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Improvement of attention and episodic memory functions in community-dwelling elderly with cognitive impairment: A preliminary study using a multimodal method

Saifon Bunyachatakul[1,2] **Phuanjai Rattakorn**[1] **Peeraya Munkhetvit**[1*]

[1]*Department of Occupational Therapy, Faculty of Associated Medical Sciences, Chiang Mai University, Chiang Mai Province, Thailand*
[2]*PhD candidate, Graduate School, Chiang Mai University, Chiang Mai Province, Thailand*

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ABSTRACT

Background: Global geriatric populations will result in increased rates of cognitive decline and dementia; elderly people may suffer from deterioration in cognitive ability, and particularly in attention and memory, that affects their functional independence. Thus, the combination methods of cognitive training are beneficial for enhancing their cognitive abilities and in slowing down the rise in numbers of demented elderly who live with cognitive impairment in the community.

Objectives: To determine the effects of a multimodal episodic memory training (MEMT) protocol on attention and episodic memory performance in community-dwelling elderly with cognitive impairment.

Materials and methods: Participants were the older adults living in community who are the members at the elderly school in the suburban municipal district, Chiang Mai province, Thailand. Twenty elderly with cognitive impairment were recruited through purposive sampling and assigned to the experimental group (n=10) and control (n=10). The experimental group received in a 36-sessions multimodal episodic memory training (MEMT) protocol including episodic memory training, multisensory stimulation, and mindfulness-based yoga training over 12 consecutive weeks. The attention and episodic memory scores were measured at baseline and after the intervention.

Results: Participants receiving the MEMT protocol intervention demonstrated statically significant improvement ($p<0.05$) on attention and memory as compared with the control group, which showed no statically significant differences at the post-intervention.

Conclusion: The findings of this study suggest that the 36 sessions within 12-week MEMT protocol intervention revealed the potential evidence in improving attention and memory in community-dwelling elderly with cognitive impairment.

Introduction

Aging populations are at a greatly increased risk of developing cognitive impairment and Alzheimer's disease. These conditions are associated with diminished cognitive function abilities that adversely affect them, their families, and society. Elderly with mild cognitive impairment referred to as objective cognitive complaints about age, in a person with essentially normal functional activities, who do not have dementia.[1] It affects 19% of people aged 65 and over.[2] Around 46% of people with mild cognitive impairment develop dementia within three years compared to 3% of the population of the same age.[3] Mild cognitive impairment often demonstrates deficits in certain cognitive domains, particularly in episodic memory, attention, and executive function.[4] Episodic memory impairment is a core feature of Alzheimer's disease and mild cognitive impairment. The

* **Corresponding author.**
Author's Address: *Department of Occupational Therapy, Faculty of Associated Medical Sciences, Chiang Mai University, Chiang Mai Province, Thailand*
** **E-mail address:** : peeraya.ot@gmail.com
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episodic memory impairment includes deficits in list recall of words, sentences or stories, and recognition memory for words, drawings or pictures. The issue of forgetting over time is of great importance. Indeed, it has been frequently shown that to-be-remembered information is rapidly lost, as measured by significantly impaired delayed free recall tasks; even when inducing deep semantic processing maximizes encoding.[5]

