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Pilot testing of Dual-task Zumba Gold (DTZ) for community-dwelling people with mild cognitive impairment: A mixed-methods study

Highlights:

1. Integrating mental tasks with Zumba Gold is a novel program for older people.
2. Dual-task Zumba Gold (DTZ) is feasible for people with mild cognitive impairment.
3. DTZ is safe and could be implemented by trained instructors in the communities.
4. DTZ may enhance the cognition of people with mild cognitive impairment.

Pilot testing of Dual-task Zumba Gold (DTZ) for community-dwelling people with mild cognitive impairment: A mixed-methods study

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Abstract

Dual-tasking (e.g., enrichment of physical activities with mental exercises) is an innovative strategy to enhance older adults' cognition. Meanwhile, Zumba is a popular dance program, but research is limited about its utility on older people or those with mild cognitive impairment (MCI). This study assessed the feasibility of a new intervention called dual-task Zumba Gold (DTZ) for people with MCI. A mixed-methods feasibility study involving ten people aged ≥55 years with MCI was conducted from December 2020 to March 2021. Nine participants completed the study (90%) with high intervention acceptability. Program adherence (90.3%) and implementation fidelity (92.2%) were high. Participants also expressed the program's benefits, challenges, and facilitators. Moreover, pilot test results suggested improvements in global cognition (Z=-2.680; p=0.007), quality of life (Z=-2.688; p=0.008), and mobility (Z=-2.333; p=0.020). Hence, DTZ is feasible and acceptable for people with MCI, offering potential multidomain effects. Future randomized controlled studies should confirm these outcomes.

Keywords: *aerobic dance; dual-task; mild cognitive impairment; Zumba Gold*

Abbreviations: DTZ – Dual-task Zumba Gold; MCI – Mild cognitive impairment

Introduction

Mild cognitive impairment (MCI) is characterized by objective cognitive deficits beyond the expected age-related changes, with maintained daily functioning abilities.[1] As MCI increases the likelihood of irreversible cognitive decline,[2] affected individuals are suitable targets of dementia risk reduction. However, there is inadequate information about strategies to improve cognitive health in low- and middle-income countries (LMICs), despite the higher aging population and dementia cases in these regions.[3] With the limited evidence on the efficacy of pharmacological interventions for MCI, employing community-based cognitive health promotion programs is crucial.

Dancing is a common recreational activity among middle-aged and older adults, which could provide physical and psychological benefits.[4,5] Meanwhile, a 2003 study involving 469 older adults found that dancing was associated with a 76% reduction in dementia risk than walking.[6] Dancing could stimulate memory, perception, coordination, and social interaction, which are essential in maintaining cognition.[7] Hence, recent studies noted that dancing could promote better cognitive performance and larger increases in brain volume/neuroplasticity markers versus repetitive exercises.[8] Systematic reviews also indicated that ballroom and aerobic-based dance programs could significantly improve the cognition of older adults, including those with MCI.[7-9]

Zumba is a Latin-based program that combines aerobic exercise components with various dance elements, such as merengue, salsa, reggaeton, and contemporary rhythms.[10] Zumba is also popular in several regions, particularly in LMICs like the Philippines, which has the world record of the largest Zumba class.[11] For younger adults, Zumba was found to improve aerobic capacity, neuromuscular strength, and body composition.[10,12,13] However, as the intensity and pacing of regular Zumba dance are not suitable for older adults or people with disabilities, modifications in the program were made. Zumba Gold is the adapted version for

people aged 50 years and older, which involves simpler choreography and lower impact routines to promote a moderate-intensity activity.[14] However, literature has limited information about the feasibility and safety of Zumba Gold on various groups, with a few small-scale studies conducted on older adults,[15] Parkinson's disease,[16] and hemodialysis patients.[17] Currently, the utility and potential effects of Zumba Gold on the aging population, particularly on people with MCI, are not fully explored. With the popularity of Zumba dancing across several countries, exploring its feasibility in community settings would be vital in promoting integrated health approaches for older people.

The simultaneous performance of physical activities and mental exercises, known as dual-task training, provides significant cognitive outcomes for older adults.[18,19] Dual-task training also has superior cognitive benefits on older people compared to single interventions (either motor exercise or mental training).[19,20] In particular, this approach could benefit people with cognitive impairment by involving multiple processes to reinforce brain function.[20] Previous dual-task interventions on MCI patients involved routines such as asking participants to step into an agility ladder while playing word/memory games[21,22] or ride a training bicycle while answering language/arithmetic questions.[23] Another strategy was exergames (i.e., playing digital games that require bodily movements), which utilized virtual reality training[24] or commercial videogame consoles.[25] While these approaches enhanced older adults' cognitive outcomes, they required combinations of complex routines and sophisticated equipment, which may have limited utility in low-resource settings. There is a need for inexpensive approaches to facilitate physical and cognitive training on community-dwelling older people, especially those with MCI.

While moving with music could stimulate multisensory processes, the cognitive load of aerobic dancing might not be adequate to produce similar benefits with traditionally partnered dances[26] or superior outcomes than conventional exercises.[27] According to the

literature, sufficient mental challenge in physical activity is crucial to promote significant cognitive benefits.[18,28] Several studies also found that increasing the doses of mental tasks in complex motor activities could yield better cognitive outcomes. For example, having higher/interactive mental challenges in exergaming provided more improvements in older adults' executive functions than low-dose or normal conditions.[29] Tai chi, a mind-body exercise, also offered better cognitive benefits in older people when Sudoku challenges were added.[30] Thus, incorporating cognitive tasks with the age-appropriate Zumba Gold dance could be an innovative dual-tasking strategy that may benefit individuals with MCI. However, no study has been conducted yet about this potential intervention for people with cognitive decline.

Notably, the increasing incidence of dementia and declining physical performance among people 50 years or older[31,32] warrant the involvement of these groups in cognitive health promotion programs. Evidence also showed that the reversion of MCI to normal cognition is higher among individuals <65 years than those in late age (≥65 years).[33,34] With the potential to alter the trajectory of irreversible cognitive decline, early detection and management of MCI are crucial in dementia prevention strategies.

