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Feature Article

Music therapy intervention in community-dwelling older adults with mild cognitive impairment: A pilot study



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ABSTRACT

The purpose of the pilot study was twofold, seeking to investigate both the feasibility and preliminary effects of a music therapy intervention on the global cognitive state (attention, immediate and delayed memory, and executive function) and gait parameters (gait velocity, cadence, and right and left stride length) in older adults with mild cognitive impairment (MCI). Sixteen participants attended the one-hour music therapy sessions three times a week for 12 weeks. The intervention was feasible, achieving a retention rate of 84%. Significant effects were found in global cognitive state ($p = .001$), attention ($p = .007$), immediate memory ($p < .001$), delayed memory ($p = .001$), executive function ($p = .002$), gait velocity ($p = .021$), right stride length ($p = .007$), and left stride length ($p = .014$). These results suggest that music therapy intervention is a potentially innovative strategy for improving cognition and gait parameters in older adults with MCI.

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Introduction

Mild cognitive impairment (MCI) is a prodromal stage and represents the point between an age-appropriate cognitive state and the early manifestation of dementia.^{1,2} Therefore, older adults with MCI represent a high-risk population, with the annual conversion rate from MCI to dementia of the Alzheimer type estimated at between 10.2% and 33.6%, while this is between 1 and 2% in the general population.^{1,3–5} MCI is associated with gait impairment,^{6,7} with both forms of impairment representing a high fall risk.^{8–12} Further to the early detection of cognitive and gait declines, nurses could help prevent further declines by implementing complementary therapies such as music therapy.

Music acts as a complex stimulus, exerting neurophysiological effects that activate brain structures associated with cognition, motor skills, and the regulation of emotions.^{13–20} Evidence of a music therapy intervention showed increased cerebral blood flow and pre-frontal cortex activity in older adults with cognitive decline, suggesting the development of new neural networks.²¹ Both cerebral blood flow

and pre-frontal cortex activity were related to improved executive function.²¹ Clinical trials of music therapy interventions have improved global cognitive state, memory, and executive function in older adults with dementia.^{22–24}

Music also induces body movement, generating a profound effect on the motor system^{19,20,25} through rhythmic auditory stimulation (RAS) and becoming a rhythmic signal that is translated into a motor response.²⁵ RAS in older adults has been shown to achieve walking improvements, especially in terms of gait velocity, due to increased activity in multiple cortical areas.^{26–28} However, these studies did not report on other gait parameters, such as cadence and stride length, and other relevant variables for gait, such as joint flexibility, which is essential as poor performance is associated with an increased risk of falls and further frailty.^{29,30}

Evidence shows that music therapy has been effective in reducing symptoms of depression in older adults with different neuropathological states.^{31–35} However, the effects of music therapy on the cognitive function of attention, cadence and stride length gait parameters, and joint flexibility are unknown in community-dwelling older adults with MCI.

As the implementation of music therapy interventions is innovative in the Mexican context, pilot studies are required to support the implementation of music therapy interventions as a care strategy for community-dwelling older adults. The purpose of the pilot study was

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twofold, seeking to investigate both the feasibility and preliminary effects of a music therapy intervention on the global cognitive state (attention, immediate and delayed memory, and executive function) and gait parameters (gait velocity, cadence, and right and left stride length) in older adults with MCI. The preliminary effects of such an intervention on both the symptoms of depression and joint flexibility were also explored.

Theoretical framework

The theory of music, mood, and movement (MMM)³⁶ has been used as both a guide in the development of music therapy interventions and to predict the possible outcomes of the intervention, since it is a prescriptive theory. The theory proposes an explanation of the possible relationship between the use of music and psychological and physiological responses and aims to predict health outcomes in different populations and contexts.

The theory of MMM comprises five concepts: music; psychological responses (mood alteration); physiological responses (movement); the initiation and maintenance of physical activity; and, health outcomes. It also takes into account the musical aspect of the participant's cultural context in order to stimulate emotional responses and initiate body movements according to the music's rhythms, melodies, and harmonies, thus creating a sensory experience. It has been tested in countries such as Singapore and the United States in adult populations aged from 40 to 90,^{31,37,38} with these studies reporting a reduction in depression and anxiety and improvements in physical function.