Medical service provision for elderly with mild cognitive impairment includes pharmacological treatment and non-pharmacological treatment. However, the standards of care did not recommend the approval to use any medications to reduce mild cognitive impairment symptoms.[5] Cognitive training is an alternative treatment used among the elderly with mild cognitive impairment to promote the decrement of the severity of mild cognitive impairment. Cognitive training program was effective in reducing the impairment in cognitive domains with memory, attention, and reasoning which affect the ability to perform activities in daily life and have better well-being.[6] A systematic review has reported on the effectiveness of cognitive interventions targeted at remediating memory processes; include training to stimulate visual and auditory attention, memory, abstract thinking, and constructional ability. The evidence-based of cognitive and episodic memory training in several studies have investigated non-pharmacological treatment effects of cognitive and episodic memory training intervention among individuals with mild cognitive impairment. This training revealed the increasing of cognitive score and functional performance[7] and uses of memory strategies have been found to enhance memory performance within an elderly population.[8] Effective strategies encourage deeper analysis and elaborative encoding of the material to be recalled, and a level of processing which enhances retrieval.[9] Another non-pharmacological treatment, multisensory stimulation (MSS) is a specifically designed room containing a variety of equipment to stimulate the senses of sight, hearing, touch, taste, and smell.[10] MSS provides a non-threatening environment through the sensory stimulation activities and an enriched environment that is beneficial to mediate relaxation and promote emotional benefits with enjoyment experience, with consequent enhancement of motivation to participate in occupations as well as improvement of attention span, memory and functional performance.[11] Additionally, the mindfulness-based yoga training is associated with physical yoga discipline includes asanas (postures), pranayama (breathing techniques), and dhyana (meditation).[12] Tools to withdraw the senses (pratyahara), concentrate the mind (dharana), and develop unwavering awareness (dhyana) manifest from dedicated yoga practice.[13] Yoga practice comprises not just stretching, but rather dynamic movements tied to the breath. Indeed, yoga is associated with multiple health benefits including increased physical stamina, balance, flexibility, and relaxation.[14] However, yoga also appears to offer potential psychological benefits through the inclusion of mindfulness training, involving the practice of meditation as well as the dynamic combination of proprioceptive and interoceptive awareness.[15] Regular practice of mindfulness skills results in both awareness and profound focus by drawing attention to the present moment without judgment. Previous evidence also supports the ability of mindfulness meditation to improve aspects of cognitive functioning, such as attention- and memory-related parameters.[16] Similar to aerobic exercise, even brief mindfulness meditation training has been found to be effective in improving cognition.[17]

Furthermore, previous studies demonstrated that the benefits of cognitive intervention combined with other promising non-pharmacological intervention like multi-facet cognitive program including mindfulness, yoga, physical activity, art therapy, music therapy resulted in cognitive performance improvement in mild Alzheimer's disease and mild cognitive impairment[17, 18] and sustained beneficial effect within 4-6 months after the end of the program.[19]

This study hypothesized that three combination multimodal interventions; episodic memory training, multisensory stimulation, and mindfulness-based yoga training would result in improvements in cognitive function. Therefore, the aim of the present study was to determine the benefits using a multimodal episodic memory training (MEMT) protocol intervention for enhancing cognitive and episodic memory performance in elderly with cognitive impairment.

Materials and methods

Participants

In the present study, twenty community-dwelling elderly were recruited from members at Nong-Kwai elderly school in suburban municipal district, Chiang Mai, Thailand. Inclusion criteria for participants were: 1) either male or female aged between 60-80 years old, 2) complained of memory decline, 3) absence of depressive symptom which determined by the TGDS[20] (Thai Geriatric Depression Scale), 4) had scored 19-23 points in MSET10[21] (Thai Mental State Examination), and 5) had graded with mildly impaired of cognitive function which measured by the KASCA[22] (Kendrick Assessment Scales of Cognitive Ageing). The exclusion criteria used in the study including; having previous diagnosis of either dementia, or Alzheimer's disease, or any cerebrovascular accident history. The study protocol was conformed to the ethical guideline of Declaration of Helsinki as reflected in a priori approval by the institution's human research committee. Informed written consent was obtained from all participants prior to taking part in the study.

Multimodal episodic memory training protocol

Multimodal episodic memory training protocol (MEMT protocol) emphasized on attention and episodic memory functions and it was developed based on the knowledge and theoretical literature review of previous cognitive training programs,[18, 24, 32] multisensory stimulation[11] in person with cognitive impairment, and mindfulness based yoga training.[23, 32] MEMT protocol was integrated into group-based activities that consisted of the combination of the episodic memory training, multisensory stimulation and mindfulness based yoga training. Episodic memory training activities was included paper-based activities and mnemonic memory strategies training, the multisensory stimulation activities was provided a variety of sensory stimulation thoroughly

a specific environmental-setting or recreational and ludic activities, and the mindfulness based yoga training was based on the mindfulness Yin Yoga practice.[23] MEMT protocol contents are presented in Table 1.

Table 1 Detailed content of MEMT protocol component.

