EFFECTIVENESS OF NEUROBIC EXERCISE PROGRAM ON MEMORY PERFORMANCE IN COMMUNITY-DWELLING OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT: A RANDOMIZED CONTROLLED CROSSOVER TRIAL

WIYAKARN SANGHUACHANG

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR DOCTOR DEGREE OF PHILOSOPHY

(INTERNATIONAL PROGRAM)

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WIYAKARN SANGHUACHANG : EFFECTIVENESS OF NEUROBIC EXERCISE PROGRAM ON MEMORY PERFORMANCE IN COMMUNITY-DWELLING OLDER ADULTS WITH MILD COGNITIVE IMPAIRMENT: A RANDOMIZED CONTROLLED CROSSOVER TRIAL. ADVISORY COMMITTEE: PORNPAT HENGUDOMSUB, Ph.D., NUJJAREE CHAIMONGKOL, Ph.D. 2023.

Mild cognitive impairment (MCI) is a condition that affects the memory and thinking abilities of the individual involved and their caregivers. Improving and maintaining cognitive functions are essential goals for older people with MCI to delay or prevent the transition to dementia. A two-period crossover design was used to examine the effectiveness of the neurobic exercise program on memory performance in community-dwelling older adults with MCI. The sample included older adults who met the study inclusion criteria. They were randomly assigned into group A (n = 16) and group B (n = 16). Group A received three weeks of neurobic exercise, followed by a three-week washout period, and then three weeks of the traditional brain exercise program. Group B received the treatments in the reverse order but otherwise in a similar manner. Memory performance was measured in two aspects: subjective memory measured using the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) and objective memory measured using the Common Objects Memory Test (COMT). Cronbach's alpha reliability for these questionnaires was 0.94 and 0.80, respectively. Blinded evaluators measured the outcome four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). For data analysis, descriptive statistics, independent t-tests, and repeated measures ANOVA were employed.

The study results revealed that the participants in both groups had significantly lower mean scores of the IQCODE (subjective memory) and significantly higher mean scores of the COMT (objective memory) after receiving the neurobic exercise program. These findings affirmed the effectiveness of neurobic

exercise program which represents a new innovative approach to enhance memory performance. Training nurses to have adequate competency to provide this program is recommended.

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Wiyakarn Sanghuachang

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CHAPTER 1
INTRODUCTION

Statements and significance of the problems

The world's population is rapidly ageing, and approximately 12 percent of the global population is comprised of people aged over 60. From 2015 to 2050, the percentage of the world's population over 60 will nearly double from 12 to 22 percent (World Health Organization [WHO], 2018). In addition, around 8.5% of the global population (617 million) is at least 65 years old, and this proportion is anticipated to reach nearly 17% (1.6 billion) by 2050 (Mace & Mansbach, 2018).

In Thailand, the proportion of older people in the total population reached 12 million in 2021 and will continuously increase. By 2038, the number of elderly aged 60 years or older will reach 30 million (Foundation of Thai Gerontology Research and Development Institute, 2018). Thailand is expected to become a full-fledged ageing society by 2022, according to data released by the National Statistics Office of Thailand (2018). In addition, it will become a super-aged society in 2031, with 28 percent of the population being 60 or older. The public health system and social services are under more pressure due to the aging population. All countries have challenges and difficulties in maximising older people's health and functionality (WHO, 2015). One of the most common problems among older people is memory impairment. According to DeCarli (2003), memory problems are a common result of aging.

Many older people complain about memory loss and perform worse than young people in various cognitive tasks, particularly those involving memory. Furthermore, the number of those 65-year old’s who have dementia is estimated to increase as the population of the world's elderly continues to increase. It is currently estimated that 35.6 million people worldwide suffer from dementia, with the figure expected to double by 2030 and more than triple by 2050 (Abd Razak et al., 2019).

Memory problems are a common result of getting older and are a significant public health concern. Memory performance decline is actually considered either an early indicator or a significant risk factor for dementia, especially Alzheimer's disease

(AD), and improvement of cognitive functioning is considered an important strategy to prevent dementia (Iuliano et al., 2017). Memory impairment is one primary symptom of dementia. Dementia, a common condition in the older population with a reported prevalence of 2–10 percent, is a progressive loss of cognitive function affecting thinking and social abilities, interfering with daily functioning. This loss can affect multiple intellectual functions and produce occupational and social disabilities (Hengudomsub, Watanasin, Srisopa, & Kangchai, 2017). The prevalence of dementia increases with age, leading to community health problems as it is a high-cost disease that affects families, caregivers, medical resources, and the economy (Wangtongkum, 2008).

