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Original Article

Effects of traditional Thai folk dance combined with cognitive stimulation program on behavior and cognition among older adults with cognitive decline: A randomized controlled trial ☆

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ABSTRACT

Background: Older adults with mild behavioral impairment (MBI) are at the higher risk of developing dementia compared to those without MBI, leading to decreased quality of life (QoL). Addressing MBI in older adults provides valuable opportunities to prevent dementia.
Objectives: This study aimed to determine the effects of traditional Thai folk dance combined with a cognitive stimulation program on MBI, QoL, subjective cognitive decline (SCD), and cognitive functioning in older Thai adults.
Design: Single-blinded, two-armed, randomized controlled trial, with a three-month follow-up period.
Setting: Outpatient chronic disease clinics at two districts in Suphan Buri province, Thailand.
Participants: One-hundred twenty-eight older adults with MBI were randomly assigned to either the experimental (n = 64) and cognitive education control group (n = 64).
Intervention: The 14-session, 7-week traditional Thai folk-dance program combined with cognitive stimulation focused on enhanced moderate intensity physical activity and cognitive stimulation engagement to improve MBI of older adults.
Measurements: The primary outcome was MBI assessed using Mild Behavioral Impairment Checklist. Secondary outcomes were QoL, SCD, and cognitive tests of memory and executive functions.
Results: Compared to the control group, participants in the experimental group demonstrated significantly reduced MBI (p <.01), improved QoL (p <.01), decreased SCD (p <.01), and enhanced cognitive functioning (p <.01) after the 7-week intervention and at the 12-week follow-up.
Conclusion: The traditional Thai folk dance combined with cognitive stimulation improved outcomes related to early signs of dementia and enhanced the overall QoL of older adults.

1. Introduction

Dementia, including Alzheimer's disease (AD), is an irreversible neurodegenerative disorder characterized primarily by cognitive decline and behavioral impairment symptoms. These symptoms typically begin to manifest during the preclinical stage, often referred to as subjective cognitive decline (SCD), where recurrent cognitive lapses and mild behavioral impairment (MBI) are evident [1]. In the National Institute on Aging and Alzheimer's Association (NIA-AA) research framework, MBI is recognized in Stage 2 or called preclinical AD, representing sustained neuropsychiatric symptoms without clinical cognitive symptoms. According to Ismail et al. (2021), MBI carries the highest risk for conversion to AD. Their longitudinal study, which followed 2769 older adults in the preclinical stage, found that 51.6 % of those with MBI exhib-

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ited cognitive and functional decline over 3 years, compared to 21.7 % of those without MBI [1]. Older adults with MBI, particularly in the preclinical stage, represent a critical transitional phase between normal cognitive aging and dementia, with the potential for reversion to normal cognitive functioning [2]. MBI is associated with reduced quality of life (QoL) and increased dependence on caregivers [3,4]. Addressing MBI in older adults offers opportunities for early prevention programs aimed at enhancing QoL and cognitive functioning, with nurses playing a pivotal role in these efforts.

Physical activity (PA), especially moderate-to-vigorous PA (150 min weekly), and cognitive stimulation are strongly recommended for adults with preclinical dementia to reduce cognitive decline and improve QoL [5,6]. Moderate-to-vigorous PA stimulates the production of growth factors such as brain-derived neurotrophic factor by supporting the survival and growth of neurons and synapses [7]. Mudalige et al. (2024) found that each 1 standard deviation (SD) increase in moderate-intensity PA was associated with a 5.64 % reduction in MBI severity [8]. The Lancet Commission on Dementia Prevention, Intervention, and Care also identified social engagement as an effective intervention for improving QoL and cognitive functioning in older adults [9,10].

Self-determination theory (SDT) posits that social–contextual conditions can either support or hinder PA engagement, depending on their capacity to fulfill individuals' basic psychological needs [11]. These needs consist of [1] autonomy, which refers to engaging in PA with a sense of volition and personal choice [2]; competence, the feeling of mastery and effectiveness in activities; and [3] relatedness, the desire to establish meaningful connections with others. PA programs integrating social interaction and cognitive stimulation have significantly improved QoL in older adults [12]. Additionally, PA interventions that combine social activity with cognitive stimulation can enhance cognitive functioning in older adults with mild cognitive impairment [13]. Regarding culturally appropriate PA, traditional folk dance has shown promise as an enjoyable, socially supportive activity that promotes neuroplasticity by integrating movement and cognition. Its rhythmic and structured nature requires coordination, balance, and memory, which stimulate cognitive processes [14]. Cognitive stimulation, often conducted in small, enjoyable group settings, is widely used to improve cognitive functioning such as attention and memory in older adults [15].

Despite significant evidence supporting the efficacy of PA interventions such as traditional folk dance combined with cognitive stimulation to enhance neurocognitive domains in older adults, adherence to PA remains a challenge. Interventions specifically targeted to reduce MBI symptoms are still limited. Soto et al. (2024) emphasized the critical need to develop and test interventions aimed at addressing MBI symptoms [16]. In response to this gap, the current study sought to develop and implement a 14-session, 7-week traditional Thai folk-dance program combined with cognitive stimulation as an enjoyable, socially supportive activity. Grounded in the SDT framework [11], it aimed to promote neuroplasticity by integrating movement and cognition to sustain decreased MBI severity, improved QoL, and enhanced cognitive functioning in older adults by fulfilling their psychological needs for autonomy, competence, and relatedness.