The authors developed a novel program known as dual-task Zumba Gold (DTZ), which combined mental exercises with aerobic dancing to enhance the cognitive functioning of people with MCI. To the best of our knowledge, this is the first pilot investigation of a dance-based dual-tasking approach for people with MCI. The present study could identify the feasibility of this new dual-tasking program and contribute salient knowledge towards cognitive health promotion strategies among people with dementia risk.

Aims and hypothesis

This study investigated the feasibility and acceptability of dual-task Zumba Gold (DTZ) among community-dwelling people with MCI, aiming to: (1) determine participant recruitment

and retention, intervention adherence, implementation fidelity, and safety; (2) assess intervention acceptability based on the participants' satisfaction and program perceptions; (3) identify preliminary efficacy of the intervention on cognitive, psychological, and physical health. For the clinical outcomes, it was hypothesized that at post-implementation of the DTZ, there would be significant improvements in the participants' global cognition, quality of life, and functional mobility.

Material and methods

Study design

This single-arm, mixed-methods feasibility study involved a sample of people with MCI from a community site in Bulacan, Philippines. We conducted this feasibility study before the pilot randomized controlled trial registered at Clinicaltrials.gov (NCT04788238). A feasibility study aims to identify crucial parameters for the main research, especially when introducing new interventions. Moreover, this design could provide important information about participant recruitment, program delivery, and intervention acceptability to target users.[35] For a comprehensive picture, we employed both quantitative and qualitative approaches in data collection. Quantitative methods provided information about the recruitment and retention rates, implementation fidelity, adherence, and acceptability. Meanwhile, post-intervention qualitative interviews offered richer details about the participants' program perceptions.

Participants

We utilized purposive sampling to recruit the study participants through the assistance of a local government health office (Plaridel, Bulacan province) that provides medical services to all community residents. The inclusion criteria were: (1) aged 55 to 80 years old; (2) screened for MCI according to Petersen[36] criteria – with subjective concern/report of cognitive changes and show objective cognitive impairment (i.e., Montreal Cognitive Assessment (MoCA) score

of ≤25[37,38]; (3) independent performance of activities of daily living (ADL), confirmed by the Katz[39] ADL scale; and (4) no dementia diagnosis. Furthermore, individuals who understood the Filipino language and did not require ambulatory devices were included. Meanwhile, the exclusion criteria were: (1) medical diagnosis of any mental/psychiatric disorder; (2) uncontrolled cardiovascular condition, severe musculoskeletal impairment, gross hearing/visual impairment, or any condition that would limit study safety; (3) participation in any structured group exercise program for the past three months; and (4) intake of medications such as antidepressants, sedatives, or antiepileptics that may affect cognition. Antidepressant use was excluded as its association with older people's cognition is inconclusive, with some studies suggesting negative effects[40,41] and others implying protective outcomes.[42,43]

We recruited participants from a selected village in the municipality with around 400 – 500 older residents, a satellite health clinic, and an outdoor community gymnasium. The local health staff gave a list of potentially eligible participants, who were contacted via phone to introduce the study and arrange a meeting for its detailed explanation. We then provided an information sheet to the prospective participants and discussed the relevant study details. After securing their informed consent, individuals were screened for eligibility. A total of 33 people were invited, and 25 of them consented to the initial assessment. For this feasibility study, we recruited a sample of 10 people with MCI. The group size was guided by previous dance interventions implemented on people with MCI and existing government regulations regarding the maximum number of people for mass gatherings due to COVID-19.[44-46]

Interventions

The authors developed the intervention following the Medical Research Council (MRC) guidelines.[47] First, we performed a literature review to integrate the current evidence about aerobic dancing[7,9,44,45,48,49] and dual-tasking for people with MCI.[18,19, 21-25,50-53] Moreover,

two experts (one from physiotherapy and one from gerontological nursing) provided inputs for the delivery strategies (e.g., participant cuing, safety considerations in dual-tasking), which were incorporated in the protocol. This was followed by a qualitative study using focus group interviews with 44 community-dwelling older adults to explore their perceptions/concerns about the proposed intervention. The process enabled further refinement of the protocol (e.g., pre-implementation session, adaptation of physical and mental tasks). Prior to implementation, four experts from physiotherapy, neurology, cardiology, and gerontological nursing reviewed the intervention protocol. They provided positive feedback about the program and advised no further changes. Table 1 details the intervention components supported by relevant literature.

Insert Table 1 here

Dual-task Zumba Gold is a 12-week program (3 times/week on non-consecutive days for 60 minutes) implemented from December 2020 to March 2021. Table 2 shows the intervention protocol. Specifically, Zumba Gold dance routines (i.e., reggaeton, cumbia, salsa, batchata, and balance sequences) were incorporated with cognitive exercises involving the domains of executive function, perceptual-motor ability, memory, and complex attention. An experienced and professional Zumba Gold instructor trained by the first author (also a licensed Zumba facilitator) implemented the sessions at the covered outdoor community gymnasium. The venue is located at the center of the community, accessible to the participants within a 5- to 10-minute walk or pedicab ride (tricycle for hire). Apart from the instructor, two trained project assistants also conducted safety monitoring and collected the participants' feedback in the classes. One week before the actual implementation, we conducted an orientation and practice training to enable the participants to adjust to the program's novel approach. Specifically, the instructor explained the program features and demonstrated the basic movements with mental tasks while the project assistants guided the participants.

Insert Table 2 here

The session began with a 10-minute warm-up integrated with attention training by asking orientation questions about time, place, and person. This was followed by Zumba Gold dancing for 40 minutes, incorporated with the following cognitive tasks: executive function (serial counting in forward and backward manner); perceptual-motor ability (performing arm clock positions based on instructions); memory (forward and backward repetition of number/word series); and complex attention (spelling words forward and backward). Executive functions were further involved in reverse counting, repetition, and spelling.[52] Moreover, mental flexibility and working memory were needed to coordinate the physical and cognitive tasks.[52,53] The DTZ session ended with a 10-minute cool-down, which incorporated memory training by reminding the participants to summarize the activities accomplished.

