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Effects of cognitive training on fall risk and cognitive performance in individuals with mild cognitive impairment

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ABSTRACT

Background: Accumulating evidence suggests that older adults with mild cognitive impairment (MCI) not only had cognitive impairment but also fall risk. Cognitive training has been shown to either improve cognitive function or reduce fall risk among older adults with and without cognitive impairment. Only a limited number of studies have investigated the beneficial effects of cognitive training on both cognitive performance and fall risk in older adults with MCI and the findings have been inconclusive.

Objectives: To examine the effectiveness of cognitive training program on fall risk and cognitive performance in older adults with mild cognitive impairment.

Materials and methods: Forty older adults with MCI (mean age 68.91±4.25) were randomized into the intervention group (n=20) and control group (n=20). Participants in the intervention group underwent cognitive training program for 60-70 minutes per session, 3 times per week for 12 consecutive weeks. The control group received educational tutorial covering cognitive enhancement and fall prevention strategies. Outcome measures were fall risk including Timed Up and Go test (TUG) single and dual task, Physiological Profile Assessment (PPA), and cognitive performance including, Alzheimer's disease Assessment Scale (ADAS-cog), Verbal Paired Associated (VPA)-immediate recall, and Trail Making Tests (TMT). All outcomes were assessed at baseline and the end of the 12-week training.

Results: At the end of 12-week training, participants in the intervention group had significantly better performance on ADAS-cog, VPA-immediate recall, and TUG dual task compared to the control group (p=0.007, p=0.033, and p=0.006 respectively). They also demonstrated significant improvement on TUG single and dual task, ADAS-cog, VPA-immediate recall, and TMT B-A from baseline (p=0.006, p=0.002, p=0.001, p=0.012, and p=0.019 respectively), whereas these improvements were not observed in the control group.

Conclusion: The 12-week cognitive training program has a beneficial effect in improving global cognitive function, memory, and decreasing fall risk while performing functional mobility in concurrent with cognitive task in older adults with MCI. The findings suggest that cognitive training should be considered when designing a fall prevention program for older adults with MCI.

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Introduction

Cognitive impairment such as dementia and Alzheimer's disease (AD) is a common geriatric syndrome that leads to functional decline and loss of independence in older adults.[1] Mild cognitive impairment (MCI) is the transitional state between early dementia and normal cognitive function.[2] Rate of progression to dementia is about 3 to 5 times greater for older adults with MCI as compared to cognitively intact older adults.[3] However, unlike Alzheimer's disease and dementia, MCI is potentially reversible.[4] Previous study found that approximately 44 percent of older adults with MCI return to normal cognition one year after the first assessment.[5] Therefore, MCI has been regarded as the target population for preventive interventions of dementia.

Executive function, episodic memory, and attention are neurocognitive domains often impaired in persons with MCI.[6, 7] Emerging evidence has demonstrated that cognition particularly, attention and executive function which consisted of mental flexibility, updating working memory, and inhibition is associated with gait, balance, and falls.[8, 9] Moreover, a series of dual-task studies have demonstrated that persons with cognitive impairment showed decreased gait speed and increased gait variability when walked under dual-task condition.[10, 11] These findings suggest that cognitive impairment, balance and gait impairment are linked. Furthermore, previous studies revealed that older adults with MCI not only demonstrate cognitive impairment, but also balance and gait impairment.[12, 13] In line with these findings, it has been reported that the incidence of falls in older adults with MCI was twice that of cognitively intact peers.[14] Thus, older adults with MCI are at increased risk of dementia and falls. Therefore, interventions that could improve both cognitive function and reduce risk of falls in this population are imperative.