The program adhered to the Frequency, Intensity, Time, and Type principles outlined in the ACSM guidelines for moderate-intensity PA [5]. It incorporated evidence-based cognitive stimulation techniques [17] to decrease MBI severity, enhance QoL, and improve cognitive functioning in older adults. A pilot test conducted between April and June 2024 demonstrated promising results, with high adherence rates and a reduction in MBI symptoms among 16 older adults. Building on these preliminary findings, a randomized controlled trial (RCT) was performed to determine the program's effects on MBI, QoL, SCD, and cognitive functioning in 128 older adults who were classified as having SCD and MBI, distinct from those included in the pilot study. The study hypothesis was that the program would lead to significant improvements in these outcomes by fostering intrinsic motivation and internalizing external motivation through the SDT framework, which are essential for adherence to health behaviors in older adults.

2. Methods

2.1. Study design

The study was a single-blind RCT with repeated measures at baseline (week 0), post intervention (week 7), and follow-up (week 12) to determine the effects of a 14-session, 7-week traditional Thai folk-dance program combined with cognitive stimulation for 128 older adults who were classified as having SCD and MBI in the preclinical stage of dementia divided using block randomization to allocate participants to the experimental ($n = 64$) or control group ($n = 64$). Before the RCT, a pilot testing program was used to evaluate the feasibility and preliminary outcomes among 16 older adults with MBI. The study adhered to the Consolidated Standards of Reporting Trials (CONSORT) 2012 guidelines.

2.2. Participants

The target population comprised older adults living with SCD and experiencing MBI. The criteria for SCD were three key questions aligned with the NIA-AA definition of transitional cognitive decline along the AD continuum [1]: Have you noticed a change in your memory over the past 1–3 years [2]? Has this change persisted over the last 6 months [3]? Are you personally concerned about this change? Participants had to respond affirmatively to at least two questions, specifically Questions 2 and 3, which were indicative of preclinical dementia [18]. It is important to note that while eligible participants may exhibit SCD, a formal diagnosis was not established due to the absence of objective biomarker confirmation. These participants were recruited in June 2024 in the chronic outpatient clinics specializing in various chronic conditions such as diabetes, hypertension, and cardiovascular disease located in community health centers in two districts of Suphan Buri province, Thailand: Bang Pla Ma and Song Phi Nong. Eligible participants aged 60 years or older and diagnosed with MBI according to the ISTAART criteria [1] with an MBI Checklist score of ≥7 [3,4,19] were included.

The exclusion criteria were a confirmed diagnosis of AD or other forms of dementia; suspicion of dementia based on a Thai Mental State Examination score below 24 out of 30; a Montreal Cognitive Assessment (MoCA) score below 26, indicating mild cognitive impairment [20]; and a diagnosis of major depressive disorder, psychosis, or severe health conditions such as cancer. If participants did not meet the program session requirements (moderate-intensity PA less than 150 min per week, as assessed by the International Physical Activity Questionnaire—Short Form, Thai version) or missed two consecutive program sessions, they were excluded.

The sample size was calculated using G*Power software for repeated-measures analysis of variance with a small effect size ($g = 0.13$), derived from a previous study [21], and a small effect size ($g = 0.17$) based on mild behavior impairment checklist score, calculated from the pilot study tested with two groups of eight older adults ($n = 16$) who attended bi-weekly program sessions over 7 weeks. The average effect size of 0.15 was used. A statistical power of 90.0 % and a significance of 0.05 were applied. The study required a minimum of 96 participants, with 48 older adults in each group.

To recruit participants, the principal investigator (PI) distributed flyers across 22 outpatient chronic disease clinics in the Bang Pla Ma and Song Phi Nong districts of Suphan Buri province. A total of 286 older adults with preclinical dementia were assessed for eligibility: 57 were suspected of mild cognitive impairment, six were diagnosed with major depressive disorder, and 72 scored less than 7 points on the MBI Checklist. Although 151 older adults with SCD remained eligible for the study, 23 refused to participate. Finally, 128 agreed to participate and completed the consent form (recruitment rate = 84.8 %).

Due to the significant sex imbalance among participants (108 female and 20 male), the stratified block randomisation method was used to allocate the groups. A research assistant divided the participants into two strata based on sex (108 female participants in one stratum and 20 male participants in another). Within the female group ($n = 108$), block randomization (block size 4) was used to allocate participants to the experimental ($n = 54$) or control group ($n = 54$). Within the male group ($n = 20$), block randomization (block size 4) was used to allocate 10 participants to the experimental group and 10 to the control group. The group allocation lists and assessments were concealed from a second research assistant who was the outcome assessor.

2.3. Ethical considerations

The study was conducted following the Declaration of Helsinki and approved by the Ethics Committee of a University, Thailand (No. SDU-RDI-HS 2024-020). All participants received written and oral information regarding the purpose, data collection, and risks and benefits of the study. Participants were informed that they were free to withdraw during the study at any time for any reason without any need for explanation and that data confidentiality would be maintained.