The term "Mild Cognitive Impairment: MCI" refers to older people who have demonstrable cognitive impairment but have not reached the dementia threshold (Lopez, 2013). MCI is a stage between normal cognitive aging and dementia. The elderly with MCI are at a higher risk of developing dementia, particularly Alzheimer's disease (AD). The elderly with MCI usually have problems with memory, language, or other essential cognitive abilities that are severe enough to be noticeable to others and show up on cognitive tests. However, it does not interfere notably with daily life activities (Alzheimer's Association, 2011; Mayo Clinic, 2019). MCI criteria are based on two conceptual models: one associated with only memory deficits and the other with a broader range of deficits (i.e., memory and other areas of cognition). Mild to severe cognitive impairment exists. With mild impairment, the person may notice a change in cognitive functions while still performing daily activities. A severe level of impairment, on the other hand, can result in the loss of the ability to understand the meaning or importance of something, as well as the ability to speak or write, resulting in the inability to live independently (Alzheimer's Association, 2009).

Memory complaints and impaired performance on memory tasks are symptoms of MCI in older people (Belleville, 2008; McDougall, 2017). MCI is diagnosed based on objective memory impairment, subjective memory impairment, and intact activities of daily living (ADL) with an absence of dementia (Lenehan, Klekociuk, & Summers, 2012; Petersen, 2011). Subjective cognitive impairment refers to subjects who have memory-related complaints but no pathological results on neuropsychological tests (Garcia-Ptacek et al., 2016). Subjective cognitive impairments are determined by an older adult's self-report or by a report from an informant, relative, or friend who has observed changes in the older adult's cognitive functioning (Hohman, Beason-Held, Lamar, & Resnick, 2011). While objective cognitive impairment can be used to predict cognitive decline in the elderly through clinical interviews or psychometric testing, the prognostic utility of memory complaints in the elderly in the absence of objective evidence of cognitive impairment is unknown (Flicker, Ferris, & Reisberg, 1993). Subjective cognitive complaints may detect changes before objective neuropsychological tests, which might become more important in detecting cognitive decline and impairment at the earliest possible stage. Attempts to predict objective cognitive performance using subjective cognitive complaints have yielded mixed results (Hohman et al., 2011). Recent research suggests that older people who report subjective memory complaints are at greater risk for developing dementia (Crumley, Stetler, & Horhota, 2014). Several studies have demonstrated a correlation between subjective complaints and the development of dementia (Jessen, 2010; Jungwirth et al., 2004; Luck et al., 2015; Manes, Serrano, Calcagno, Cardozo, & Hodges, 2008; Reed, 2010).

The prevalence of MCI is expanding rapidly with an increase in the older population. Approximately 30-40 percent of older adults have some type of cognitive impairment, and roughly 10 percent of them will, later on, develop MCI (WHO, 2019). Severe cognitive impairment or dementia will develop in more than 50 percent of the MCI population within five years (Hyer et al., 2016). Previous studies have demonstrated that characteristics such as age, level of education, pre-stroke cognitive and functional status, and history of diseases are all associated with an increased chance of developing dementia following a stroke. There is a correlation between prolonged and extremely stressful situations and the progression of mild cognitive impairment to dementia (Chen, Cheng, Lin, Lee, & Chou, 2018). The elderly who have MCI are considered a high-risk population because they have a dementia development rate of 10 to 15 percent per year, which is much higher than the rate of 1 to 2 percent seen in the general population (Geda, 2012). Normal aging is associated with the loss of two billion million neurons and forty percent of brain tissue involved in memory formation. Dementia is characterized by the loss of neurons in the cortex and hippocampus, a region that generates the chemical acetylcholine, which aids in learning and remembering (Kanthamalee & Sripankaew, 2014). The effects of MCI in older adults can negatively impact both the individuals themselves and the other people surrounding them. MCI can affect many-body systems' functioning, making it difficult to carry out daily tasks, creating problems with personal safety, and increasing neuropsychiatric symptoms, functional disability, quality of life, and health expenditure (Mayo Clinic, 2019; WHO, 2019).

