

## Effects of integrated interventions on the brain's ability of elderly people with mild cognitive impairment

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### ABSTRACT

The goal of the quasi-experimental study was to examine the effects of integrated interventions on the brain's ability of elderly people with mild cognitive impairment (MCI). Six weeks of integrated interventions consisted of promoting physical activities, brain training, and group activities, which were developed for the experimental group. The Montreal Cognitive Assessment Thai Version (MoCA-Thai Version) was used for evaluating the brain's ability of the elderly people. The data were analyzed by using frequency, percentage, mean, standard deviation, Chi-square, dependent t-test, and independent t-test. The study's findings showed that the experimental group's average MoCA-Thai Version test score increased after finishing the program ( $p < 0.01$ ). Additionally, the experimental group's average MoCA-Thai Version test score was significantly ( $p < 0.01$ ) higher than the control group. Therefore, elderly people with MCI should be encouraged to engage in physical activities, brain training, and group activities through the integrated program for promoting the brain's ability.

### Key words:

integrated interventions; brain's ability; elderly people; mild cognitive impairment

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## INTRODUCTION

Dementia is one of the primary causes of disability and dependency among older people and is the seventh greatest cause of death among all diseases. Almost 10 million new cases of dementia are diagnosed each year, and there are already over 55 million people living with the disease worldwide.<sup>1</sup> Thailand is currently an aging society, as there were 12.10 million older people in the country in 2020, or 18% of the total population.<sup>2</sup> The prevalence of dementia among Thai elderly people is 8%.<sup>3</sup> Therefore, it is crucial to prevent or slow the progression of dementia to lessen its negative effects on the physical, psychological, social, and economic domains.<sup>1</sup> Between normal cognitive aging and dementia is a condition known as mild cognitive impairment (MCI). This condition could remain stable or develop into dementia. According to the study by Thaipisuttikul et al.,<sup>2</sup> the rate of reversion from MCI to dementia was 18.40%. Consequently, this could increase the declining rate of cognitive functions. Hence, early detection and appropriate management would be important for promoting the brain's ability and preventing the decline of cognitive functions among elderly people with MCI.<sup>2, 4</sup>

Previous studies have shown that physical activity was a significant intervention for promoting the brain's ability of elderly people. Exercising three times a week for at least 30 minutes could promote the brain's capacity among elderly people.<sup>5-7</sup> Some studies found that exercising once a week could promote the brain's capacity among elderly people, such as mind-motor training or coordinating exercise.<sup>8, 9</sup> Moreover, brain training or cognitive training is a crucial intervention to activate and promote the brain's cognitive functions consisting of attention,

executive function, learning and memory, language, visuospatial function, and social cognition. Recent research studies have also demonstrated that brain training programs could improve the cognitive functions of elderly people.<sup>10,11</sup> Furthermore, group activities or social participation of the elderly would be beneficial not only for positive emotions, but also for cognitive functions.<sup>12, 13</sup>

According to the aforementioned studies, integrating interventions would thus be effective for promoting the brain's ability of elderly people with MCI. Therefore, the researchers aimed to study the effects of integrated interventions, including physical activities, brain training, and group activities on the brain's capacity of elderly people with MCI.

## MATERIALS AND METHODS

### *Research design and setting*

This quasi-experimental research aimed to compare the cognitive functions of elderly people with MCI before and after obtaining the integrated interventions to promote the brain's ability, and to compare the cognitive functions between elderly people with MCI who obtained the integrated interventions to promote the brain's ability and those who did not obtain the program. The study was conducted in Ubon Ratchathani Province, which is ranked as the fifth largest province in Thailand. The population consisted of 244,132 elderly people (13.10%)<sup>14</sup>, and the prevalence of dementia among the elderly people was 13.75%.<sup>15</sup> Ban Dam Pha Tambon Health Promoting Hospital, Kham Yai, Ubon Ratchathani is responsible for caring for 2,436 elderly people (16.23%). There are nurses who are trained as healthcare managers, and social networks to promote the health of the elderly people. However, there is no cognitive function evaluation of the elderly people and a lack

of guidelines to promote the brain ability of elderly people.

### ***Study population***

The samples in the study were elderly persons with MCI living in Ban Dam Pha, Kham Yai, Ubon Ratchathani, Thailand. They had the following characteristics: 1) No major depression, 2) memory loss did not interfere with daily activities, decision-making, reasoning, or dementia, 3) routine activity: day-to-day living, 4) effective communication, and 5) willingness to participate in the study. The sample size was calculated by applying G\*Power with the power value ( $1-\beta$ ) at 0.80, the alpha value ( $\alpha$ ) at 0.05, and the effect size at 0.80. Thus, the resulting sample size was 15 people per group. The math pair technique was used for assigning the samples into the experimental and control groups, which were composed of age, gender, marital status, educational level, income, present illness, depression, and cognitive function.