2.4. Program development

According to WHO (2019) guidelines, 150 min of moderate-intensity PA per week and cognitive stimulation are strongly recommended for older adults with SCD to reduce MBI severity and enhance QoL [6]. Evidence-based cognitive stimulation [17] was incorporated into the program. ACSM guidelines (2020) and the reviewed literature recommended the program dosage [5]. The researchers developed a 14-session, 7-week traditional Thai folk-dance program combined with cognitive stimulation, mainly grounded in the SDT framework [11].

The program was designed to address participants' basic psychological needs in PA, including autonomy (respecting their preferences), competence (enhancing PA skills), and relatedness (engaging in group-based PA with social support). Twelve older adults were invited to participate in group discussions to provide input. The group discussion included questions such as, "What types of physical activities do you currently enjoy or have you enjoyed in the past?" From the discussion, traditional Thai folk dance or "Tone Dance" was identified as preferred. This traditional dance is characterized by relaxed, natural movement, no stiff rhythms, and a relaxation of the rigid standard of other Thai dance. This type of movement involves not stressing the fingers and hand movements. It aligns with moderate-intensity PA suitable for older adults. The program was subsequently validated by a panel of six experts specializing in cognitive health and older adult care: two psychiatric physicians, two advanced practice nurses, an occupational therapist, and a senior sports scientist.

For the intervention delivery, 30 registered nurses were trained as CST interventionists by the PI, who holds CST certification from Saint Louis University, USA. A traditional Thai dance expert trained 30 additional health volunteers in the standard dance movements, allowing them to serve as dance co-interventionists. An education booklet was provided to facilitate learning. The dancing rehearsals were facilitated in small groups to enhance participants' perceived competence and encourage home practice, fostering a sense of relatedness and supporting the self-motivation critical to program adherence.

The pilot study was tested with two groups of eight older adults ($n = 16$) who attended bi-weekly program sessions over 7 weeks. The participants learned to self-assess PA intensity: to maintain a moderate intensity, they could talk but not sing during the activity [5]. Throughout the sessions, the co-PI observed to ensure program fidelity using a standardized checklist and asked the participants to demonstrate an understanding of the core skills of moderate-intensity PA. To deepen participation, reflection sessions were facilitated by the co-PI with open-ended questions such as, "How did you feel physically and mentally during today's dance?" and "Did the cognitive activities present any challenges? What did you enjoy most about today's session?" A final group discussion was facilitated to provide feedback. Sample questions included, "What were the most valuable views for you?" and "How do you think the combination of traditional dance and cognitive stimulation affected your behaviors and quality of life?" The pilot study demonstrated strong feasibility, evidenced by 100 % adherence, with no dropouts or reported adverse events.

2.5. Experimental group

Sixty-four older adults with SCD in the experimental group devided into eight groups. Participants in each group were enrolled in a 14-session, 7-week traditional Thai folk-dance program combined with cognitive stimulation. The intervention followed the same protocol as the pilot study. To reduce confounding effects, all sessions were conducted at the same time in a community health center. The 90 min of each session was administered by a registered nurse interventionist and a health volunteer co-interventionist to groups of eight older adults. The experimental group engaged in traditional Thai folk dance, starting with a 5-minute dynamic warm-up, followed by 60 min of continuous dance to 10 Thai songs. Additionally, 30-minute CST sessions were conducted twice a week after the dance sessions.

After the program concluded at week 7 (Time 2), three second blinded research assessors, certified in the MoCA scale, collected outcome data. Follow-up data were collected at week 12 (Time 3). The assessors were trained in standardized protocols to ensure consistency throughout the study. Eight participants from the experimental group withdrew between weeks 2 and 7, and 56 participants completed the program through the 12-week follow-up (see Fig. 1).

2.6. Control group

Participants in the control group were tested at baseline at week 0 (Time 1) and then invited to participate in routine care at the community health center clinics. They attended a one-day educational program that included dementia knowledge, cognitive skills for daily life, and exercises for improving cognitive functioning, all of which were regularly offered and delivered by clinic nurses. The second research assistant assessed outcome data at week 7 (Time 2) and follow-up data at week 12 (Time 3). Twelve participants in the control group withdrew during weeks 2 to 7, and 52 participants in the control group completed the intervention until the 12-week follow-up.

2.7. Measurements

The demographic survey developed by the researcher was collected at the baseline. It included demographics of age, gender, marriage status, income, education, and chronic diseases.