Systematic review and meta-analysis have concluded that cognitive interventions are an effective method to delay cognitive decline in MCI. The training duration of 12 weeks is recommended as this period has been shown to be sufficient to demonstrate the sustained effects of training on cognition without inducing the attrition risk.[15, 16] While extensive studies have demonstrated benefits of cognitive training on cognitive outcomes, only a limited number of studies have examined their effects on gait, balance, and fall risk and findings have been inconclusive. Li et al.[17] found that healthy older adults who received computer-based cognitive intervention involved executive function training skills over 10 weeks improved significantly in body sway compared with baseline, while the control group showed no improvement. In addition, Smith-Ray et al.[18] found that cognitively intact older adults who received computer-based cognitive training program which focused on executive function demonstrated significantly better performance on the Timed Up and Go (TUG) and 10 meters walk test (10MWT) than the control group. However, in their later study, they only found an improvement trend for TUG and other 4 of 5 standing balance outcomes when implemented the cognitive training program to older adults with cognitive impairment.[19] The authors attributed the discrepancies in findings to methodological limitations in the study including the lack of information on confounding factors (i.e. polypharmacy and change in social engagement) and the use of pre-post, within-subject design. Taken together, further research is warranted to confirm the beneficial effects of cognitive training on gait, balance, and falls. Furthermore, studies that concurrently explore the effects of cognitive training on both cognitive and physical outcomes are scarce. This information would provide better understanding regarding the link between cognitive and physical functions.

Therefore, the present study aimed to examine the effects of cognitive training on fall risk and cognitive performance in older adults with MCI and hypothesized that cognitive training would significantly reduce fall risk and improve cognitive performance compared to controls.

Materials and methods

Design and Participants

A cluster randomized controlled trial design was used in the present study to avoid contamination between the intervention and control groups. The sample size calculation was based on the following assumptions: a general linear model, medium effect size (0.24), a power of 0.80, and an alpha level of 0.05. The effect size of 0.24 was obtained from the PPA fall risk score from the pilot study. With this, a total sample size of 34 participants was required. To accommodate 15% drop-out, a total sample size of 40 participants (20 participants per group) was recruited in the study.

Forty older adults aged 65 years or older with MCI were recruited from the local communities in Chiang Mai. All participants met the following criteria for MCI:[20] (a) subjective concern on declining cognitive function or changing in cognition by the participants and/or informant, (b) objective cognitive impairment in one or more cognitive domains, (c) generally independence in everyday functioning, (d) absence of clinical dementia which determined by Mental State Examination T10 (MSET10).[21] Other inclusion criteria were presence of mild impairment based on the Montreal Cognitive Assessment (MoCA) score of <23[22], able to walk without an assistive device at least 10 meters, and able to follow the study procedures.

Participants were excluded if they had neurological conditions (e.g. cerebrovascular Disease, multiple sclerosis, and Parkinson's disease, etc), chronic diseases (e.g. severe cardiovascular disease, poorly controlled hypertension, and crippling arthritis) which affect gait and balance, depressive symptoms (Thai Geriatric Depression Scale (TGDS) ≥6), uncorrected visual or hearing impairment, participated in other cognitive training programs, treated with cognitive enhancing drugs, or exercised regularly (≥30 min/d, ≥3 d/wk). The study protocol was approved by the Human Ethical Review Board of the primary investigator's institution (COA No. AMSEC60EX024). All participants signed the written informed consent form and were asked for demographic data including age, gender, weight, height, medicine, education, and fall history prior to participation. A fall is defined as "an unexpected event in which a person comes to rest on the ground or lower level".[23]

Cognitive training protocol

Participants in the intervention group received cognitive training program. The training protocol was based on previous studies which shown to be effective for older adults with MCI.[24-26] Specifically, it covered three neurocognitive subdomains (i.e. memory, executive function, and attention) often impaired in people with MCI[6, 7] and associated with gait and balance.[8, 9] The training protocol included the following training components:

Memory training included the practice of using Method of Loci (MOL) technique, visual and auditory memory training. For the MOL technique, participants practiced remembering words by forming an association between the words and participant's familiar environment.[25] For visual memory training, they practiced remembering the objects and its location presented on the screen. They were asked to listen to a short story and remember its content in auditory memory training.[24]

Attention training included the practice of both visual and auditory attention. For the visual attention training, participants were asked to find the pair of cards which had the same letter/picture sequences.[26] They practiced detecting specific words in a song in auditory attention training.[24]

Executive function training included the practice of visuospatial skill through visual perception, inhibition training, and simulated tasks in activity of daily living that require executive function. For visuospatial skill training, participants practiced visual perception by associating body positions with object positions or the relationship between objects.[26] For inhibition training, they were asked to respond or not respond to certain conditions predetermined in the game's rule. Finally, complex tasks in activity of daily living such as creating a recipe from the ingredients available, describing a cooking process, calculating the total cost of goods.[24]

The cognitive training was implemented in a group-based setting (3-5 persons per group) by one physiotherapist researcher. Participants attended 60-70 minutes per session, 3 days per week for 12 consecutive weeks (36 sessions). The training program was classified into 3 phases based on the level of cognitive demand. The training program was progressed every 4 weeks in a group based format.