### ***Instruments***

1. The Thai Geriatric Depression Scale (TGDS) was used to assess the depression of elderly people. There were 30 items with 30 points. The interpretation of the scores was 0-12 for no depression, 13-18 for mild depression, 19-24 for moderate depression, and 25-30 for severe depression. The reliability of the TGDS was 0.93.<sup>16</sup>

2. The Montreal Cognitive Assessment Thai Version (MoCA-Thai Version) was used to assess MCI in elderly people, which included attention, concentration, executive function, memory, language, visuoconstruction, conceptual thinking, calculation, and orientation. The overall score was 30 points. The cut-off point of normal cognitive function was less than 25. The reliability of the MoCA-Thai Version was 0.91.<sup>17</sup>

3. Barthel Activity Daily Living (ADL) was used to assess the capacity of

the basic ADL of the elderly people, which included feeding, grooming, transfer, toilet use, mobility, dressing, bathing, bowels and bladder. The interpretation of the scores was less than 13 for independent, 5-11 for mildly independent, and 0-4 for dependent. The reliability of the Barthel ADL was 0.92.<sup>18</sup>

4. The Chula Activity Daily Living Index (CAI) was used to assess the capacity of the daily activities of the elderly people, which included walking, cooking, heavy housework, money exchanging, and using public transportation. The interpretation of the scores was 0-4 for dependent, 5-8 for moderately independent, and over 9 for independent. The reliability of the CAI was 0.90.<sup>18</sup>

5. Research instruments for conducting research comprised the integrated intervention program to promote the brain's ability of the elderly people with MCI, including physical activities, brain training, and group activity, a lesson plan about the brain's functions and mild cognitive impairment, and a guide book for continuous brain stimulation at home. These were tested for content validity by three experts at the center for caring for elderly people consisting of a doctor, a nursing instructor, and a nurse who had experience caring for elderly people with dementia. The content validity index (CVI) was 1.00.

5.1 Physical activities were important for enhancing the hippocampal neurogenesis of the elderly people. Thus, it would be important to promote the brain's capacity of elderly people. Previous research showed that moderate-intensity exercise for 30-60 minutes three times a week for more than six weeks was beneficial for promoting the brain's capacity in elderly people.<sup>5-7</sup> In contrast, some studies revealed that low-intensity exercise, mind-motor training, or coordinating exercise could promote the brain's capacity among elderly people.<sup>8, 9</sup> As such, the researchers selected

coordination exercises for promoting the brain's capacity of the elderly people, including movement with music and breathing control, four movement exercises,<sup>8</sup> and square-stepping exercise.<sup>9</sup>

5.2 Brain training was a crucial intervention for promoting the brain's functions of elderly people, which consisted of attention, executive function, learning and memory, language, visuospatial function, and social cognition.<sup>19</sup> There were many activities for training the brain's function of the elderly people, including a participatory lecture about the brain's functions and exercises, such as writing/talking about one's autobiography; drawing a picture or mapping one's house; classifying image; guessing words from pictures; numerical mathematics; and cooking. In addition, each week the participants had continuous brain stimulation at home. Along with the workbook that corresponded to the activities of each week, every activity was checked and repeated before starting a new one.

5.3 Group activity was an important activity to activate the cognitive functions by sharing information and group participation interaction. Previous studies showed that group activity and social networking could improve the brain's functions and prevent dementia in elderly people.<sup>12,13</sup>

### ***Ethical consideration***

This research was certified by the Ethics Committee, Ubon Ratchathani Provincial Health Office (SSJ.UB 2563-140). The researchers maintained the rights to the samples by clearly explaining the objectives and asking for permission before collecting the data by having them sign the informed consent forms. The participants could withdraw from the study at any time without affecting the standard of care. The

data analysis and presentation were kept confidential.

### ***Data collection***

The data collection was gathered from July 1 to August 31, 2021. There were three steps of data collection as follows:

#### **1. Preparation**

Before starting the program, the researchers made an appointment with staff in the research area and explained the purpose of the study and the study process. The research members were trained to use the MoCA-Thai Version test. Then, the elderly were screened for the program. They had characteristics consisting of 1) a depression score of less than 13, 2) the MoCA-Thai Version score was less than 25, 3) ADL was more than 12, and 4) CAI was more than 5. The participants in the experiment group received integrated interventions for enhancing the brain's ability. In the control group, the participants obtained the usual care.