The Mild Behavioral Impairment Checklist (MBI-C), developed by Ismail et al. (2017) [1], was employed as the primary assessment tool. This checklist consists of 34 items and was independently translated into Thai by two bilingual experts fluent in both Thai and English. A back-translation was conducted by a blinded expert, following the WHO (2016) guidelines for ensuring translation accuracy [22]. The Thai version of the MBI-C was validated with 120 older Thai adults presenting preclinical dementia symptoms, yielding a Cronbach's α coefficient ranging from 0.84 to 0.94, indicating strong internal consistency. In addition, five experts evaluated the content validity, resulting a content validity index of 0.97. The MBI-C assesses five behavioral domains consistent with MBI criteria: reduced motivation (apathy), affective dysregulation (mood and anxiety), impulse dyscontrol, social inappropriateness, and abnormal perception or thought content (psychotic symptoms). Each item on the scale is scored for both presence (yes [1]/no

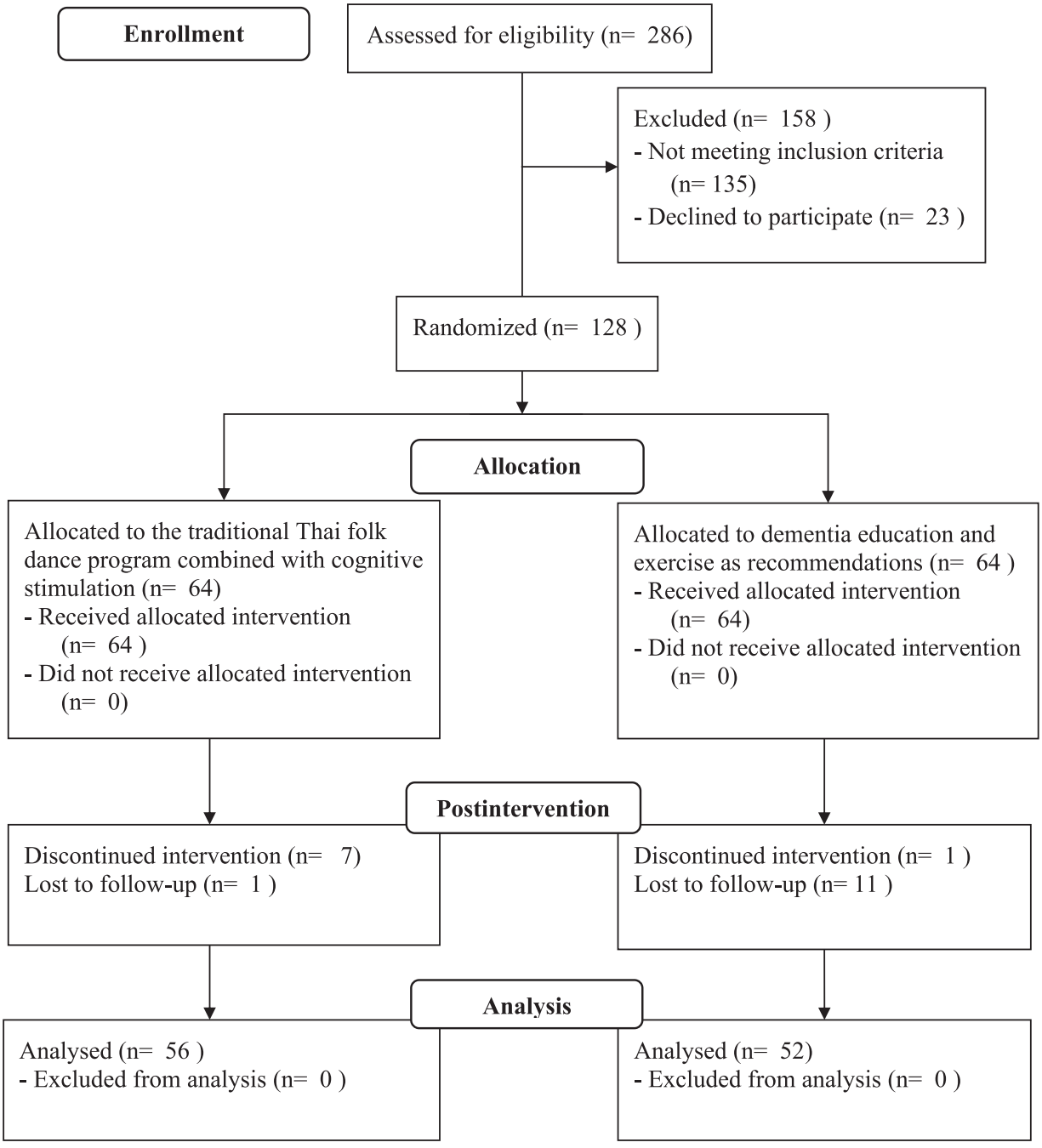

Fig. 1. Consolidated Standards of Reporting Trials Diagram.

[0]) and severity (1 = mild, 2 = moderate, 3 = severe). The overall MBI-C score is calculated by summing the severity ratings, resulting in a total score ranging from 0 to 102.

The World Health Organization Quality of Life Brief Scale (WHOQOL-BREF) [23] was used to assess the QoL. The scale consists of 26 items, including 24 items for physical, psychological, social, and environmental QoL, one item for general QoL, and one item for health-related QoL. The WHOQOL-BREF items are rated on a 5-point Likert scale ranging from 1 to 5, with higher scores indicating better QoL. The scores for each subscale are obtained by summing the scores of the corresponding items within each subscale. The overall score is calculated by summing all subscale scores and two global item scores. Because the number of items is different for each domain, the domain scores are calculated by multiplying the average of the scores of all items in the domain by 4. Thus, the domain scores have the same range, from 4 to 20. The WHOQOL-BREF scale was back-translated by Mahatnirunkul et al. (1998), yielding a Cronbach's α of 0.83 [24].