The instructor used verbal instructions and projected visual prompts via PowerPoint slides to cue the participants in performing the cognitive exercises during the dance sessions. After each dual-task was done as a group, individual participation was facilitated by having the tasks move from one person to another or pointing out members to carry out the activities. This was done by pre-assigning an identification number (e.g., 1–10) to each participant. When the instructor mentioned a specific number, the participant individually performed the mental exercise while dancing, and the project assistants confirmed their task execution. Participants executed the dual-tasking when they were stepping in place or not moving around to ensure safety. They were also instructed to identify their rate of perceived exertion (RPE) from 0 to 10 during the sessions to maintain the activity up to moderate intensity (should be rated as 5 to 6 out of 10).[54] For individual considerations, participants were provided the option to sit on a chair or perform the dance in place instead of moving in several directions. Rest periods were also offered during the session as necessary.

New movement sequences and additional cognitive tasks were gradually introduced every four weeks to promote adjustment and continuous mental stimulation. This included

increasing intervals of serial counting (from ones to threes); adding instructional arm steps (3- to 5-arm clock positions); repeating number/word series in gradual length (3- to 5-series); and spelling short then long words (3- to 5-letters).

Vital signs were monitored before and after the DTZ sessions. Participants were also provided with light refreshments to prevent dehydration and allowance for travel expenses to and from the venue. The venue for the DTZ sessions had adequate shading, open ventilation, and sufficient space to accommodate the participants while keeping them one to two meters apart.

Ethical considerations

Study approval was secured from the two research ethics committees (*Blinded for peer review*). Participation in the study was purely voluntary, and people who declined were not disadvantaged for community services. Trained research personnel provided complete study details to eligible individuals to obtain informed consent before screening and participation.

Outcome measures

Feasibility outcomes

Feasibility was assessed through participant recruitment, retention, adherence rate, report of adverse events, and implementation fidelity.[35] Recruitment rate referred to the proportion of eligible participants who agreed to join the study. Retention rate pertained to the number of participants who completed the 12-week program, while adherence rate indicated the percentage of actual sessions they attended. Safety assessment included identifying any adverse event (e.g., falls, dizziness, chest pain, physical injury, persistent blood pressure elevation) during and after the class while the participants rested.

To assess consistency in delivering the new intervention, we utilized a fidelity checklist from the DTZ protocol (Appendix A). The sessions were videotaped, and one recording per week was randomly chosen for fidelity assessment. The first author and an independent

research assistant then rated the sessions with corresponding scores based on three options: done (2 points), done to some extent (1 point), and not done (0 point).[55] Implementation fidelity percentage was computed by dividing the total ratings from the highest possible score in intervention delivery. According to current guidelines, a fidelity rate of >80–90% is considered acceptable.[56]

Meanwhile, program acceptability was assessed via the 4-item Acceptability of the Intervention Measure (AIM).[57] Participants answered this tool on a 5-point Likert scale (1=completely disagree; 5=completely agree). Higher AIM scores indicated better intervention acceptability.

Preliminary health outcomes

To identify the potential effects of this new intervention and facilitate formal outcome assessment in a future study, we conducted a preliminary evaluation of the changes in the participants' health outcomes immediately after the DTZ program. These included measures of global cognition, quality of life, and functional mobility.

Global cognition. The local and validated versions of MoCA and Mini-Mental State Examination (MMSE) were used. MoCA is recommended for MCI screening (sensitivity: 90% & specificity: 87% at cutoff score of <26),[37,38] while MMSE is indicated for general cognitive assessment (sensitivity: 85% & specificity: 86% at cutoff score of ≤23 for MCI).[59,60] These tools evaluate multiple cognitive domains, including attention, orientation, concentration, language, memory, executive functions, and visuospatial skills. The scores for each tool ranged from 0 to 30, with higher numbers indicating better cognitive function.

Quality of life. The 14-item Perceived Well-Being (PWB) Scale was utilized to assess the participants' quality of life in the physical and psychological domains.[60] PWB was answered on a 7-point Likert scale (1=strongly disagree; 7=strongly agree), with higher scores referring

to increased perceptions of well-being. Its local version was utilized among Filipino community-dwelling older adults,[61] with high internal consistency (Armor's θ=0.91) and validity.

Functional mobility. The Short Physical Performance Battery (SPPB)[62] measured the participants' performance on three tasks (standing balance, gait speed, and rising from a chair), deriving a score from 0–12 to denote physical function. SPPB is recommended for evaluating functional mobility of older adults in community settings,[63] having superior measurement properties and minimal equipment requirements.

Qualitative data/intervention evaluation

We conducted focus group discussions on all participants (two groups with 4-5 members each) one week after the last DTZ session to explore the participants' perceptions about the program, including its strengths and limitations. Two research assistants who were not involved in the treatment administration facilitated the interviews through a semi-structured guide (Appendix B). Sample questions included: 'How was your experience attending the DTZ sessions?' and 'What did you like or dislike about the DTZ activity?' The interviews had an average of 60 minutes and ended when no new information was discovered. We recorded these interviews with the participants' permission and transcribed them for further analysis.

Data analysis

For the quantitative data analysis, IBM SPSS version 25.0 (Armonk, NY: IBM Corp) was employed. Descriptive statistics, including frequency and percentage, were used to analyze the demographic information, recruitment, retention, adherence, fidelity, and intervention acceptability. Median, range, mean, and standard deviation were used to summarize the clinical outcome results. Given the small sample size, we used the Wilcoxon signed-rank test, a nonparametric analytical approach, to determine preliminary changes in the participants' health

outcomes from baseline to post-intervention period. A p <0.05 was considered statistically significant. We then calculated the effect size using the formula: r = Z/$\sqrt{}$N, with results classified as small (≥0.1), moderate (≥0.3), or large (≥0.5).[64]

To facilitate the qualitative analysis, we transcribed the audio-recorded interviews verbatim. Conventional content analysis was used to analyze the data, using an inductive approach to understand the participants' unique perspectives about the DTZ program.[65] Particularly, two research team members (*** & ***) performed open coding of the significant statements from the transcripts. Generated codes were then grouped into sub-categories and condensed further into categories. Their initial findings were compared and contrasted, followed by a group discussion to establish the final results. In the process of data analysis, data saturation was observed. This refers to the situation in which participants' responses to a particular topic were similar, and no new codes/categories emerged from the iterative data analysis.[66] The team also sought the participants' feedback about the findings to ensure that their meanings were appropriately described. Representative quotations were reported to help readers link the data with the results and assess transferability to other settings.