Participants in the control group received educational tutorial covering cognitive enhancement and fall prevention strategies. A weekly phone call was delivered to each participant to monitor their general health and activities. Furthermore, participants in both groups were asked to maintain their routine lifestyle throughout the study period and to inform the research team if any unexpected events occurred. Participants who missed the class ≥20% of the total training sessions or unable to complete both pre- and post- assessment were withdrawn from the study.

Outcome measurement

The outcome measurement were fall risk (Timed Up and Go test and Physiological Profile Assessment) and cognitive performance (Alzheimer's Disease Assessment Scale, Verbal Paired Associated-mmediate recall, and Trail Making Tests). Structured instructions and demonstration of each test were given to the participants prior to testing. All outcomes were assessed at baseline and the end of the 12-week training by blinded assessors. Each outcome measure (i.e. PPA, TUG, cognitive outcomes) was administered by one assessor, therefore, baseline and post-training assessment for each test was performed by the same assessor. The assessors were physiotherapists trained by experienced geriatric physiotherapist or neuropsychologist to deliver the assessment using a standard protocol. All assessors practiced administering the test to ensure that they provided standardized assessment prior to data collection.

Timed Up and Go test (TUG)

TUG is extensively used as a routine screening test for falls in older adults. TUG is a functional mobility test that involves activities in daily life through an aspect of balance and gait assessment. The participants were asked to rise from a chair, walk as fast and safely as possible to a 3-meter line marked on the floor, then turn 180 degrees and walk back to the chair and sit down.[27] Furthermore, the TUG dual task was assessed in the study. The participants were instructed to perform the TUG test in concurrent with the naming test in each trial (i.e. animal and fruit naming tests).[28] Two trials were undertaken and the average time to complete the trials was recorded.

Physiological Profile Assessment (PPA)

The PPA is used to evaluate risk of falls through directly assessing an individual's physiological abilities. The short version of PPA was used in the study. It involves five simple tests of vision (edge contrast sensitivity), knee proprioception, knee extension force, hand reaction time, and body sway.[29] Edge contrast sensitivity was assessed by using the Melbourne Edge Test, which includes 15 circular patterns containing edges with reducing contrast. The lowest contrast patch that the participant can identify correctly was recorded in decibel units. Knee proprioception was assessed by using lower limb matching test. The participants were asked to align their lower limbs on either side of a vertical clear acrylic sheet inscribed with a protractor which placed between their legs. The average of five differences in aligning the lower limbs was measured in degrees. A spring gauge was used to measure force of knee extensor muscle. The participant was asked to extend the dominant knee against the spring gauge with maximal force. The maximal force of the three trials was recorded in kilograms. For hand reaction time, the participant was asked to press the modified computer mouse with their finger as fast as possible in response to the light stimulus. An average of 10 testing trials was recorded in milliseconds. Finally, the sway meter was used to measure a displacement of body sway. The participants were asked to stand on medium density foam with eyes open for 30 seconds. The sway path was recorded in millimeter. PPA composite score which calculated from the five subdomains through the NeuRA FallScreen® software was used to indicate fall risk. The higher composite PPA scores indicate higher risk of falling.[29]

Alzheimer's Disease Assessment Scale (ADAS-cog)

The ADAS-cog was used to measure global cognitive function in the study. The ADAS-cog is the most commonly used test to measure cognitive changes in persons with Alzheimer's disease (AD).[30] It has also been verified to be useful for assessing cognitive function among individuals with MCI.[31, 32] The ADAS-cog consists of 11 test items as follows; word recall, naming, commands, constructional praxis, ideational praxis, orientation, word recognition and 4 questions for the assessor to rate the participant's ability on remembering test instructions, language, comprehension of spoken language and word finding difficulty. The higher the ADAS-cog score indicates the greater severity of cognitive impairment.[30]

Verbal Paired Associated-immediate recall (VPA-immediate recall)

The VPA-immediate recall was used to assess memory in the study. It is a subtest in the Wechsler Memory Scale-III (WMS-III). The participants were asked to remember eight pairs of related and unrelated words which the assessor read. Then, the assessor read the first word of each pair and the participants were asked to provide the corresponding word. The higher score of average three testing trials indicates a greater memory performance.[33]