Subjective cognition was assessed by the Cognitive Failure Questionnaire (CFQ), developed by Broadbent et al. (1982) [25]. This is employed to assess SCD or recurrent cognitive lapses. The CFQ is a 25-item self-report questionnaire designed to measure everyday cognitive lapses, such as forgetting names, losing things, and making mistakes. Each item is scored on a 5-point Likert scale ranging from 0 to 4. The total CFQ score is obtained by summing the scores across all 25 items, with higher scores indicating a greater frequency of cognitive failures. The Thai version of the CFQ demonstrated a content validity index of 0.97 [26]. Cognitive functioning was also assessed using the MoCA developed by Nasreddine et al. (2005) [20]. The tool has high test–retest

Table 1
Characteristics of the Older Adult Participants in theExperimental and Control Groups.

Characteristic	Experimental group (n = 56)		Control group (n = 52)		t	χ^2	p
	n	%	n	%			
Age (years)	M = 69.82 ± 6.18; Range 60–84		M = 68.78 ± 6.46; Range 60–85		−0.85		.39
Gender							
Male	10	17.90	6	11.50		0.85†	.42
Female	46	82.10	46	88.50			
Marital status							
Single	10	17.90	10	19.20		4.46	.22
Married	32	57.10	23	44.20			
Widowed	0	0	3	5.80			
Divorced/ separated	14	25.00	16	30.80			
Education							
No formal education	0	0	1	1.90		2.32	.51
Primary school	45	80.40	42	80.80			
Secondary school	6	10.70	7	13.50			
Higher education	5	8.90	2	3.80			
Income a month	M = 3257.14 ± 4578.16; Range 600–21,000		M = 2196.15±2864.72; Range 600–16,700		−1.45		.15

Note. χ^2 = Chi squared tests; † = Fisher's exact test.

reliability (ICC = 0.92, p <.001) and good internal consistency (Cronbach's α = 0.82). The Thai version of the MoCA was used to evaluate various brain functions, including visuospatial and executive skills, naming, attention, language, abstraction, delayed recall memory, and orientation. The total possible score ranges from 0 to 30, with a score of ≥25 considered to indicate normal cognitive functioning.

2.8. Data analysis

The data were analyzed using IBM SPSS statistical software, version 26.0, with the alpha level set at <.05. Descriptive statistics of frequency, percentage, mean, and standard deviation were employed to analyze participation and dropout rates. Chi-square and Fisher's exact tests were applied to compare baseline characteristics between the experimental and control groups. An independent t-test was used to compare the outcome variables between the experimental and control groups at the baseline (Week 0; Time 1). To assess differences in MBI-C, WHOQOL-BREF, CFQ, and MoCA scores over time, intention-to-treat analysis as a two-way repeated-measures ANOVA was conducted, with one between-subjects variable (group: experimental vs. control) and one within-subjects variable (time: pre intervention, post intervention, follow-up). Post hoc analysis was performed using the Bonferroni-corrected t-test to examine statistically significant changes. Effect sizes were calculated using partial eta squared (η^2), which expresses the sum of squares of the effect in relation to the sum of squares of the effect and the sum of squares of the error associated with the effect [27]. No missing data or extreme outliers were met in either the experimental or control groups. Data were analyzed for 56 participants in the experimental group and 52 in the control group (See Fig. 1). Histograms indicated visual normal distributions for the MBI-C, WHOQOL-BREF, CFQ, MoCA scores. Tests for homogeneity of variance between the groups showed no statistically significant differences (p >.05). Mauchly's test indicated a violation of sphericity (p <.05). While linear mixed-effect models are preferred for unbalanced data and sphericity violations, a two-way repeated measures ANOVA was used with Greenhouse-Geisser correction to ensure valid results. This method was applied for the interpretability, established use in similar studies [13], minimal group size imbalance, and absence of missing data.

3. Results

3.1. Attendance and attrition

Attendance at the program sessions was 100.0 % in weeks 1 and 2. After week 7, seven participants in the experimental group did not meet the program requirements. They were excluded due to missing two consecutive program sessions. At the week 12 (Time 3) follow-up, one participant dropped out, and the remaining 56 (87.5 %) in the experimental group completed the study. There was no harm reported by any participants.

Participants in the control group (n = 64) attended usual care with a single educational program. At week 7 (Time 2) post intervention, one participant in the control group dropped out. At the week 12 (Time 3) follow-up, 11 participants withdrew, and 52 (81.2 %) in the control group completed the study. Chi-square, Fisher's exact test, and independent t-test indicated no significant differences in demographic characteristics between dropouts and completers in the control groups.

3.2. Characteristics of the participants

Participants in the experimental group had a mean age of 69.82 ± 6.18 years, and participants in the control group had a mean age of 68.78 ± 6.46 years. Most participants in the experimental and control groups were female, at 82.1 % and 85.5 %, respectively. No significant differences in characteristics existed between the groups (Table 1).

3.3. Baseline

The results of the independent t-tests indicated no statistically significant differences in the MBI-C, WHOQOL-BREF, CFQ, or MoCA scores between the experimental and control groups at the baseline (t(106) = −0.87, p >.05; t(106) = 1.52, p >.05, t(106) = −1.76, p >.05, and t(106) = 1.25, p >.05, respectively).