#### **2. The Experiment**

For six weeks, the elderly were organized to have the integrated interventions program for 1-2 hours once a week.

**Week 1:** Greeting and establishing relationships, explaining the study's objectives, memorizing group members, watching videos to connect to the context of "the brain's functions and mild cognitive impairment", summarizing the activity, and assigning a home task by writing an autobiography.

**Week 2:** Using music and breathing control to encourage physical activity, autobiography discussion, brain training by playing games with image classification, summarizing the activity, and assigning a home task by image classification in a workbook.

**Week 3:** Using music and breathing control to encourage physical

activity, reviewing previous activities, brain training by word guessing from pictures, summarizing the activity, and assigning a home task by word guessing from pictures in a workbook.

**Week 4:** Promoting physical activity by using the four movement techniques, reviewing previous activities, brain training by writing a map from home to the current location for reflecting on the visuospatial function, and assigning a home task by indicating landmarks on the map.

**Week 5:** Promoting physical activity by using the four movement techniques, reviewing previous activities, brain training by memorizing numbers, simple number calculation, and assigning a home task by memorizing the numbers and simple number calculation in a workbook.

**Week 6:** Promoting physical activity by using eight steps of movement, reviewing previous activities, and brain training by selecting the ingredients and cooking.

### 3. Evaluation

The MoCA-Thai Version test was used to compare the cognitive abilities

of the elderly people with MCI between the experimental and control groups.

### Data Analysis

The demographic data of the participants were analyzed by using descriptive statistics, including frequency, percentage, mean, and standard deviation. Moreover, the paired sample t-test was used to compare the cognitive functions before and after completing the program. Additionally, the independent t-test was used for comparing the cognitive functions between the experimental and control groups.

## RESULTS

According to the study results, there were no differences in age, ADL, CAI, TGDS, gender, marital status, educational level, occupation, alcohol intake, smoking, present illness, drug use, exercise, social participation, and hobby/leisure activity between the experimental and control groups ( $p > 0.05$ ) (Tables 1 & 2).

**Table 1.** Comparing the personal information between the experimental and control groups.

Variables	Experimental Group (n=15) (Mean±SD)	Control Group (n=15) (Mean±SD)	t	p-value
Age	65.27±13.06	66.87±4.87	0.445	0.660
ADL	19.73±0.59	19.80±0.77	0.265	0.973
CAI	9.00±0.00	8.93±0.26	1.000	0.334
TGDS	2.40±1.35	2.80±1.85	0.674	0.506

**Table 2.** Comparing the personal information between the experimental and control groups.

Variables	Experimental Group (n=15)	Control Group (n=15)	$\chi^2$	p-value
Gender				
Female	9 (30%)	13 (43.33%)	0.727	0.215
Male	6 (20%)	2 (6.67%)		
Marital status				
Single	4 (13.33%)	5 (16.67%)	0.159	1.000
Married	11 (36.67%)	10 (33.33%)		

Variables	Experimental Group (n=15)	Control Group (n=15)	$\chi^2$	p-value
Educational level				
≤ Primary school	5 (16.67%)	8 (26.67%)	1.222	0.462
≥ Secondary school	10 (33.33%)	7 (23.33%)		
Occupation				
No	10 (33.33%)	10 (33.33%)	0.000	1.000
Yes	5 (16.67%)	5 (16.67%)		
Alcohol intake				
No	13 (43.33%)	6 (20%)	2.727	0.215
Yes	2 (6.67%)	9 (30%)		
Smoking				
No	14 (46.67%)	15 (50%)	1.034	1.000
Yes	1 (3.33%)	0 (0.00%)		
Present illness				
No	5 (16.67%)	5 (16.67%)	0.000	1.000
Yes	10 (33.33%)	10 (33.33%)		
Drug use				
No	5 (16.67%)	4 (13.33%)	0.159	1.000
Yes	10 (33.33%)	11 (36.67%)		
Exercising				
No	2 (6.67%)	2 (6.67%)	0.000	1.000
Yes	13 (43.33%)	13 (43.33%)		
Hobby/leisure activity				
No	4 (13.33)	1 (3.33)	2.160	0.330
Yes	11 (36.67)	14 (46.67)		

In the comparison of the research results before and after completing the program in the experimental group, it was found that the MoCA-Thai Version score had increased significantly ( $t=8.892$ ;  $p=0.000$ ). In the control group, on the other hand, it was found that the MoCA-Thai

Version score had decreased significantly ( $t=-2.874$ ;  $p=0.12$ ). Additionally, the MoCA-Thai Version score in the experimental group was higher than in the control group ( $t=6.333$ ;  $p=0.000$ ) (Tables 3 & 4).