Trail Making Tests (TMT)

The TMT is one of the most commonly used tests to measure executive function. The TMT consists of 2 parts, A and B. In the TMT Part A, the participants were asked to draw a line to connect the consecutive numbers as fast and correctly as possible (e.g. 1–2–3). For TMT Part B, they were asked to draw a line to connect consecutive numbers and Thai letters alternately (e.g. 1–ก–2–ข–3) as quickly and correctly as possible. The difference between the time taken to complete part B and A (B-A) was used as a measure of task switching ability, a subdomain of executive function. A smaller difference score indicates better shifting ability.[34]

Statistical analysis

All statistical analyses were performed using SPSS software (version 21.0, IBM Corporation, Chicago, IL). Tests of data normality were performed using the Shapiro-Wilk test. The demographic data of the two participant groups were compared by using independent student t-test and Chi-Square test. Two-way mixed model repeated measures ANOVA was used to compare the outcome measures across the two different assessment intervals (at baseline and the end of 12-week training) and between the two groups. The significance level was set at $p<0.05$, 2-sided. Partial eta-squared (η_p^2) was used to estimate effect size in the present study. The equation of partial eta-squared is

$$\eta_p^2 = \frac{SS_{effect}}{SS_{effect} + SS_{error}}$$

; where SS is sums of squares. Partial eta-squared values are interpreted as follows: 0.01 or more are small effect size, 0.06 or more are medium effect size, and 0.14 or more are large effect size.[35]

Results

Participants

Forty older adults with MCI aged between 65-80 years old (mean 68.91±4.25 yr.) participated in this study. There were no significant differences in any demographic characteristics between the two groups ($p>0.05$). Participant demographic characteristics are shown in Table 1. Participants in the intervention group attended the class with an average of 33.95±.39 sessions (range 30-36 sessions). No participant was withdrawn from the study.

Table 1 Baseline characteristics of participants (N=40).

Characteristic	Intervention Group, n = 20	Control Group, n = 20
Age, yr	68.78±4.52	69.03±4.07
Sex, female, n (%)	17 (85)	17 (85)
Weight, Kg	55.29±11.92	57.46 ±7.93
Height, cm	153.40±5.47	154.00±4.77
Education, yr	5.05±2.63	5.05±2.16
Number of types of medicine	0.85±0.99	0.85±1.44
Falls of the past year, n (%)	5 (12.5)	1 (2.5)
MSET10 score (0-29 points)	24.55±2.24	23.70±2.39
MoCA score (0-30 points)	17.55±2.48	18.9±2.67
TGDS score (0-15 points)	2.60±1.50	2.10±1.65

Note: *All values are means±SD except for gender and falls of the past year, MSET10: Mental State Examination T10, MoCA: Montreal Cognitive Assessment, TGDS: Thai Geriatric Depression Scale.*

Cognitive Performance

There was no significant difference between the intervention and control groups for baseline cognitive outcomes. The significant group x time interaction was found in ADAS-cog and VPA-immediate recall test (Table 2). At the end of 12-week, the intervention group had significantly better performance on ADAS-cog score and VPA-immediate recall than the control group (*p*=0.007 and *p*=0.033, respectively). In addition, participants in the intervention group demonstrated significant improvement in ADAS-cog and VPA-immediate recall from their baseline (*p*=0.001 and 0.012, respectively). The time taken to complete TMT B-A for the intervention group significantly decreased from baseline (*p*=0.019) while this was not observed in the control group.

Table 2 Cognitive performance between the intervention and control group at baseline and the end of 12-week.

Cognitive performance	Intervention Group (n=20)		Control Group (n=20)		Group x Time Interaction		
	Baseline	Post-assessment	Baseline	Post-assessment	F (1,38)	*P*-value	η_p^2
ADAS-cog (points)	7.68±2.75	4.93±2.07 [a, b]	7.42±3.19	7.72±3.82	10.664	0.002	0.219
VPA-immediate recall (points)	4.55±1.38	5.27±1.31 [a, b]	4.25±1.25	4.12±0.77	4.821	0.034	0.113
TMT part B-A (sec)	238.49±179.65	150.06±89.31 [b]	211.16±135.61	183.20±88.57	1.626	0.210	0.041