3.4. Outcomes

The results of the two–way repeated-measures ANOVA indicated that the mean MBI-C, WHOQOL-BREF, CFQ, and MoCA scores of the experimental and control groups varied across the three time points: baseline (Time 1, Week 0), post intervention (Time 2, Week 7), and follow-up (Time 3, Week 12): F(1.87, 197.75) = 32.15, p ≤.001, partial η^2 = 0.23; F(2, 112) = 45.44, p ≤.001, partial η^2 = 0.30; F(1.85, 196.38) = 28.23, p ≤.001, partial η^2 = 0.21, and F(1.79, 189.54) = 26.719, p ≤.001, partial η^2 = 0.20, respectively (Table 2).

Based on Fig. 2, post hoc analysis identified the Bonferroni-corrected results of the t-test of the mean MBI-C scores of the experimental and control groups at 7 weeks post intervention (Time 2) and the 12-week follow-up (Time 3). The participants receiving the traditional folk dance combined with cognitive stimulation program significantly lowered their MBI symptoms compared to the control group at both post-

Table 2
The Interaction Effect (Time*Group) of the Mean Scores of Outcome Variables Between the Experiemental Group (n = 56) and Control Group (n = 52) Measured at Three-time: Baseline (Week 0, Time 1), Post-intervention (Week 7, Time 2), and Follow-up (Week 12, Time 3).

Variable	Time	Experimental group M±*SD*	Control group M± *SD*	*F*	Partial η^2
Thai version of MBI-c scores – mild behavioral impairment	1	15.23±7.24	14.09±7.38	32.15**	.23
	2	9.42±5.48	17.78±10.22		
	3	9.61±9.60	19.17±11.87		
Thai version of WHOQOL-BREF scores – quality of life	1	87.32±10.63	90.60±11.69	45.44**	.30
	2	97.39±11.25	87.94±12.98		
	3	98.66±11.56	83.17±11.05		
Thai version of CFQ scores – subjective cognitive decline	1	33.52±11.82	29.53±11.71	28.23**	.21
	2	26.91±12.65	32.77±11.80		
	3	24.96±12.80	36.92±11.63		
Thai version of MoCA scores – objective cognitive functioning	1	27.37±1.46	27.75±1.66	26.72*	.20
	2	27.73±1.55	27.33±2.00		
	3	28.04±1.45	26.48±2.35		

Note. CFQ = Cognitive Failure Questionaire; MBI-C = Mild Behavioral Impairment Checklist; MoCA = Montreal Cognitive Assessment; WHOQOL-BREF = World Health Organization Quality of Life Brief scale; η^2 = Eta squared; ** p <0.01, *p < 0.05.

intervention and follow-up periods: $F(1, 106) = 28.58$, p <.001, partial $\eta^2 = 0.21$, and $F(1, 106) = 21.34$, p <.001, partial $\eta^2 = 0.17$, respectively. This supports the hypothesis that older adults receiving the intervention would experience decreased MBI symptoms compared to those in the control group.

The WHOQOL-BREF scores of the post hoc analysis of the experimental group at the 7-week (Time 2) and 12-week follow-ups (Time 3) showed significantly higher scores than in the control group: $F(1, 106) = 16.41$, $p \leq .001$, partial $\eta^2 = 0.13$, and $F(1, 106) = 50.48$, $p \leq .001$, partial $\eta^2 = 0.32$, respectively. These results are consistent with the hypothesis that older adults receiving the intervention would experience enhanced QoL compared to those in the control group.

The CFQ scores were also significantly reduced in the experimental group at the 7-week (Time 2) and 12-week follow-ups (Time 3) compared to both time measures of the control group: $F(1, 106) = 6.17$, $p = .015$, partial $\eta^2 = 0.05$, and $F(1, 106) = 25.67$, $p \leq .001$, partial $\eta^2 = 0.20$, respectively. The results support the hypothesis that older adults receiving the intervention would express less cognitive decline compared to the control group.

The MoCA scores were not significantly increased in the experimental group at 7 weeks (Time 2) compared to the time measures of the control group: $F(1, 106) = 1.39$, $p = .24$, partial $\eta^2 = 0.01$. However, the 12-week follow-up (Time 3) compared to the follow-up measures of the control group showed $F(1, 106) = 17.32$, $p \leq .001$, and partial $\eta^2 = 0.14$. These results support the hypothesis that older adults receiving the intervention would demonstrate increased cognitive functioning compared to the control group.

4. Discussion

The results of this study indicate the benefits of combining traditional Thai folk dance with a cognitive stimulation program for older adults with MBI. Compared to the control group, statistically significant improvements were observed in the experimental group for MBI as measured by the MBI Checklist, QoL as evaluated by the WHOQOL-BREF, SCD as assessed using the CFQ, and cognitive functioning as measured through the MoCA scale.