Evidence showed that older adults with MCI had an increased mortality risk than those with normal cognition. MCI can contribute to the mortality of the elderly as much as dementia. The population attributable risk percentage (PAR%) of death attributable to MCI is 10.7 percent for ages 65–74 years, 16.0 percent for ages 75–84 years, and 24.2 percent for ages ≥85 years (WHO, 2016). Greater mortality risks from cerebrovascular disease, respiratory disease, and external causes will be associated with MCI than with normal aging (Bae et al., 2018). MCI leads to increased costs for governments, communities, families, and individuals. The expense of health and social care has substantial financial consequences for the elderly with MCI and their family (WHO, 2016). For older persons with MCI, controlling the risk factors for mortality and creating treatments to prevent mortality are essential since MCI is a prodromal stage of dementia and is common in the aged population.

The condition of having severe cognitive impairments, dementia, in particular, affects the quality of life of the sufferers and those who care for them. Therefore, preventing and delaying dementia should be a prime concern. Developing dementia prevention techniques is one of the World Health Organization's (WHO) research priority for reducing the global dementia burden (WHO, 2016). One strategy for lowering dementia prevalence is to create techniques to delay its beginning in healthy adults or those at risk for developing dementia, such as those with MCI (Napatpittayatorn, Kritpet, Muangpaisan, Srisawat, & Junnu, 2019). The general belief was that the brain is fully developed in adulthood, and the number of brain cells starts to be decreased and will not be regenerated any longer. However, if the brain is being used continuously and stimulated properly, the brain will improve even with advanced age (Eschweiler, Leyhe, Kloppel, & Hull, 2010). Cognitive intervention is a nonpharmacological intervention strategy that is appealing for treating older adults with MCI. It improves performance in one or more cognitive areas by enhancing the cognitive function of patients with cognitive impairment (Chaikham, Putthinoi, Lersilp, Bunpun, & Chakpitak, 2016). Cognitive training has been shown to improve numerous areas of objective cognitive functioning, including memory performance, executive functioning, processing speed, attention, fluid intelligence, and subjective cognitive performance, as shown by the research (Wang et al., 2020). Recent evidence has suggested using the neurobic exercise which is one of cognitive interventions as an alternative way to constantly stimulate the human brain. The beneficial effects of the neurobic exercise in delaying the decline of cognitive function and benefits regarding the outcome variables of activities of daily living, mood, and memory performance in older adults with MCI have been reported (Kurz, Pohl, Ramsenthaler, & Sorg, 2009; Rapp, Brenes, & Marsh, 2002).

Neurobic exercise is a form of brain exercise which is designed to help keep the brain healthy and active. This exercise is different from other types of brain exercises, which uses various combinations of physical senses, vision, smell, touch, taste, hearing, and emotional sense to stimulate the function of neural networks in the brain (Katz & Rubin, 1999). Furthermore, neurobic exercise helps stimulate nerve cells to create neurotrophins, which have a pharmacological influence on the development of nerve cells, as well as promote the branching of nerve fibers and prevent the degradation of nerve cells, which may improve memory recall (Katz & Rubin, 1999; Napatpittayatorn et al., 2019). Neurobic activity stimulates both short- and long-term memory. It may assist in activating neurological systems, increasing blood flow to the brain, and enhancing nerve impulses and linkages between various brain data (Kanthamalee & Sripankaew, 2014). The activities of the neurobic exercise involve getting the human brain out of its comfort zone by exposing it to new sensations or challenges that are out of the routine such as blindness activities to modify the information from the senses. The senses must be used as much as possible, and more than one sense needs to be used. Moreover, doing new things that have never been done before is good brain stimulation, and using all the senses, including the emotional sense, is adequate stimulation. Neurobic exercise makes the brain more attentive and agile in general, making it better able to take on any mental challenge, whether it is memory, task performance, or creative thinking. It also helps prevent the decline in memory performance and maintains a constant level of memory performance (Katz & Rubin, 1999).

Considering the rising prevalence of dementia, all attempts to decrease brain degradation are critical. Evidence suggested that improving cognitive function in older people using a neurobic exercise program is a novel strategy and deserved more attention. Previous studies have explored the potential benefit of neurobic exercise. Patani (2020) conducted a randomized clinical trial (RCT) among patients with stroke (N=40). Participants in the neurobic exercise group had significantly improved cognitive function and quality of life 4 weeks after completing the intervention than the control group. Another RCT study among older adults undergoing major, noncardiac, non-neurological surgery (N=268). After receiving the neurobic exercise intervention, patients had lower delirium incidence than controls at 7 days post-operation (Humeidan et al., 2021). In addition, in a non-randomized two-group posttest design among older adults with comorbidities (N=60). The result showed that participants in neurobic exercise group reduced depression scores at one-month post-intervention as compared to the controls (Raj, Santhi, & Sapharina, 2020). Evidences showed that nurses play significant role in delivery such program or activities for the seniors for a wide range of cognitive declines such as MCI and dementia.