In order to expand the science on music therapy interventions, the present study used MMM to predict the preliminary effects of the following primary outcomes: global cognitive state; attention; immediate and delayed memory; executive function; and, gait parameters (gait velocity, cadence, and right and left stride length). The symptoms of depression (psychological response) and upper and lower body flexibility (physiological response) were the secondary outcomes of this music therapy intervention.

Material and methods

Design

The present study used a single-group pretest-posttest design to explore the preliminary effects and feasibility of a music-with-movement intervention.

Sample

Sixteen older adults aged 60 and over were recruited at a senior center located in the northeast of Mexico. The participants met the following inclusion criteria: a) MCI identified via Montreal Cognitive Assessment (MoCA); b) being able to walk safely; and, c) a low level of physical activity assessed by means of a physical activity questionnaire.³⁹ Older adults with visual impairment and those with hearing problems who did not use hearing aids were excluded.

Afterward, flyers were used for recruitment; thirty-six potential participants expressed interest in the study. The screening process identified that 14 older adults did not meet the inclusion criteria. Another three declined to participate, arguing that they did not have enough time ($n = 1$) or were not interested in music therapy activities, and that they would prefer to learn to play an instrument, such as the guitar ($n = 2$). Therefore, in total, 17 participants were excluded. Nineteen participants gave their consent and then starting the music therapy intervention. Three participants dropped out of the intervention

between weeks three and six, due to health problems ($n = 2$) and family situations.

The study was approved by the Ethical and Research Committees of a university in the northeast of Mexico. Participants who met the inclusion criteria received an explanation about the intervention sessions (duration, activities, measurements, and responsibilities) and their questions answered by the Principal Investigator (PI) before signing the written informed consent form.

Music-with-movement intervention

Music-with-movement interventions are eclectic, given that they are based on a theoretical knowledge of nursing, knowledge of the cognitive processes involved, and the resources set out in the music teaching methodologies proposed by Zoltan Kodály, Dalcroze, Orff and Tort.

The intervention sessions were held for one hour, three times per week for 12 weeks, and comprised activities based on the expression of rhythm, melody, harmony and qualities of sound (timbre, intensity and height) through body movements. These activities stimulate the cognitive, physical, and social abilities of older adults. The participants' musical preferences were taken into account in the design and implementation of the intervention.

The order of the activities undertaken by the participants was as follows: 1) the coordinated movement of hands and feet and exercises involving walking in time with rhythmic schemes; 2) the reading of rhythmic patterns via body percussion; 3) listening to music while undertaking activities such as musical bingo (guessing the name of the song and then identifying it on a bingo card) or the identification of sounds and instruments; 4) listening to music and following the rhythm with coordinated movements while holding a glass in their hands; 5) playing instruments (maracas, tambourine, or guiro) to the rhythm of songs from Mexican folklore; and, 6) singing. The activities increased in complexity week by week.

Chlan and Heiderscheit recommend that collaborative research be undertaken using an interdisciplinary approach involving both nurses and a music therapist.⁴⁰ However, the sessions in the present study were delivered by five music professors with experience in music education, as there were no music therapists available at the time in the northeast of Mexico.

Data collection procedures

The older adults who indicated a verbal interest in the study were screened based on the inclusion criteria. Those who met the inclusion criteria were given a verbal explanation by the PI about the music therapy intervention. Data collection was scheduled according to the participants' availability and conducted prior to starting the intervention and after the 12th week. The measurement procedures were applied during two different appointments, one for the global cognitive state, attention, immediate memory, delayed memory, executive function, symptoms of depression, and upper and lower body flexibility, and one for the gait parameters. The time required for the data collection was between 60 and 75 min.

Measurements

The participants' sociodemographic data, medical history, and musical preferences were collected during the screening phase. The data collection sheets were developed by the PI, based on the literature review,^{41–43} for recording the feasibility information (attendance records, records detailing the perceived utility of the intervention, the fulfillment of expectations, and reasons for participating).