**Table 3** Comparing the MoCA-Thai Version score before and after completing the program between the experimental and control groups.

Variable	Group	Pretest (Mean±SD)	Posttest (Mean±SD)	t	p-value
MoCA-Thai Version	Experimental group (n=15)	16.67±2.91	24.67±3.94	8.892	.000
	Control group (n=15)	16.07±3.33	15.00±4.41	-2.874	.012

**Table 4** Comparing the MoCA-Thai Version score after completing the program between the experimental and control groups.

Variable	Experimental Group (n=15) (Mean±SD)	Control Group (n=15) (Mean±SD)	t	p-value
MoCA Thai Version	24.67±3.94	15.00±4.41	6.333	0.000

## DISCUSSION

The research results found that the integrating interventions, including physical activities<sup>7-9, 19</sup>, brain training<sup>10, 11, 13, 17, 19</sup>, and group activities<sup>12</sup> significantly improved the brain's ability of the elderly people with MCI after completing the program in the experimental group. In addition, the brain's ability of the elderly with MCI in the experimental group was significantly higher than in the control group. This was explicable by the fact that the integrating interventions could activate the cognitive functions of the elderly with MCI<sup>8, 21, 22</sup>.

Physical activities enhanced hippocampal neurogenesis. Therefore, this affected the brain's functions consisting of memory, attention, and task achievement.<sup>20</sup> Promoting physical activities with coordination exercises<sup>9</sup>, including movement with music<sup>21</sup> and breathing control, four movement exercises<sup>8</sup>, and eight steps of movement improved the cognitive functions of the elderly with MCI.<sup>8, 9</sup> Furthermore, Kwok et al. found that after completing an eight-week coordination program focusing on the coordination and conscious control of the body, the cognitive functions of older adults were improved.<sup>9</sup> Kawabata et al. also found that square stepping exercise enhanced executive functions, including mental flexibility, abstract reasoning, and problem-solving skills.

Moreover, brain training is an important intervention for improving the cognitive functions of elderly people,

which consisted of attention, executive functions, learning and memory, language, visuospatial function, and social cognition.<sup>10, 11, 17, 19</sup> Likewise, Sipollo et al. found that brain training improved the cognitive ability among elderly people with dementia.<sup>23</sup> Brain training through activities including writing / speaking about one's autobiography; memorizing the numbers, drawing a map of my house, classifying images, guessing words from pictures, numerical mathematics, selecting ingredients, and cooking improved the brain's functions of elderly people with MCI, which comprised attention, executive function, learning and memory, language, visuospatial function, and social cognition.<sup>19, 23</sup> This could be explained by the fact that writing and talking about oneself (autobiography) activated the brain's learning and memory functions by recalling recent, remote, semantic, and personal memories of oneself in the past and present.<sup>23, 24</sup> Additionally, memorizing the numbers activated the cognitive functions in the attention domain.<sup>23</sup> Image classification and word guessing from pictures also activated the cognitive functions in the language domain.<sup>23</sup> In addition, drawing a map of my house activated the cognitive functions in the visuospatial function by locating the main points and landmarks from the current place to their home.<sup>25</sup> Additionally, simple number calculation, selecting ingredients, and cooking activated the cognitive functions in the executive domain.<sup>23</sup>

In addition, group activities were important for promoting the cognitive functions in social cognition. Cohen et al.

found that group activities improved engagement, mood, and the cognitive functions of people with dementia. Participants could share their experiences, learn and understand the emotional expressions and behavior of the group members through group activities.<sup>12, 13, 23</sup>

## CONCLUSION

The results found that the integrating interventions, including physical activities, brain training, and group activities could improve the brain's abilities of elderly people with MCI in the experimental group. Furthermore, the brain's ability of the elderly people with MCI in the experimental group was higher than in the control group. It was confirmed that integrating interventions were important to promote the brain's capacity of elderly people with MCI.

## RECOMMENDATIONS

Further studies should follow-up or monitor the effectiveness of integrating interventions in the long term on the cognitive functions of elderly people with MCI. Other activities should be added to the integrating interventions, such as doing meditation, playing games, and reminiscence for promoting the effectiveness of the program.

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