Component	Content
Episodic memory training Reality orientation	Group-based activities (paper-based, tabletop) • Inquire about the current date, place, weather, what happened today
Attention	• Stimuli through the techniques of attention in a group; i.e. clapping when a specific number or word was spoken out by the leader, naming the color of words
Autobiographical memory	• Recalling events of their personal lives, story-telling
Recall Memory	• Use mnemonics memory strategies, story-recall, shopping list recall, face-name association, remember the location on the map
Multisensory stimulation	Provided a variety of sensory stimulation thoroughly a specific multisensory room setting or recreational and ludic activities • Use relaxing sound and music • Use sound stimuli and body movement • Tactile stimuli of objects, hand massage • Use flavors odors
Mindfulness based yoga training	Based on the manual of mindfulness Yin Yoga practice[23] step by step training • Slow and hold position in each movement practice • Awareness of body movement and slow breathing exercise

Procedure

A matched pair was used with the matched by age, gender, and education as summarized in flow diagram (Figure 1). Twenty participants were allocated within pairs to either the control or the experiment group. Participants in the experimental group (n=10) received MEMT protocol intervention while those in control group (n=10) did not received the MEMT protocol intervention. The experimental group took part in a 36-session group-based MEMT protocol intervention. Each session of intervention lasting about 2 hours, with the 40-minute in combination of multisensory stimulation and mindfulness-based yoga training and followed the 80-minute episodic memory training activities, 3 days per week for 12 consecutive weeks.[24]

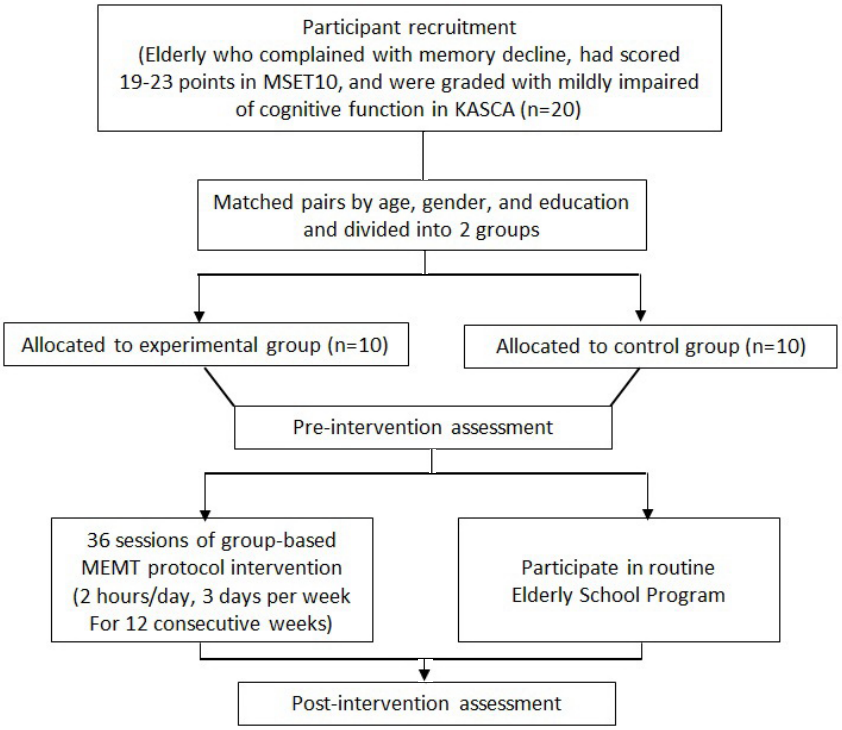

Figure 1. *Flow diagram of the study.*

Outcome measures

The outcome measurements of cognitive function are tests of specific domains of attention of everyday memory, episodic memory, and level of mindfulness are as follows.

Digit Span forward-backward test

The test was used to assess attention, a series of lists of numbers present verbally to participants. Participants are asked to immediately repeat the numbers verbally either in forward or the backward numerical order.[25]

Thai Cognitive-Perception Test (Thai-CPT)

Thai-CPT test has a validity and reliability to assess cognitive and perceptual functions. The test consists of six subtests incuding visual perception, body scheme perception, praxis, memory, matching and categorization, and problem solving. This study emphasized everyday memory by using a memory subtest, which is divided into 5 topics; auditory Thai alphabet memory; visual Thai alphabet memory, auditory object names memory, visual object names memory, and object recognition.[26]

Episodic memory test

Episodic memory is examined using the Logical Memory-Delayed Recall and Logical Memory-Recognition subtests.[27] During the test, participants were instructed to listen carefully to two stories and remember the content of the stories. After a 30-minute delay, they would be asked to repeat each story as close to the original story as possible (Delayed Recall) and provide "Yes" or "No" answer in response to a series of 30 questions (Recognition).