Intervention delivery fidelity was verified by video recording the sessions, with a researcher present during all sessions and using checklists to register the fulfillment of the objectives and the details of the activities completed per session. Weekly meetings were held with the music professors overseeing the sessions in order to identify possible barriers that could affect attendance. To monitor the participants' engagement with the intervention, daily session attendance was recorded, and their performance in the activities documented. To monitor the delivery of the intervention, the participants' perceptions and weekly feedback were also recorded.

The MoCA was applied as a screening test for MCI and to evaluate the effects of the music therapy intervention on the participants' global cognitive state. The MoCA uses cognitive functions to assess global cognitive state and comprises 32 items distributed across the following subscales of cognitive function: visuospatial / executive (5 items); naming (3 items); attention (4 items); language (3 items); abstraction (2 items); delayed recall (5 items); and, orientation (6 items). The total score ranged from 0–30 points. Given the low number of years of schooling in older Mexican adults, the cutoff scores to determine MCI were as follows: a) < 5 years of schooling – 16 to 20 points; b) 5–10 years of schooling – 21 to 22 points; and, c) ≥ 11 years of schooling – 23 to 24 points.⁴⁴

Attention was evaluated by the digit span subtest (backward and forward) of the Wechsler Intelligence Scale; the score was based on the number of digits that each participant repeated correctly and a higher score indicating a higher level of attention (range 0–17). The Spanish version of the digit span subtest has shown an acceptable level of internal consistency in older adults.⁴⁵

Immediate memory and delayed memory were evaluated using the Texts I and Texts II tests, respectively, from the Wechsler Memory Scale. Both Texts I and texts II comprising of text A y B. For the Text I subtests, the PI read Text A to each participant, after that, the participant was asked to repeat all the information that she/he could remember. Text B was completed in the same manner. The Text II tests were applied 30–35 min after the application of Text I, wherein the PI asked the participant to remember both Text A and Text B. The score was calculated as the sum of each item of texts, with higher scores indicating a greater memory capacity (range 0–75). Both tests have shown an acceptable reliability coefficient.⁴⁶

The executive function was measured by Frontal Assessment Battery (FAB), which comprised six subscales: similarities; lexical fluency (mental flexibility); motor series (Luria test); conflicting instructions; go/no-go (inhibitory control); and, prehension behavior (environmental autonomy). The PI read each subscale text aloud and waited for the participant's response. Lower scores were an indication of executive function impairment (range 0–18). The Spanish version of the FAB showed an adequate internal consistency in patients with Parkinson's disease.⁴⁷

Symptoms of depression were measured by the Depression Questionnaire (DQ) of the Mexican National Study on Health and Aging 2001 developed by researchers from the universities of Pennsylvania, Wisconsin and Maryland in collaboration with staff from the Mexican National Institute of Statistics, Geography, and Informatics; and was validated in the Mexican population with an adequate internal consistency.⁴⁸ The DQ was used to measure symptoms of depression (restlessness, unhappiness, loneliness, anhedonia, sadness, fatigue, and lack of energy) during the last week.⁴⁸ The DQ comprises nine items (range 0–9), with a score equal to or greater than five indicating the presence of the symptoms of depression.

Gait velocity patterns (centimeters per second), cadence (steps per minute) and right and left stride length (in centimeters) were evaluated with the GAITRite® system. Gait pattern data were obtained by asking each participant to walk through an electronic walkway, with the data obtained automatically entered into a specialized computer software.

Lower and upper body flexibility were evaluated using the Sit and Reach and Back Scratch tests,⁴⁹ respectively. The scores were registered on specific data collection sheets. The lower body flexibility score was obtained from the distance in centimeters between the tips of the participant's middle fingers and the tips of his/her toes when their body was leaned forward. The upper body flexibility score was the distance in centimeters between the tips of the middle fingers of both of the participant's hands when bringing his/her arms to the middle of their back, with one hand on the top of the back and the other hand on the lower part of the back.

Scores obtained in the Sit and Reach, and Back Scratch tests were recorded as zero if the participant was able to touch the tips of their toes or fingers. If the fingers exceeded the tips, the score was reported positively (+2 cm), while if they did not manage to touch the tips at all, the distance was recorded negatively (–1 cm).