Results

Sample characteristics

Participants were aged 57 to 73 years old (M = 64.6; SD = 5.7). Most of them were females (70%) and married (60%). Half of the participants had a secondary level of education and reported having physical activity fewer than three times per week (Table 3).

Insert Table 3 here

Feasibility outcomes

Participant recruitment and retention

Out of the 25 people initially screened for eligibility, 16 were identified to have MCI. Of these, four declined to participate due to unavailability for the planned sessions, while the other two had underlying medical conditions that might hinder study participation. The overall recruitment rate was 62.50% (10/16). One participant withdrew from the study after two sessions due to the inability to commit to the program schedule. The other nine participants completed the intervention and post-study assessments. Thus, the retention rate was 90% (9/10). Figure 1 shows the study participant flow.

Insert Figure 1 here

Intervention adherence, fidelity, and acceptability

Participants had a mean adherence rate of 90.3%, with the attendance rate ranging from 80.6% to 100.0% for the 36-session DTZ program. The classes were noted to have acceptable implementation fidelity at 92.17%, with values ranging from 90.32% to 96.48%. Meanwhile, the AIM scale had high internal consistency (Cronbach's α=0.85). Participants had a mean intervention acceptability of 4.58 (SD=0.52) (maximum score of 5.0).

Intervention safety

No adverse events, such as falls, dizziness, injury, severe difficulty breathing, or chest pain, were reported during and after the sessions. All participants chose to perform the movements while standing instead of being seated. The participants' average RPE was 5.4 (SD=0.30), indicative of moderate-intensity activity. Meanwhile, no persistently elevated blood pressure measurements (e.g., systolic BP>140, diastolic BP>90) were noted on the participants post-session. Participants had a mean systolic BP of 128.1 (SD=5.64) and diastolic BP of 80.8 (SD=8.03) after the class.

Preliminary analysis of health outcomes

Results showed preliminary changes in the participants' cognitive outcomes from baseline to the post-intervention period. Significant improvements and large effect sizes were found in measures of global cognition, which included MoCA (Z = -2.268; p = 0.007; r = 0.89) and MMSE (Z = -2.687; p = 0.007; r = 0.90). There were also positive changes in the participants' quality of life (Z = -2.688; p = 0.008; r = 0.89). While functional mobility improved after the intervention (Z = -2.714; p = 0.007; r = 0.78), significant changes were only noted in balance ability (Z = -2.000; p = 0.046; r = 0.67) and not on the other domains (i.e., gait speed and chair rise) (Table 4).

Insert Table 4 here

Qualitative findings

Three categories were identified to summarize the participants' perceptions about the dual-task Zumba Gold program, namely: (1) beneficial impacts of DTZ, (2) challenges in dual-tasking performance, and (3) facilitators of DTZ participation.

Beneficial impacts of dual-task Zumba Gold

Participants noted several outcomes from the DTZ program, including physical, psychosocial, and cognitive benefits. They also expressed that the program motivated them to integrate dual-tasking into their daily lives, which increased their confidence in learning new skills. Particularly, they reported improvements in health-related well-being, as participation in the program enhanced their feelings of vitality.

I feel healthier... I don't get easily tired now, unlike before when I was inactive. After I joined this program, I felt livelier. (Focus group 1, Participant 3)

Others mentioned positive changes in emotional well-being, as their participation enabled the diversion of negative thoughts and promotion of enjoyment. The DTZ also allowed

a conducive environment for interacting with their peers and getting to know each other, thereby promoting a sense of togetherness.

> *Whatever burdens I was thinking, I felt that they went away because of the enjoyment I felt. Aside from that, we got to know one another…I felt a sense of being with others in this program.* (FG2, P7)

They noted that the demands of performing simultaneous physical and mental exercises stimulated their cognitive skills and promoted mental sharpness.

> *It sharpened my thinking abilities because I had to think and speak while dancing. The two tasks had to be done together, so I need to think about performing them. This challenge was helpful since my mind was getting rusty.* (FG2, P8)

Apart from joining in the sessions, participants reported performing dual-tasking routines on their own. They were motivated to integrate dual-tasking activities into their daily lives, even when doing household chores. Thus, engaging in the DTZ program boosted their confidence to learn new activities they thought were difficult.

> *Sometimes, I would do some mental exercises when cooking. I'm more confident that I could do several tasks at the same time. I learned that it's possible to learn things you thought you couldn't do.* (FG1, P5)

Challenges in dual-tasking performance

While acknowledging the benefits of DTZ, participants also noted some challenges in this novel intervention. They expressed initial difficulties in performing the combined tasks and specific challenges related to some physical and cognitive components. These concerns were eventually managed through constant participation in the sessions.

> *Since this dual-task Zumba Gold is a combined activity – dancing and thinking, I found it challenging at first. Performing the exercises until we get adjusted to them helped us adapt to this new routine.* (FG2, P6)

Some participants mentioned difficulties in performing movements that required balance at the start of the program, and continuous performance enabled them to adapt.

At first, there were steps that I couldn't follow, especially the ones that required balancing. But when my body got used to it, I was able to execute them. (FG1, P4)

Participants also experienced initial challenges in the performance of cognitive tasks, particularly in the backward mental exercises. They mentioned that they were able to adjust to the tasks upon regularly attending the sessions.