The success of traditional Thai folk dance combined with cognitive stimulation in reducing MBI severity, improving QoL, reducing SCD, and maintaining cognitive functioning can be attributed to participants' self-motivation and adherence to the program. Grounded in SDT, the program fostered enjoyment and autonomy by providing traditional Thai folk dance as the moderate-intensity PA component, tailored to the participants' preferences and interests. Competence was supported by offering clear instructions, small-group rehearsals led by a traditional Thai dance expert, and an education booklet to enhance dance learning. Additionally, relatedness was encouraged through the establishment of a program support group where participants could connect. Each session also included focus groups to explore perceived benefits and barriers, providing positive feedback to further motivate participants and encourage adherence. This program integrated enjoyable PA activities with cognitive stimulation into meaningful, socially and culturally relevant interventions, providing a comprehensive approach to promoting sustained PA adherence among older adults. This enhances neuroplasticity, potentially reducing the severity of MBI symptoms and leading to improvements in QoL and cognitive outcomes.

This program also promoted increased cerebral blood flow during moderate-intensity PA, which stimulates the production of growth factors such as brain-derived neurotrophic factor. Before the program, participants' nervous systems processed auditory and sensory stimuli, preparing them for dance. During the dance sessions, the nervous system facilitated movement and coordinated external stimuli processing, which promoted cognitive reserve, enhanced social interaction, increased mental engagement, and improved mood. This process resulted in better cognitive functioning in memory, attention, and executive function for the experimental group, as supported by the findings of Foster Vander Elst et al. (2023), who noted that the involvement of the nervous system is crucial for such activities [28].

The traditional Thai folk dance in this study, classified as moderate-intensity PA, supported the hypothesis that moderate-to-vigorous PA enhances brain performance on a molecular level [5]. Klimova and Dostalova (2020) reported that moderate-to-vigorous PA positively impacts brain functioning by increasing resistance to oxidative stress and aiding in cognitive recovery and maintenance [29]. Additionally, Di Liegro et al. (2019) found that moderate-to-vigorous PA has the greatest effect on the prefrontal cortex and hippocampal regions, which are critical for cognitive functioning, potentially reducing damage to gray matter [30].

The results are consistent with the study of Rongmuang et al. (2023), who indicated that Thengtuk dance (a type of Thai dance) applied based on ACSM (2020) guidelines improved cognitive functioning among older Thai adults [31]. Additionally, a systematic review reported that