Data analysis

Data analysis was performed using the Statistical Package for the Social Sciences, version 21. Demographic data (age, gender, marital status, years of schooling, and medical history), participation rates (number of older adults who met the inclusion criteria, number of older adults recruited, number of older adults that refuse to participate, and number of older adults who withdrew from the intervention) and attendance were analyzed using descriptive statistics (mean, standard deviation and percentages).

The data were checked for normality with the Kolmogorov-Smirnov test. The paired *t*-test and Wilcoxon signed-rank tests were applied to identify significant changes between the pretest and posttest results ($p \leq .05$ values were considered statistically significant). To further explore variables affecting the results linear regression models were run, introducing the posttest scores of the global cognitive state, gait velocity, cadence, and right and left stride length as dependent variable and age, years of schooling and the pretest scores (global cognitive state, gait velocity, cadence, and right and left stride length) were the independent variables.

Results

The participants' mean age was 71.25 (SD = 4.56), while the mean number of years of schooling was 10.06 (SD = 2.83). The 87.5% were women ($n = 14$) and 56.3% were widows/widowers ($n = 9$). Participants reported a history of hypertension ($n = 5$), diabetes ($n = 1$), osteopenia ($n = 3$), arthritis ($n = 1$) and osteoarthritis ($n = 1$).

Feasibility

The instructors completed a total of 36 sessions, three per week for one hour per day. The objectives and activities for each session were fulfilled according to the intervention manual. During the sessions, the participants were able to perform all the activities. No adverse events occurred. At the end of the study, the program was then incorporated into the senior center's program. The participants registered 90% attendance; the average attendance was 32.50 sessions (SD=1.41). The most common reasons for non-attendance were doctor's appointments and personal situations, such as family visits or vacations. Retention and attrition rates were 84% ($n = 16$) and 16% ($n = 3$), respectively.

Concerning the participants' perceptions, they stated that the music therapy intervention activities were both excellent and beneficial for their health. Fourteen participants described the music therapy intervention as meeting their expectations, while the reasons for participating in the sessions were: performing a different activity ($n = 16$); learning something new ($n = 15$); socializing and gathering

in a group with other people ($n = 10$); and, changing their daily routine ($n = 5$).

The participants also expressed their opinion about the duration of each session and the frequency of the sessions per week. Eleven participants suggested increasing the length of each session, while five considered that one hour per session was enough. Nine participants felt that three times per week was enough, and seven would have liked to attend five days per week. All the participants stated that the instructors' attitude was excellent and that they were very patient with them.

Preliminary effects

Significant increases were found between the participants' pretest and posttest scores (see Tables 1 and 2) for global cognitive state ($p = .001$), attention ($p = .007$), immediate memory ($p < .001$), delayed memory ($p = .001$), executive function ($p = .002$), gait velocity ($p = .021$), right stride length ($p = .007$) and left stride length ($p = .014$). Moreover, pretest and posttest scores for depression symptoms ($p = .007$) and lower body flexibility (right side) ($p = .042$) significantly decreased (see Tables 1 and 2).

A linear regression model with age and years of schooling revealed significant results for the global cognitive state ($F = 8.833$, $p = .004$), suggesting that 47.31% of the variance in the global cognitive state posttest scores was explained by the years of schooling ($p = .020$) rather than the pretest measurements. Gait velocity, cadence, and right and left stride length models were not significant.

Discussion

The intervention was feasible for implementation in a senior center, with the participants attending 90% of the sessions, while a high retention rate was achieved, and no adverse events were reported. Preliminary results suggest improvements in the participants' ability to concentrate (attention) and retain and remember information in both the short and long-term (immediate and delayed memory), as well as the ability to organize, plan and execute actions (executive function).

Gait parameter improvements are not often reported as outcomes in music therapy interventions in older adults with cognitive decline. The present study found preliminary effects in two gait parameters, gait velocity, and stride length, with higher scores at the end of the music therapy intervention. These results suggest that the participants were able to walk faster and that the distance between the heel touches (step) of their right and left feet increased as a result of the music therapy.