Counting with several intervals, especially doing it backward, was a challenge at first. But I eventually got to adjust to it as I attended the sessions. (FG1, P5)

Facilitators of dual-task Zumba Gold participation

Participants highlighted the aspects they liked in the program: tailoring approaches, task repetition and progression, and individual participation within the group setting. Participants appreciated the program design as they were allowed to regulate and pace the movements according to their capacities. Moreover, some participants highlighted the importance of local and simple words in the memory and spelling exercises. This made the mental tasks adaptable as the terms used were related to their daily lives.

I liked the steps taught to us. While some movements could not be perfectly executed, we could pace and perform the steps based on our abilities. (FG2, P9)

The words we needed to spell and repeat were relatable because they were common in our language. (FG1, P2)

While some participants reported having difficulties at the beginning of the program, they mentioned that repeatedly performing the physical and mental tasks helped them to adjust. The progressively increasing task challenges also enabled them to gradually adapt to the dual-tasking demands before performing advanced exercises.

When we repeatedly performed the dance and mental exercises, the dual-tasking became manageable. Even with the backward counting, we adapted as we continuously did them… The mental tasks were not all difficult. There's grade 1, grade 2, and grade 3. So, there's a challenge once we got used to the easier ones. (FG1, P3)

While DTZ was carried out as a group, participants enjoyed the individual opportunities to perform the activities. This allowed them to remain focused on the dual-tasking requirements and adjust to the novel approach. Accomplishing the exercises in front of their peers also motivated them to perform better and show that their cognitive abilities were still good.

The part where I am called to perform the exercises individually was what I liked the most because it kept me on my toes to learn this new Zumba program. It also encouraged me to be better and prove my mental skills to others. (FG1, P1)

Discussion

This study found that DTZ, a program integrating cognitive tasks with Zumba Gold dancing, was feasible and safe for people with MCI. While identified as a novel intervention, DTZ had high acceptability among the participants who had some level of cognitive impairment. Preliminary analysis also offered promising results on cognition, quality of life, and physical mobility. Qualitative interviews corroborated these findings and provided more information about the benefits, challenges, and facilitators of this dual-tasking program.

This intervention had high retention and adherence rates. A possible contributing factor to this could be the group setting, which allowed the participants to interact with their peers and enjoy the sessions. Previous literature noted that older adults were motivated to participate in exercise programs that promoted fun and socialization.[67] Performing activities with people of similar age, needs, and limitations could enable people to understand themselves and others, reinforcing exercise adherence.[67,68] The results of the current study are also similar to previous dance programs for cognitively-impaired individuals.[44,48,49] Nevertheless, DTZ is one of the

first interventions to utilize dancing as a strategy to facilitate dual-task training among people with MCI. Zumba is a popular activity in several countries, and enriching it with mental exercises could be an attractive means to introduce dual-tasking programs to community-dwelling people with cognitive decline.

Meanwhile, most of the recruited participants were females, similar to previous studies employing dance and dual-tasking interventions for people with MCI.[21,48-50] However, this restricts the extrapolation of the study results, implying the need to recruit more men in future studies. Strategies that could promote male participation include arranging gender-specific classes, as older men value group homogeneity in physical activities.[68,69] Encouraging attendance with partners or spouses could also promote male engagement in group-based activities.[69] Consequently, recruiting more men could contribute to the generalizability of the study outcomes to the broader aging population.

Participants also identified several intervention characteristics that promoted their engagement. According to them, tailoring approaches, such as appropriate activity pacing, simple dance steps, and locally adapted cognitive exercises, were crucial in their participation. Although some healthy older adults could participate in regular Zumba classes for the general public,[70] this may not be suitable for people with physical and cognitive limitations. Traditional Zumba programs tend to have high-impact or vigorous-intensity movements; hence, the age-appropriate Zumba Gold could promote a more conducive approach for the aging population. Modifying complex motor activities for older people could further encourage their participation by increasing self-efficacy and allaying safety concerns.[71] Moreover, language- and culturally-adapted cognitive interventions are vital to engaging individuals who are more familiar with the local dialect and those from lower socioeconomic settings.[72] Some MCI patients could also experience concerns in language abilities, prompting the need for support strategies for their participation in interventions for improving cognition.[73] Thus, facilitating mental activities

adaptable to the local context ensured that the involvement of MCI participants was not hampered by literacy or language problems.

Evidence showed that DTZ has good intervention fidelity and can be carried out in community settings by trained Zumba Gold instructors. In this study, fidelity was supported by adequate training to the interventionist, providing pre-implementation sessions to the participants, facilitating group and individual performance of the activities, and monitoring the components delivered in each session. These strategies offer significant insights for a definitive trial to ascertain the implementation of DTZ on a larger sample of people with MCI. Moreover, the findings contributed evidence for the future incorporation of DTZ as a leisure and health program for soon-to-be-aged/older adults in community settings. Ensuring the fidelity of new interventions is vital to attribute the treatment effects to the program and not to the variations in its delivery.[56]

DTZ could also be safe for some individuals with MCI, particularly for females who are not on antidepressants. The study had no adverse event, and such finding is comparable to previous dance and dual-tasking programs on MCI patients.[21,22,48-50] This may be due to the flexible approach in Zumba dancing, allowing the participants to control the extent of their actions based on their capacities. Bruyneel[74] emphasized that dancing could be safe for people with chronic disorders due to its adaptability across ages and self-regulation of movements. Thus, while the steps were structured, participants were encouraged to consider their body rhythm and limits, ensuring that their efforts did not exceed their abilities. This was observed in a study of Zumba dancing on fibromyalgia patients, with participants reporting high acceptability because they felt adequate control over their movements.[75] Hence, allowing people with MCI to adjust their steps contributed to the safety and acceptability of DTZ.

However, given DTZ's new approach, some participants noted a few challenges. At the beginning of the program, some participants found it hard to cope with the combined exercises.