In Thailand, a few neurobic exercise studies have been previously tested with older adults during hospital admission and in the communities. Kanthamalee and Sripankaew (2014) conducted a single-group posttest design testing the effects of neurobic exercise with 22 female dementia patients. The results demonstrated an improvement in memory at one month after completing the neurobic exercise intervention. Nevertheless, this study had no control group and only focused on female participants and one domain of cognitive function. Napatpittayatorn et al. (2019) tested the effects of neurobic exercise program among older adults with normal to MCI (N=55). The results showed that participants in the neurobic exercise group had improved cognitive function and serum brain-derived neurotrophic factor (BDNF) at 6 months after the intervention completion than controls. Kansri, Yotthongdi, and Booranarek (2018) examine the effects of the neurobic exercise on depression among older adults with MCI (N=60). The results revealed that the neurobic exercise program could be used to reduce depression among older adults with MCI in the community. Kriengkaisakda and Chadcham (2012) developed a brain training program based on neurobic exercise theory to target short-term memory in patients with mild dementia (N=34). The result found that the brain training program can improve short-term memory in patients with mild dementia. Wongkhamchai and Pantong (2017) used a non-randomized two-group post-test design to examine the effectiveness of the neurobic exercise program among type 2 diabetes mellitus patients (N=120). The result showed that the experimental groups' scores on short-term memory were significantly higher after training than the control groups at 3 months follow-up.

The finding of all studies demonstrated that neurobic exercise could improve memory performance in older adults with MCI. However, most previous studies targeted healthy ageing and elderly with dementia and older adults with chronic illness rather than those with MCI (Kanthamalee & Sripankaew, 2014; Kriengkaisakda & Chadcham, 2012; Wongkhamchai & Pantong, 2017). In addition, the activities focus on health education and only use each physical sense to stimulate the brain (Kansri et al., 2018; Kanthamalee & Sripankaew, 2014; Napatpittayatorn et al., 2019). It could be illustrated that the literature on nursing interventions to improve health in older adults, especially those with MCI, is limited and has methodological limitations. Therefore, this study used a randomised, controlled, two-period crossover design to examine the effectiveness of the neurobic exercise intervention aimed at enhancing memory performance, both objective and subjective memory, in community-dwelling older adults with MCI.

A two-period crossover design was used to compare the two treatments' effectiveness between the neurobic exercise and the traditional brain exercise intervention. The advantages of the crossover design require a smaller number of patients compared to parallel-group studies. It might permit adequate enrollment of patients at a single center rather than requiring a multicenter trial (Woods, Williams, & Tavel, 1989). This design is suitable for the COVID restriction. In addition, the researcher can minimize the risk of confounding because all interventions are measured on the same participants, and every participant receives both treatments. The participants serve as their control. The results of this study would beneficial not only for older adults with MCI themselves but also those who care for them such as their families, nurses, and other relevant health care providers.

Research objectives

The research objective in this study consisted of 1) the primary objective aimed at testing the mean differences of subjective and objective memory between experimental and control groups and 2) the secondary objective aimed attesting the differences of subjective and objective memory within the experimental and the control group.

Research hypotheses

The proposed hypotheses are as followed:

For primary objective:

1. The participants receiving the neurobic exercise program had a significantly lower score of subjective memory which indicated better or improvement in subjective memory than the participants received the traditional brain exercise program.

2. The participants receiving the neurobic exercise program had a significantly higher score of objective memory which indicated better objective memory performance than the participants received the traditional brain exercise program.

For secondary objective:

1. There are differences in scores of subjective and objective memory across the four times in both groups at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9).

Conceptual framework of the study

The research framework of this study was derived from integrating the concept of MCI (Domínguez-Chávez, Murrock, & Salazar, 2018), neurobic exercise (Katz & Rubin, 1999), and the empirical findings. MCI was characterized as a loss of certain brain processes, such as memory, thinking, or language, that is evident but does not interfere with everyday life (Domínguez-Chávez et al., 2018). Objective and subjective evidence of impairment, independence in everyday activities, dementia development risk factor, and reversible stage were the characteristics of mild cognitive impairment (Domínguez-Chávez et al., 2018; Petersen, 2001). It is feasible to postpone or return from the transient stage of MCI to an age-appropriate cognitive state. Nonpharmacologic therapies have been demonstrated to enhance cognition and cognitive domains such as attention, memory, and executive function in older persons with MCI (Meng et al., 2021; Wang et al., 2020).