Note: *All values are means±SD, ADAS-cog: Alzheimer's Disease Assessment Scale-cognitive section (total score = 70 points), VPA – immediate recall: Verbal Paired Associated-immediate recall (total score = 8 points), TMT: Trail Making Test, a Significant difference between two groups; b Significant difference between baseline and post-assessment.*

Fall risk

There was no significant difference in baseline of fall risk between the intervention and control groups. The significant group x time interaction was found in TUG-single and dual task (Table 3). At the end of 12-week, participants in the intervention group took significant lesser time to perform TUG-dual task than the control group (*p*=0.006). Their performance on TUG for both single and dual task significantly improved from baseline (*p*=0.006 and 0.002, respectively) while it did not change for controls. PPA composite score and its components were comparable between the two groups both at baseline and post-intervention.

Table 3 Fall risk outcomes between the intervention and control group at baseline and the end of 12-week.

Fall risk outcomes	Intervention Group (n=20)		Control Group (n=20)		Group x Time Interaction		
	Baseline	Post-assessment	Baseline	Post-assessment	F (1,38)	*P*-value	η_p^2
PPA composite score	1.51±1.07	1.21±1.29	1.35±0.69	1.26±0.72	0.459	0.502	0.012
• Vision (dB)	20.15±1.73	19.40±3.45	20.55±1.76	20.65±2.58	1.011	0.321	0.026
• Knee Proprioception (deg)	2.65±1.14	2.34±1.27	2.08±0.97	2.25±1.29	0.788	0.380	0.020
• Knee strength (kg)	17.70±8.24	20.75±5.43	19.60±5.83	19.95±5.58	1.261	0.269	0.032
• Hand reaction (msec)	291.82±45.31	273.33±29.13	304.18±54.56	292.85±50.91	0.171	0.682	0.004
• Sway path (mm)	196.70±108.37	179.95±124.64	167.15±87.89	163.70±63.58	0.239	0.628	0.006
TUG single task (sec)	8.69±0.97	8.09±0.97 [b]	8.22±1.31	8.59±1.13	10.641	0.002	0.219
TUG dual task (sec)	10.56±1.48	9.12±1.33 [a, b]	10.52±1.82	10.58±1.83	5.953	0.019	0.135

Note: *All values are means±SD, PPA: Physiological Profile Assessment, TUG: Timed Up and Go, a Significant difference between two groups, b Significant difference between baseline and post-assessment.*

Discussion

This study aimed to investigate the effectiveness of the cognitive training program on fall risk and cognitive performance in older adults with MCI. The results partly support the study hypothesis in that the 12-week cognitive training was effective in improving certain aspects of cognitive function and fall risk. After 12-week training, participants in the intervention group demonstrated significantly better performance on global cognitive function and memory as assessed by ADAS-cog and VPA-immediate recall, respectively, and significantly decrease fall risk as assessed by TUG with dual task as compared to controls.

The finding that the intervention group significantly improved performance on ADAS-cog after cognitive training suggests the beneficial effect of the program on global cognition. This finding is consistent with previous studies which found that persons with MCI had a significant improvement in ADAS-cog score after receiving cognitive intervention.[31, 32] The average magnitude of change in ADAS-cog score after cognitive training in the present study was slightly greater than that reported in previous studies[31, 32]; however, still considered in the same range. Such comparable gain observed might be due to the similarity in cognitive domains (i.e. memory, attention, and executive function) covered in the training protocol across studies. Further analysis of the ADAS-cog's subparts revealed that only improvement of word recognition test reached statistical significance. This finding suggests that the improvement of ADAS-cog was due mainly to memory improvement.

Similar to ADAS-cog, participants in the intervention group showed significantly greater VPA-immediate recall scores when compared to the control group and their baseline. This finding is consistent with previous studies that reported the beneficial effect of cognitive training in improving memory of persons with MCI.[24, 36] The VPA-immediate recall test required the participants to remember related and unrelated word list. It is likely that the Method of Loci (MOL), a memory enhancement strategy, included in the cognitive training protocol is responsible for the gain in the VPA-immediate recall scores. Specifically, the Method of loci technique activated their sequential retrieval ability by recall unrelated list item via a self-generated mental association between the new information and the information that already known. In addition, repetitive practice might be another factor contributing to memory improvement as repetition has been proven to be one effective strategy that persons with cognitive impairment use to gain new information.[37]

On the whole, the present study revealed the potential benefit of the cognitive training program in improving cognition in part of global cognitive function and memory of older adults with MCI. Previous study suggested that cognitive training induces neural plasticity, stimulates neuron activity at bilateral temporal poles, insular cortices and hippocampus cortices.[38] Increasing in neural volume and changing in neural activity occurs when face with novel and challenging task.[39] Thus, it may be possible that the cognitive training protocol in this study which included practice of new tasks with progression of difficulty might induce changes at the neuronal level, consequently resulting in memory improvement observed at the behavioural level. Further study of this aspect would provide insight into this issue.