Mindfulness Attention Awareness Scale (MAAS)

MAAS is a 15-item instrument measuring mindfulness.[28] Each item is scored from 1 (almost always) to 6 (almost never). Total score for MAAS is computed by calculating the mean across items. For MAAS, high scores indicate higher levels of mindfulness. It is a single factor measure that includes the following aspects of mindfulness: attention to and awareness of present-moment experiences in daily life.[30]

Data analysis

Chi-square test was used to analyze demographic comparison between control and experimental groups. Comparisons of the outcome measurement scores before and after the MEMT protocol intervention were carried out using the Mann-Whitney U Test. Significance was set at $p<0.05$. Statistical analyzes were carried out using SPSS (Statistical Package for the Social Sciences 22.0) (SPSS/IBM, Armonk, NY, USA).

Results

Demographic characteristics of participants in both groups including gender, age, and education level, screening scores from Thai Mental State Examination (MSET10), Kendrick Assessment Scales of Cognitive Aging (KASCA), and Thai Geriatric Depression Scale (TGDS) are presented in Table 2.

Table 2 Demographic characteristics of the participants (control group n=10, experimental group n=10).

Characteristics	Control group n (%)	Experimental group n (%)	Chi-square
Gender			
Male	3 (30.00)	4 (40.00)	
Female	7 (70.00)	6 (60.00)	
Education			0.78
Primary	2 (20.00)	2 (20.00)	
Secondary	7 (70.00)	8 (80.00)	
High school	1 (10.00)	0	
Age (years) (mean±SD)	67.30±3.94	67.00±4.59	0.64
Screening scores (mean±SD)			
MSET10	17.30±1.82	16.70±2.02	0.26
KASCA	8.10±0.99	7.80±0.91	0.79
TGDS	1.80±1.22	2.00±0.94	0.61

From Table 2, participant characteristics showed almost equal distribution of gender, age, and education level between control and experimental group. The average age of control and experimental group was 67.30±3.94 years and 67.00±4.59, respectively. Education level of control and experimental group were secondary level at 70% and 80%, respectively. Cognitive screening scores of MSET10 demonstrated the average scores for control group was 17.30±1.82 and 16.70±2.02 for experimental group. While KASCA assessment reported mildly cognitive function grade in both groups, the control group's average score was 8.10±0.99 and 7.80±0.91 for the experimental group. Both groups revealed no depressive symptoms with TGDS assessment, control group's average score was 1.80±1.22 and 2.00±0.94 for experimental group. On Mann-Whitney U test was used to test the differences of demographic characteristics of the participants before conduction of the experiment between control and experimental groups. The correlations were found on age, education level at 0.78

and 0.64. Correlation of screening scores from MSET10, KASCA, and TGDS were 0.26, 0.79, and 0.61, respectively. This demonstrated that before experiment, participant characteristics of control and experimental group were not statistically different.

Table 3 Mean rank and p value of the outcome measurement scores before and after experiment between control and experimental groups.

Component	Pre-intervention Mean rank		*p* value	Post-intervention Mean rank		*p* value
	Control group (n=10)	Experimental group (n=12)		Control group (n=10)	Experimental group (n=12)	
Attention						
Digit span forward	9.60	9.20	0.75	9.20	10.10	0.03*
Digit span backward	6.70	7.40	0.48	6.40	8.50	0.01*
Episodic memory						
Logical Memory-Delayed Recall (LM I)	12.40	11.60	0.52	12.10	14.80	0.01*
Logical Memory-Recognition (LM II)	17.80	16.70	0.78	18.10	22.10	0.01*
Everyday memory (Thai-CPT)						
Visual Memory	8.70	7.80	0.76	8.60	9.80	0.01*
Auditory Memory	8.80	9.00	0.85	8.80	9.70	0.01*
Object Recognition	8.80	8.30	0.75	8.30	9.30	0.01*
Mindfulness (MAAS)	3.40	3.20	0.93	3.25	5.10	0.01*

