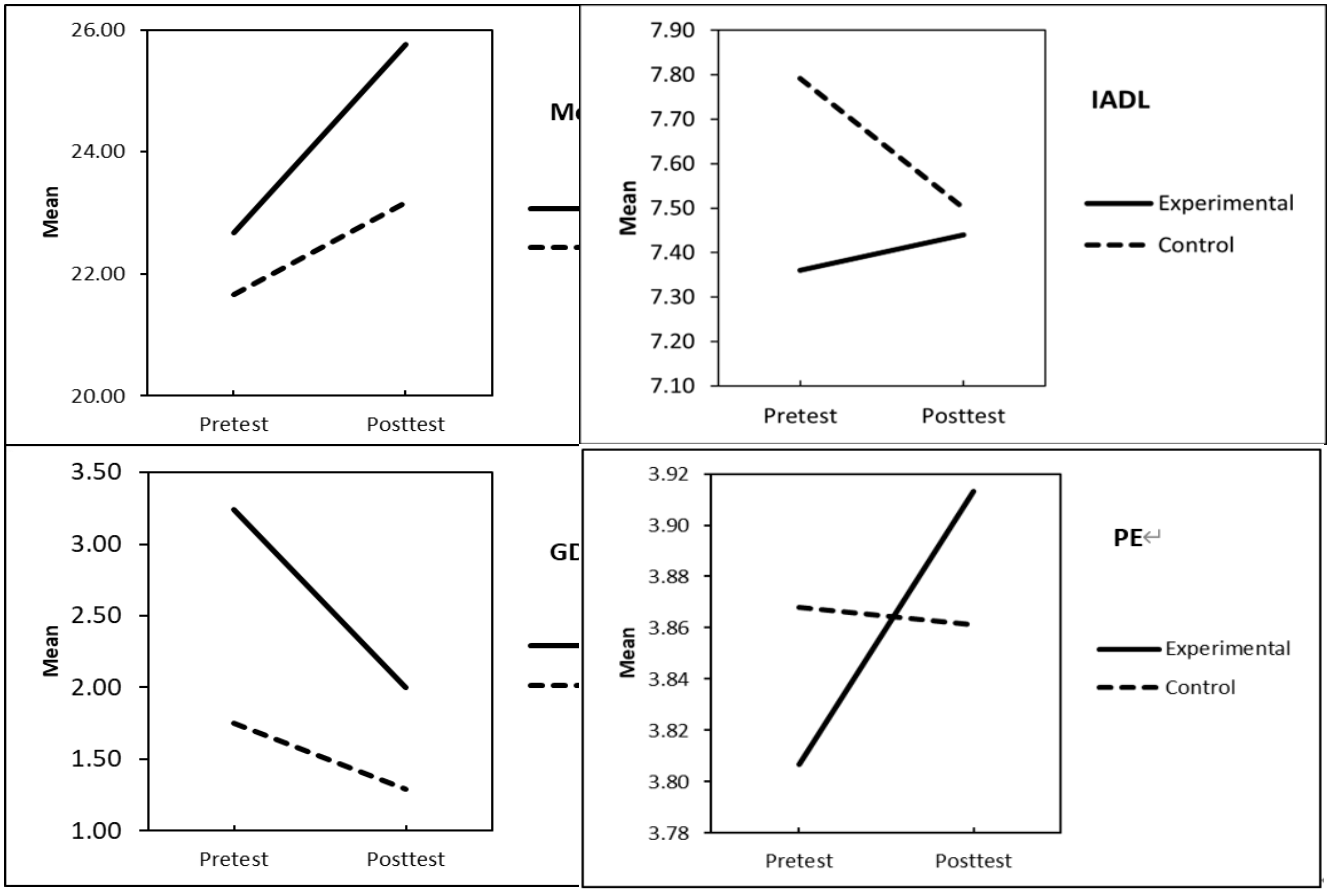

Figure 1. The scores of each task performed by the experimental and control groups from time 1 to time 2.

tion effect between MoCA (cognitive function) and group, indicating that the nostalgic music intervention program had a significant impact on cognitive function in community residents with Mild Cognitive Impairment (MCI). This effect was observed when considering the within-subject factor of time and the between-subject factor of group. However, no significant interaction effects were found for other factors such as depression, positive emotion, and instrumental ability of daily living (IADL). This suggests that the intervention of music combined with five-sense activities may have a stronger influence on cognitive function compared to the other factors. It is consistent with previous studies that have shown the neurological benefits of listening to favorite music and its enhancement of cognitive functions [25] and memory [28]. As shown in (Table 2) the objective of the intervention program was to improve cognitive function, and the results support this objective. The inclusion of other factors in the study aimed to explore potential "side effects" of the intervention, such as improvements in depression, positive emotion, and Instrumental Ability of Daily Living (IADL). However, the non-significant results suggest that the dosage of the intervention may not have been strong enough to observe significant effects in these areas.

CONCLUSION

Listening to nostalgic music and singing songs is popular among elderly individuals in Taiwanese communities. The prevalence of Mild Cognitive Impairment (MCI) is increasing in aging societies worldwide. This study examined the effects of combining nostalgic music with five sensory activities on cognitive function, emotion, and daily function in Taiwanese community residents with mild MCI. The results showed improvements in cognitive function and a reduction in depression in the experimental group. These findings suggest that this intervention can be easily implemented and beneficial for the aging population in Taiwan and beyond. Further innovative research is needed to support these results and expand their application.

FUTURE STUDY AND LIMITATIONS

Future research can explore cost-effective, at-home group settings for self-administered cognitive and emotional stimulation, broadening the reach of the intervention. Longitudinal studies can be conducted to examine long-term changes in participants. Objective tests should be considered to supplement self-report data. The impact of olfactory materials on cognitive function and mood in older adults warrants further investigation. Including IADL-related activities in nostalgic music training programs can provide insights into changes in daily functioning. Active control of the control group's activities would enable a detailed examination of their influence on depression (GDS).

ACKNOWLEDGMENT

This work was supported by grant MOST 110-2410-H-017-011, from the Ministry of Science & Technology, Taiwan

IRB PROTOCOL APPROVAL

This study was reviewed and approved by the National Cheng Kung University Human Research Ethics Committee, approval number (NCKU HREC-E-110-190-2).

AUTHOR CONTRIBUTIONS

Pai-Lin Lee contribute to this article and as the first authorship. Chih-Kun Huang and Hui-Hsiang Chang are co-authors.

FUNDING

This work was supported by grant MOST 110-2410-H-017-011, from Ministry of Science &Technology, Taiwan.

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