For executive function, there was a significant difference in TMT B-A performance between baseline and post-cognitive training. A similar result has been demonstrated in a study by Boripuntakul et al.[24] which found that MCI participants who received 18-session cognitive training significantly improved their TMT B-A performance from baseline. However, contrary to the study hypothesis, TMT B-A performance did not differ between the two groups at the end of the trial. Fiatarone Singh et al.[40] also failed to demonstrate difference in executive function between the cognitive training and sham training group. The authors did not discuss why their results were not as expected. In the present study, we postulated that the large variability observed in TMT B-A data may account for the non-significant differences. In addition, the statistical analysis indicated small effect size of TMT part B-A as represented by the partial eta squared (η_p^2=0.041) (Table 2). Given a small effect size and large variability of the data, further research with larger sample size is required to confirm this finding.

The present finding demonstrated that the intervention group significantly improved in TUG single task performance from their baseline but there was no difference between the two groups after training. It is noteworthy that the time to complete TUG single task at baseline was quite short, suggesting that this test might not challenge enough for MCI participants in the present study. Therefore, there might be only a small room of improvement after training, not sufficient to reveal the difference between groups. A previous systematic review suggested that balance impairment in older adults with MCI were more pronounced when adding the cognitive load to the balance test (i.e. dual task).[41]

Dual-task paradigm has been widely used to examine the interaction between cognition and mobility function by having an individual to simultaneously perform another activity while walking.[11] The finding of significantly better performance in TUG dual task (motor-cognitive dual task) in the intervention group compared to the control group supports the existing knowledge that cognitive process is associated with gait, balance, and falls.[8, 9] Previous studies reported that not only executive function and attention are associated with gait and balance, but global cognitive function and memory are also linked to gait and balance performance.[9, 42-43] Thus, the improvement of TUG dual task performance in the intervention group might be explained by the improvement of memory and global cognitive function after 12-week cognitive training. The result of this study was in line with findings from previous studies which demonstrated improvement of gait and balance performance after implemented the cognitive training program in cognitively intact older adults.[18, 44] Based on our knowledge, this study is among a few studies that investigated the impact of cognitive training on fall risk in older adults with MCI.

The finding of PPA outcome did not support the study hypothesis. The PPA evaluates risk of falls through directly assessing an individual's sensorimotor abilities including vision, proprioception, knee extension force, hand reaction time, and body sway. It is expected that reaction time and postural sway would improve after cognitive training as these tasks related to cognitive function, consequently resulting in improving the PPA composite score. However, the results showed no significant improvement in both subtests. It may be possible that the simple reaction time test and static postural sway used in the PPA were not sufficiently challenged to detect changes in individuals with MCI.

Although the results of this study provide the potential benefits of the cognitive training program in improving cognitive function and reducing fall risk in older adults with MCI, there are some limitations to this study. Given the large variability and small effect size observed in some outcome measures, the study may not have sufficient power to detect changes. Additionally, the effects of cognitive training were examined immediately after the training cessation. Thus, it is unknown whether the training effects would retain for the longer term. A study with larger sample size and long term follow up is required to confirm these findings. Moreover, future research that investigates neuronal responses would provide better understanding about the underlying mechanisms of cognitive training in improving cognitive function and reducing risk of falls.

Conclusion

The present study demonstrated that 12-week cognitive training for 3 times per week could improve global cognitive function, memory and decrease fall risk while performing functional mobility in concurrent with cognitive task in older adults with MCI. Overall findings suggest that cognitive training had beneficial effects on certain aspects of cognitive function and fall risk. Therefore, cognitive training may be considered when designing a fall prevention program for older adults with MCI.

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Conflict of interest

The authors declare no conflict of interest.

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