This may be due to slower response rates in concurrently performing multiple tasks by people with MCI compared to cognitively intact individuals.[51] Meanwhile, other participants mentioned initial difficulties in the serial counting exercises, particularly during the backward approach. Previous studies observed that MCI patients could experience challenges in performing backward mental tracking in dual-task conditions, making these activities crucial in interventions aimed to promote changes in cognitively impaired people.[76,77] These mental exercises could also reinforce working memory, a vital aspect of executive function.[28,52] Moreover, participants expressed that their regular weekly participation enabled them to adapt to the dual-tasking performance and backward mental exercises. These findings are noteworthy and highlight the importance of employing backward cognitive tasks in the present intervention.

Notably, participants reported adjusting to the DTZ activities through task repetition and progression. Frequent repetition is an essential principle in dual-task training that could reinforce neuroplasticity and learning new routines.[78] Another study found that repeated dual-tasking allowed older participants to improve their gait performance, which reduced their fear of falling.[79] Moreover, starting the sessions with relatively easier tasks and gradually increasing their complexity every four weeks helped the participants adapt to the intervention's dual-tasking demands. Gradation of dual-tasking exercises is vital for people with limited resources to process multiple stimuli concurrently.[51,52] Simultaneous task progression could also provide a continuous challenge to reinforce brain activity and neural tissue changes, which are essential in enhancing cognition.[80]

Individual participation in the dual-tasking exercises further stimulated active engagement among the participants. This promoted a balance between two aspects: participation in a group setting, which is essential for engaging older people in physical activities[67,68]; and validation of individual performance, which is helpful for cognitive training

feedback.[81] Performing within a group could also help enhance older adults' self-esteem, motivating them to improve their skills and adhere to programs with challenging tasks.[68] These support strategies in the DTZ program were crucial in encouraging both participation and adaptation.

Preliminary findings revealed that DTZ could potentially enhance cognition among people with MCI. The participants also perceived that performing cognitive tasks while dancing could promote mental sharpness, while recalling steps, words, and numbers could stimulate memory. Prior reviews support these results, as dancing may reinforce multiple cognitive processes, such as visuospatial abilities, memory, and sensory integration.[7-9] Moreover, an enriched environment through social interaction and musical accompaniment could reinforce cognition.[7] Notably, previous studies found that dancing and traditional physical activity might have comparable cognitive effects on older people. For instance, Esmail et al.[82] observed non-significant differences in older adults' cognition after a 12-week dance/movement training, compared to a supervised aerobic exercise. Another study that utilized social dancing versus an unsupervised walking program did not detect between-group differences in the participants' executive function performance.[27] Hence, the current study findings offer encouraging results about the potential advantage of a dance-based dual-task program to promote superior cognitive benefits on people with MCI. As previously suggested, sufficient mental challenge in physical activity programs is the most crucial factor for promoting cognitive changes in older people,[18] and combined approaches could stimulate more physiological resources to support neuroplastic processes.[20,80] A future RCT could provide robust estimates regarding the actual effects of the DTZ intervention on cognition.

Significant changes in the participants' quality of life were also noted after the DTZ program. Qualitative findings corroborated these results, as participants noted increased well-being and vitality. Others reported improved emotional status, as their participation facilitated

stress relief and confidence to learn new exercises. Hence, a future study should further utilize quantitative methods to identify the effects of DTZ on emotional or psychological outcomes. Moreover, having adapted to the DTZ activities encouraged them to integrate dual-tasking activities into their daily lives. Regular physical activity participation could also promote a sense of independence and enhanced functioning among people with cognitive impairment, which might improve quality of life.[83] While previous studies observed that Zumba dancing could enhance the quality of life in overweight women[13] and sedentary university employees,[84] there is limited information about its effects on older adults. Subsequent studies employing age-appropriate Zumba dance programs for the older population could fill this gap.

Functional mobility also improved following the DTZ intervention, with balance ability having the most significant benefit. Qualitative interviews aligned with these findings, as participants mentioned that continuous program engagement enabled them to adapt to the balance sequences of DTZ despite having challenges during the first few sessions. This may be attributed to the association of MCI with deterioration in balance control and increased fall risk.[85] Meanwhile, combined exercise and cognitive interventions for MCI patients could improve fall-related factors, such as cognitive function, gait speed, and balance.[86] Despite having no untoward incidents (e.g., falls) noted in the study, prompt assessment and support during steps that require balance remain vital in a future trial. At present, only a few studies evaluated the physical outcomes of aerobic dancing on people with MCI, noting improvements in the participants' mobility[44] and balance control.[48] Given the associations between functional capacity and cognitive decline,[87] exploring the physical outcomes of DTZ on people with MCI could provide valuable knowledge about its potential multidomain effects.

Limitations

The study has some limitations. As a feasibility study, the sample size was small and had no control group. The large effect size in the clinical outcomes might also be attributed to

performance bias due to the lack of a comparison group. In addition, there is a need to recruit more men in future trials, as most of the study participants were females. While antidepressant use might be common in some people with MCI, individuals who take such medications were excluded from the study. Hence, the current research is underpowered, and the clinical outcomes assessed post-intervention cannot be generalized to the broader MCI population. There is a need for a large-scale study involving a randomized controlled design to determine the intervention's actual efficacy on health outcomes. Meanwhile, only global cognition was assessed as an indicator of cognitive functioning in this study. With multiple cognitive domains in the DTZ intervention, specific measures of executive function, attention, visuospatial function, and memory could be utilized in a subsequent trial. Moreover, this study only assessed the immediate post-treatment outcomes. While preliminary results were promising, future research is necessary to determine if significant cognitive effects could be maintained beyond the immediate post-intervention period.

Conclusions

This study found that the dual-task Zumba Gold, a program involving cognitive enrichment of Zumba dance components, is feasible and acceptable for people with MCI. The intervention is generally safe for older people and may be implemented by trained Zumba Gold instructors in communities. As a novel intervention, program-related challenges could be addressed through various support strategies, such as tailoring, task repetition and progression, and reinforcement of individual participation. Preliminary evidence also showed that DTZ could improve cognitive function, quality of life, and functional mobility in people with MCI. A more comprehensive assessment of health outcomes involving an adequately-powered sample should be conducted through a future clinical trial.