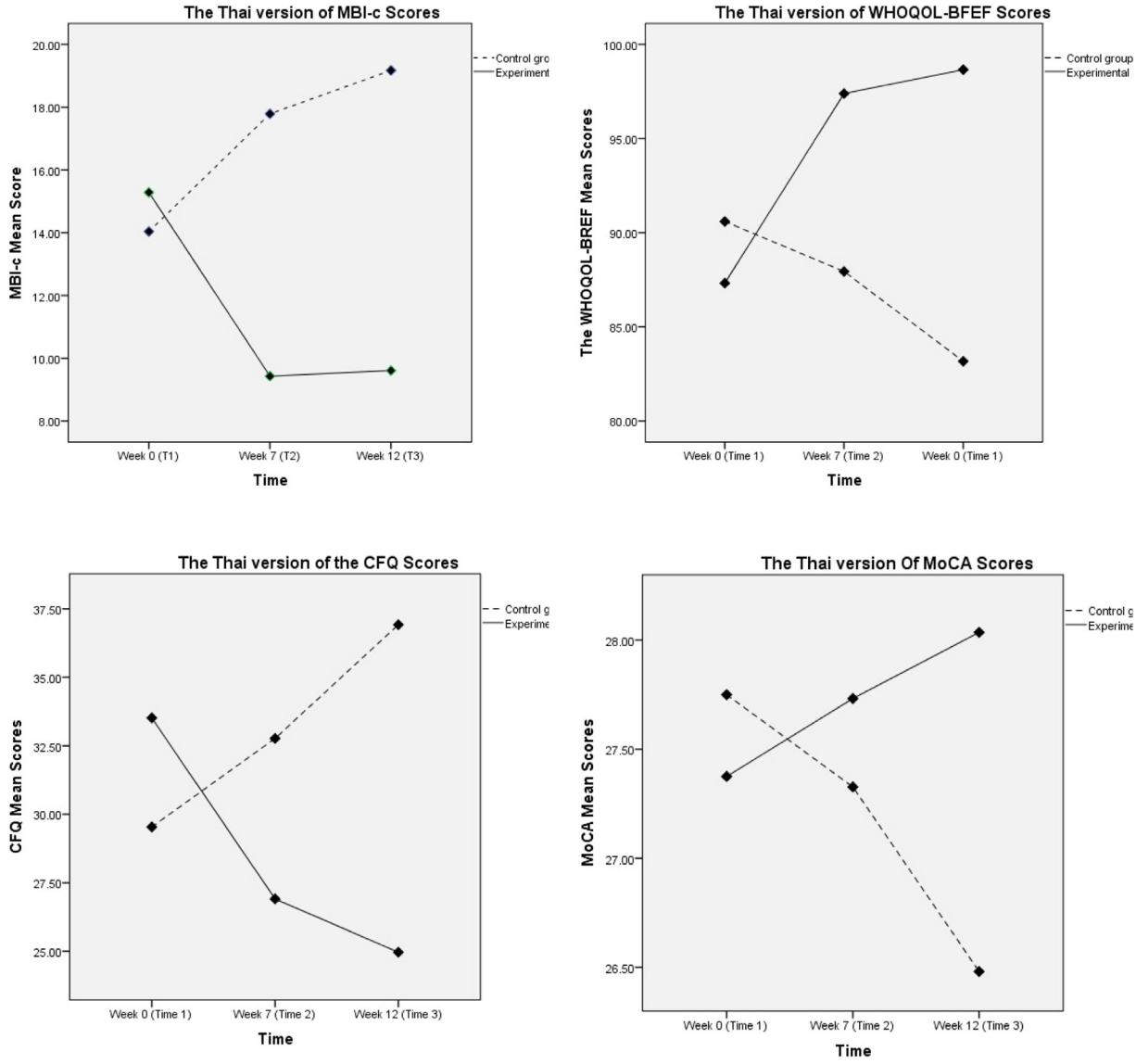

Fig. 2. Comparisons of Means the Thai Version of MBI-c, WHOQOL-BREF, CFQ, and MoCA Scores.
Abbreviations: MBI-C, Mild Behavioral Impairment Checklist; WHOQOL-BREF, World Health Organization Quality of Life-Brief; CFQ, Cognitive Failure Questionnaire; MoCA, The Montreal Cognitive Assessment.

traditional folk dances can improve QoL [32]. Traditional dance also provides older adults with opportunities for social interaction through music, fostering a sense of enjoyment and engagement, which can further enhance psychological well-being and social connectedness [33]. A systematic review and network meta-analysis by Xiang and Zhang (2024) demonstrated that cognitive stimulation interventions combined with PA could influence plasticity, benefiting older adults' behavioral or neuropsychiatric symptoms, QoL, and cognitive functioning, with a moderate effect size [34]. Although evidence supporting the use of interventions to specifically improve MBI is limited, numerous interventions exist for neuropsychiatric symptoms in older adults with clinical dementia. For instance, Mendonça et al. (2021) suggested that moderate-intensity PA could trigger the release of neurotransmitters such as serotonin and dopamine [35], which are associated with improvements in mood, anxiety, and depression [36].

Traditional Thai folk dance combined with cognitive stimulation enhanced cognitive reserve and led to slight improvements in both subjective and objective cognitive functioning, as measured by CFQ and MoCA scores, respectively, among the experimental group. This finding is consistent with Wang et al. (2024), who reported that a 7-week cognitive training and lifestyle intervention significantly improved cognitive functioning in Chinese older adults [37]. Similarly, Jeong et al. (2021) demonstrated in an RCT that 12 twice-weekly, 90-minute sessions of a multicomponent program, combining cognitive and physical exercise multitask training, resulted in cognitive improvements for Korean older adults [38].

Although this study presents positive effects of the intervention, several limitations should be addressed. First, the generalizability of the results is limited because the program was tested on a single sample within one setting, predominantly consisting of female participants. Adaptations might be necessary when translating the program for Western populations. Second, ensuring treatment fidelity requires that participants consistently apply the PA skills learned during the intervention. The use of objective tools, such as ActiGraph, to measure daily PA levels would ensure that participants engage in moderate-intensity PA, which is crucial for enhancing cognitive functioning. Third, the potential influence of apathy in participants with MBI warrants consideration, as reduced motivation may impact the effectiveness of the intervention.

Future studies should investigate the moderating effects of apathy to better understand its role in intervention outcomes and participant engagement. Lastly, the specific effects of the cognitive stimulation component on cognitive outcomes in older adults with preclinical dementia remain unclear. Future studies should focus on evaluating these outcomes.

5. Conclusion

The traditional Thai folk dance combined with cognitive stimulation program was effective in alleviating MBI as an early sign of dementia, improving QoL, resolving cognitive lapses, and maintaining cognitive functioning in older adults without dementia. This intervention, characterized by its cost-effectiveness, safety, enjoyment, and ability to foster social connectedness, is recommended for a minimum duration of 7 weeks. Specifically, a traditional folk dance combined with cognitive stimulation program is advised to increase daily levels of PA, mitigate behavioral impairments and cognitive decline, enhance QoL, and enhance cognitive functioning, particularly among older adults in rural communities. Furthermore, a group traditional folk dance combined with cognitive stimulation program is a beneficial and enjoyable activity for promoting social connectedness among older adults.

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Ethics statement

We obtained full board permission and ethical approval for this study from the Institutional Review Board, Suan Dusit University, Thailand (SDU-RDI-HS 2024–020). Written informed consent for participation in this study was provided by the participants.

Conflicts of Interest

No conflict of interest has been declared by the authors.

CRediT authorship contribution statement

Panawat Sanprakhon: Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Wachira Suriyawong:** Writing – review & editing, Writing – original draft, Software, Methodology, Conceptualization, Investigation. **Natsala Longphasuk:** Methodology, Data curation. **Natsuda Khatichop:** Investigation, Formal analysis, Data curation. **Churai Arpaichiraratana:** Writing – review & editing, Investigation, Data curation. **Sresuda Wongwiseskul:** Methodology, Investigation, Data curation. **Peerayut Rattanaselanon:** Validation, Data curation, Conceptualization. **Noppamas Pipatpiboon:** Writing – review & editing, Supervision, Methodology. **Papan Thaipisuttikul:** Writing – review & editing, Supervision, Conceptualization.

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