NB: **statistically significant difference in means.*

Table 3 reveals the statistical analysis of the outcome measurements score before and after experiment between control and experimental groups. At pre-intervention, scores of all components; attention, episodic memory, everyday memory, and mindfulness between control and the experimental group were not significantly different ($p>0.05$). This result indicated that two groups did not differ in attention, memory and mindfulness performance before intervention. After 36 sessions of multimodal episodic memory training intervention, the participants in control and experimental group showed significant differences ($p<0.05$) in their test performance on Digit Span forward ($p=0.03$), Digit span backward ($p=0.01$), Logical Memory-Delayed Recall ($p=0.01$), Logical Memory-Recognition ($p=0.01$), all everyday memory subtest of Thai-CPT ($p=0.01$), and Mindfulness Attention and Awareness Scale ($p=0.01$).

Discussion

The present study aimed to determine the effectiveness of multimodal episodic memory training protocol which was specifically designed for the community-dwelling elderly with cognitive impairment. The present findings are consistent with previous studies that demonstrated the effects of multimodal cognitive training improving the cognitive performance including attention and memory of individuals with amnestic mild cognitive impairment.[30]

In Table 3, after 36 sessions of multimodal episodic memory training intervention, participants in control and experimental group showed significant differences ($p<0.05$) in their attention, memory and mindfulness performance. The participants in experimental group demonstrated a significant improvement in attention and episodic memory and everyday memory scores. Attention score revealed the attention ability of Digit Span test,[26] and score of Mindfulness Attention Awareness Scale demonstrated attention and awareness of present-moment experiences in daily life.[29] MEMT protocol training was designed to take advantage of the combination of mindfulness yoga training and multisensory stimulation into the intervention will mediate the additional effect to improve attention. In particular, mindfulness yoga training has been shown to enhance key attention capacities, including orienting and alerting,[36] the increased moment-to-moment attention is associated with mindful task engagement.[37]

Furthermore, episodic memory scores of Logical Memory test and Thai-CPT test demonstrated the delayed recall and recognition memory.[24, 25] These findings contrary to previous studies that found the participants with mildly cognitive impairment did not improve on the Logical Memory-Delayed Recall test after 6-weeks cognitive training[18] and 8-weeks multifaceted rehabilitation program[31] and did not improve significantly in Thai-CPT memory score after 5-weeks cognitive training program in elderly with suspected dementia.[32] In the present study, improvement in episodic memory may be due to a MEMT protocol was specified on episodic memory training and being continuously performed with more frequency and time in the 36 sessions of 12-weeks lasting about 2 hours in each session. Prolong duration of MEMT protocol intervention enhancing the high availability of cue information[33] and repetitive training is an effective strategy in assisting the person with cognitive impairment to gain new information.[34] Also, a MEMT protocol was designed to take advantage of the combination of

mindfulness yoga training and multisensory stimulation into intervention will mediate the additional effect to improve attention and memory performance.[19, 35] Consistent with this, the multisensory stimulation enriched intrinsic motivation that willing to attend and participate in the activities.[11] Moreover, mindfulness yoga training has been shown to enhance associated with mindful task engagement may directly contribute to enhanced working memory[37] and in turn , the better episodic memory performance. [38]

Although the present study demonstrated the beneficial effect of multimodal episodic memory training protocol, a few limitations should be taken into account. Firstly, our limited sample size might introduce some error of inference, reduce power of the analysis and limit generalization. Secondly, it can't be assured whether the improvement in experimental group is sustainable afterward, long-term follow up is needed to confirm our findings to establish the long-term effects of MEMT protocol training on the attention and memory. Result from this study can be applied as a guideline for developing or applying multimodal episodic memory training protocol for elderly who live in the community or elderly school members. In conclusion, this study provides evidence of the effectiveness of non-pharmacological interventional approach, MEMT protocol intervention in community-dwelling elderly with mild cognitive impairment. Therefore, further study remains to be verified the sustained effects of this protocol in long-term effects.

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Conflicts of interests

The Authors declare to have no conflict of interest.

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