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Table 1. DTZ protocol components and supporting literature

Components	Intervention details with literature support
Intervention dosage	• 12 weeks[18,23,44,48-50] • 3 times per week[18,48-50] • 60 minutes[18,23,44,50]
Delivery of session components	• Warm-up – dancing/dual-tasking – cool-down period[21,22,25,44,45,48-50]
Multiple cognitive domains in dual-task training	• Executive function, perceptual-motor function, memory, attention[21-25,50-53]
Executive function training	• Forward and backward serial counting[21,51-53]
Perceptual-motor training	• Performing steps based on verbal instructions/ visuospatial clock[25,52]
Memory training	• Memory span of numbers/words[21,22,50,52,53] • Recall of activities during the cool-down period[50]
Attention training	• Spelling words forward and backward[52,53] • Orientation during the warm-up session[50]
Other program aspects	• 10 participants/session[44-46] • Assessment of vital signs (pre- and post-session) and RPE (post-session)[16,50] • Pre-implementation sessions prior to actual intervention[44,48] • Provision of time intervals between dual-tasks and single-tasks[21,22] • Repetition and gradual progression of physical/mental tasks[24,25,44,50-52]

Table 2. Dual-Task Zumba Gold Intervention Protocol

DTZ session	Physical component	Cognitive component
Warm-up (5-10 minutes)	General flexibility, breathing exercises, and slow movements of upper and lower limbs	*Orientation*: • Upon pointing out each participant, he/she will move forward and state his/her full name • Asking questions about current date, month, year, and location by pointing out to individual participants
Zumba Gold dance (40 minutes)	*Steps*: Simple and low-impact Zumba Gold steps and balance sequences *Pace and intensity*: Slow pace, low impact, low to moderate intensity *Music*: combination of Latin inspired routines, contemporary, and retro songs *Progression*: repetition of step sequences, followed by progression of tasks every 4 weeks	*Executive function:* • Serial counting forward and backward as a group based on the proposed intervals every 4 weeks (ones, twos, threes) • Counting forward and backward from one participant to another *Perceptual-motor/visuospatial ability:* • Demonstrating basic clock positions using both arms as dance steps when the instructor mentioned a particular time *Memory:* • Repetition of number/word series (forward and backward) with progressive length every 4 weeks (3-, 4-, 5-number/word series) • Performing the routine together as a group and pointing out participants for individual checking *Attention:* • Spelling words (forward and backward) within the same category (local animals) with progressive length every 4 weeks (3-, 4-, 5-letter words) • Performing the routine together as a group and pointing out participants for individual checking
Cool-down (5-10 minutes)	Stretching & breathing exercises	*Memory* • Recall of arm clock positions performed in the visuospatial task • Recall of numbers and words mentioned during the memory task

Table 3. Participants' Demographic Information (N=10)

Characteristics	Frequency	Percentage (%)
Age M=64.56; SD=5.70		
Gender		
Male	3	30.0
Female	7	70.0
Education level		
Primary education	3	30.0
Secondary education	5	50.0
College	2	20.0
Marital status		
Single	1	10.0
Married	6	60.0
Widow/Widower	3	30.0
Physical activity level		
Less active (<3x/week)	5	50.0
Active (≥3x/week)	5	50.0

Table 4. Changes in cognition, quality of life, and functional mobility after the dual-task Zumba Gold intervention

Outcome	Baseline		After the intervention		Wilcoxon signed rank test (Z)	p-value	Effect size
	Median (Range)	Mean (SD)	Median (Range)	Mean (SD)			
Global cognition (MoCA)	19.0 (18-21)	19.3 (1.06)	25.0 (19-26)	24.3 (2.24)	-2.680	0.007	0.89
Global cognition (MMSE)	24.0 (24-25)	24.2 (0.42)	26.0 (25-28)	26.7 (1.12)	-2.687	0.007	0.90
Quality of life (PWB)	63.0 (43-80)	61.6 (12.46)	77.0 (64-91)	76.1 (9.50)	-2.688	0.008	0.89
Functional mobility (SPPB)	11.0 (10-12)	10.7 (0.67)	12.0 (11-12)	11.6 (0.53)	-2.333	0.020	0.78
Balance	3.0 (3-4)	3.4 (0.52)	4.0 (3-4)	3.9 (0.33)	-2.000	0.046	0.67
Gait speed	3.5 (3-4)	3.5 (0.53)	4.0 (3-4)	3.8 (0.44)	-1.414	0.157	0.47
Chair rise	4.0 (3-4)	3.8 (0.42)	4.0 (3-4)	3.8 (0.44)	0.000	1.000	-