The participants' symptoms of depression decreased, and their lower body flexibility (right side) scores improved, wherein the distance between the fingers of the participants' right hand and the toes of their right foot was shorter when tilting their bodies forward. Results of depression symptoms have been confirmed in previous studies,^{23,31} but there is no evidence reported about the effect of music therapy on flexibility.

Table 1

Outcomes without normal distribution.

| Outcome | Pretest Mdn | Posttest Mdn | z | p |
|-------------------------------------|----------------|-----------------|---------------------|------|
| Global cognitive state | 21.00 | 23.00 | -3.23 ^b | .001 |
| Attention | 8.00 | 10.00 | -2.70 ^b | .007 |
| Executive function | 12.50 | 15.00 | -3.13 ^b | .002 |
| Gait velocity | 79.40 | 95.30 | -2.30 ^b | .021 |
| Depression symptoms | 2.50 | 0.00 | -2.67 ^c | .007 |
| Lower body flexibility (right side) | -10.50 | -9.50 | -2.032 ^b | .042 |

Mdn = Median; b = based on negative ranking; c = based on positive ranking.

Table 2

Outcomes with normal distribution.

| Outcome | Pretest | | Posttest | | t | p |
|------------------------------------|---------|-------|----------|-------|--------|------|
| | M | SD | M | SD | | |
| Immediate memory | 22.56 | 7.04 | 38.81 | 10.50 | -5.524 | .000 |
| Delayed memory | 12.88 | 3.96 | 21.00 | 7.24 | -4.159 | .001 |
| Right stride length | 109.30 | 17.30 | 120.05 | 15.48 | -3.091 | .007 |
| Left stride length | 110.20 | 17.13 | 120.16 | 15.04 | -2.791 | .014 |
| Cadence | 100.36 | 16.00 | 104.10 | 9.86 | -1.320 | .207 |
| Upper body flexibility (right arm) | -15.13 | 11.78 | -15.44 | 12.42 | .335 | .743 |
| Upper body flexibility (left arm) | -19.94 | 10.50 | -20.69 | 10.40 | 1.51 | .151 |
| Lower body flexibility (left side) | -9.50 | 7.25 | -9.44 | 7.64 | -0.128 | .900 |

M = Mean; SD = Standard deviation.

The effects in terms of cognition, gait parameters, depression symptoms, and flexibility can be attributed to the fact that music acts as a stimulus for cognitive, affective and sensorimotor processes by acting on the brain structures associated with cognitive, emotional and motor responses.^{18,50,51} The music therapy activities included rhythmic movements and coordination with music, which could result in the activation of multiple superior cognitive functions and regions that associate sounds with motor activity, thus achieving an adequate synchronization between movement and music.^{52–55}

In our study, the number of years of schooling was found to influence the participants' global cognitive state. Evidence suggests that a low educational level is a risk factor for cognitive impairment in Mexican and Mexican American older adults.^{56–58} A study conducted in Mexican older adults showed that a low educational level is a predictor of conversion to dementia in older adults with MCI.⁵⁹ For these reasons, the number of years of schooling should be acknowledged and control in cognitive studies.

Some social benefits for participants were also identified. The sessions became a positive event in which the participants shared pleasant moments, joked with each other, danced, provided transportation to those without a car, attended concerts both together and with their families, created social networks, and established friendship bonds that continued after the intervention had concluded. Studies on the use of music therapy in older adults have reported social benefits, such as social inclusion and support, a positive impact on relationships,⁶⁰ the motivation to join a group activity, and sharing and connecting with other older adults.⁶¹

Conclusion

Music therapy intervention was feasible for implementation in a senior center, with beneficial effects on cognitive function, gait velocity, stride length, depression symptoms, and lower body flexibility. These results suggest that music therapy interventions are a potentially innovative strategy for treating older adults with MCI. Nevertheless, studies on music therapy interventions with larger sample sizes are needed to gather further evidence of the social, mental, and physical benefits of this approach for older adults with MCI.

Declarations of interest

None.

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Supplementary materials

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