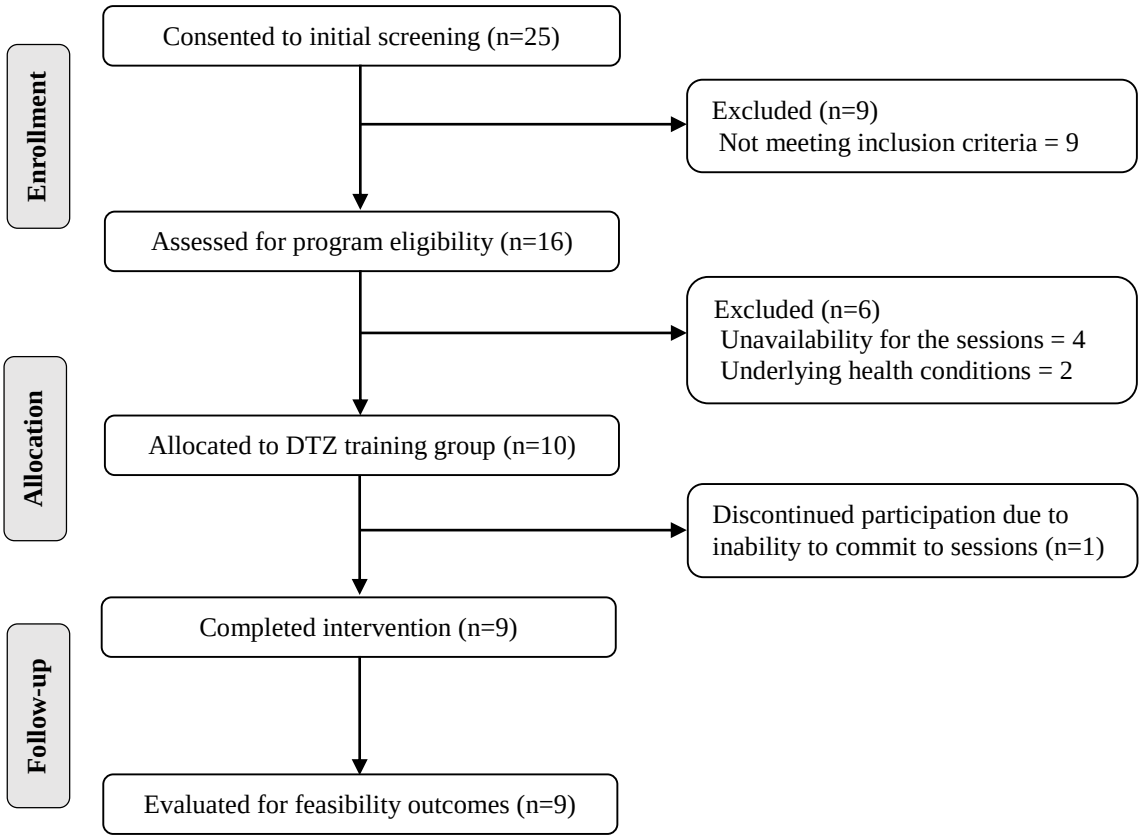

Figure 1. Flow diagram of the participants in the study

Appendix A: Intervention fidelity checklist

	Activities	Done (2)	To some extent (1)	Not Done (0)	Remarks
Warm-up with orientation training					
1	Pointing out/calling each participant to move forward and state his/her name				
2	Asking questions to individual participants by calling their ID number, about the following: - Current date - Month - Year - Current location				
Zumba Gold dance (single-task)					
Dual-task Zumba Gold (Executive function training via serial counting, forward & backward)					
1	□ Week 1 – 4: Interval of ones *(1→10; 10→1)* □ Week 5 – 8: Interval of twos *(2→20; 20→2)* □ Week 9 – 12: Interval of threes *(3→30; 30→3)*				
2	Progressive counting forward as a group based on the proposed intervals				
3	Counting forward from one participant to another				
4	Progressive counting backward as a group based on the proposed intervals				
5	Counting backward from one participant to another				
Zumba Gold dance (single-task)					
Dual-task Zumba Gold (Perceptual-motor training via performance of arm clock positions)					
1	□ Week 1 – 4: 3 arm clock positions *(3 o'clock, 9 o'clock, 12 o'clock)* □ Week 5 – 8: 4 arm clock positions *(3 o'clock, 9 o'clock, 12 o'clock, 9:15)* □ Week 9 – 12: 5 arm clock positions *(3 o'clock, 9 o'clock, 12 o'clock, 9:15, 6 o'clock)*				
2	Demonstrating basic clock positions using both arms as dance steps based on the time mentioned by the instructor				
Zumba Gold dance (single-task)					
Dual-task Zumba Gold (Memory training via forward and backward repetition of number/word series					
1	□ Week 1– 4: 3-number series (8, 3, 5) : 3-word series (*Saging [Banana], Mangga [Mango], Pinya [Pineapple]*) □ Week 5 – 8: 4-number series (8, 3, 5, 2) : 4-word series (*Saging [Banana],*				

	Mangga [Mango], Pinya [Pineapple], Buko [Coconut]) □ Week 9 – 12: 5-number series (8, 3, 5, 2, 6) : 5-word series (*Saging [Banana], Mangga [Mango], Pinya [Pineapple], Buko [Coconut], Pakwan [Watermelon]*)				
2	Performing the forward repetition as a group				
3	Performing forward repetition individually when instructor calls a particular ID number (5x)				
4	Performing the backward repetition as a group				
5	Performing backward repetition individually when instructor calls a particular ID number (5x)				
Zumba Gold dance (single-task)					
Dual-task Zumba Gold (Attention training via forward and backward spelling of words					
1	□ Week 1 – 4: 3-letter words *(ASO [Dog], UOD [Worm], USA [Deer])* □ Week 5 – 8: 4-letter words (*PUSA [Cat], BAKA [Cow], ISDA [Fish])* □ Week 9 – 12: 5-letter words (*BABOY [Pig], MANOK [Chicken], HIPON [Shrimp])*				
2	Spelling (forward) as a group				
3	Spelling (forward) individually when instructor calls a particular ID number (5x)				
4	Spelling (backward) as a group				
5	Spelling (backward) individually when instructor calls a particular ID number (5x)				
Zumba Gold dancing (single-task)					
Cool-down memory training					
1	Review of arm clock positions demonstrated				
2	Recall of numbers/words recited in the session				
Total Score (Highest possible score: 52 [26 items x 2])					
Percentage delivered		___/52 ×100 = _____%			

Done (2 pts): Activity was fully delivered by the interventionist
Done to some extent (1 pt): An attempt to implement the activity but not delivered fully
Not done (0 pt): Activity was not delivered by the interventionist

Appendix B: Guiding Questions for Post-intervention Focus Groups

General comments about the dual-task Zumba Gold

1. Overall, how was your experience attending the dual-task Zumba Gold (DTZ) sessions?
2. Do you feel that participating in DTZ has made a difference in how you feel about yourself? Please explain.

Evaluation of the activities done

3. What did you like or dislike about the DTZ activity?
4. What can you say about the physical activities/dance steps in this program? Were they too light or heavy, fast or slow?
5. What are your perceptions of the mental activities in this program? Were they too hard or easy? Were they too many or few?
6. How was your experience in performing the dance steps and mental activities simultaneously?

Feedback about other components

7. What can you say about the instructor and other facilitators (e.g., project assistants)? Please explain.
8. What do you think about the group setup of this DTZ program?
9. Do you have recommendations to make the DTZ sessions better for you or other participants?