Neurobic exercise is one of cognitive training that is designed to help the brain be healthy and active. Usually, humans rely primarily on senses of vision and hearing, while other senses (i.e., smell, taste, touch, and emotional sense) are less frequently used (Eschweiler et al., 2010). Neurobic exercise use five physical senses (i.e., vision, hearing, smelling, tasting, and touching) and emotional sense to stimulate the brain. It was used to activate many different brain areas. It also involves stimulating one or more senses in a novel context, breaking a routine activity and changing the daily routine regularly. Activities stimulate the growth of new dendrites and neurons in the brain (Ballard, 2010; Katz & Rubin, 1999). The evidence showed that if the brain is being used continuously and stimulated properly, the brain will improve even with advanced age (Eschweiler et al., 2010). The problems associated with ageing and little brain exercise are forgetfulness or difficulty learning new things. The main consequence of the neurobic exercise makes the brain active and healthy, including memory, task performance, and creativity (Katz & Rubin, 1999). Therefore, this concept was used for developing the neurobic exercise intervention for memory enhancement in older adults with MCI.

Memory performance is the capacity of older adults to remember things or manipulate information encoded, stored, and retrieved when needed. Memory performance declines with increasing age in older people (Iuliano et al., 2017). Objective and subjective memory impairment was essential for identifying MCI in older adults (Domínguez-Chávez et al., 2018). Subjective impairment is characterized by the presence of forgetfulness or trouble concentrating that is obvious to family members or friends. Each individual older adult interprets and perceives changes in memory problems and complains about their memory problems. Objective memory is materialized cognition that reflects the older adult's cognitive status, based on memory testing and tasks measuring towards actual memory. Several studies have identified a correlation between subjective memory complaints and objective memory performance, suggesting that subjective memory complaints are an essential sign of cognitive deterioration in conditions such as MCI (Bassett & Folstein, 1993; Burmester, Leathem, & Merrick, 2015; Jonker, Launer, Hooijer, & Lindeboom, 1996). MCI is a strong predictor for the development of dementia and impacts mobility (walking) in older adults (Domínguez-Chávez et al., 2018).

According to MCI patients can revert back to normal or near-normal cognition with age (Domínguez-Chávez et al., 2018). In a 4-year longitudinal study among 396 older adults, 51 percent reverted from MCI to normal cognition (Shimada et al., 2018). Therefore, this study developed the neurobic exercise program using five physical senses, including emotional sense to enhance memory performance for older adults with MCI. Activities focused on brain stimulation for one or two senses in each session. The program used the sense stimulation to break out of everyday routines in a novel way which was done in small group and game form because older adults will enjoy with friends. Interactions with other people are an important trigger of emotional responses. The emotional sense will motivate the diencephalon, notably the hypothalamus, which regulates emotion and encodes memory. The research framework is summarized in Figure 1.

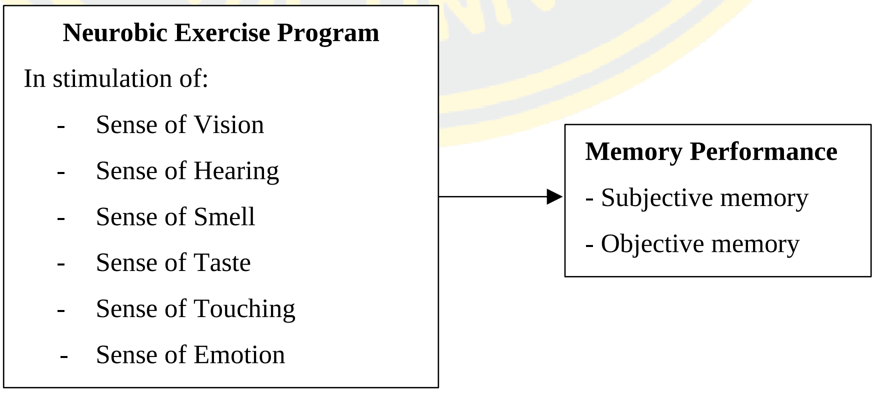


Figure 1 The research conceptual framework

Scope of the research

This study is based on a single-blind, randomized, controlled, two-period crossover design (two 3-week treatment phases followed with a 3-week washout period) investigating the effect of the neurobic exercise program on memory performance both subjective and objective memory among community-dwelling older adults with MCI. The trial consisted of two interventions that were crossed over. Thirty-two participants who met the inclusion criteria were assigned to groups A or B using simple randomization. In the first period, participants were randomized to group A, which received the neurobic exercise program, or group B, which received the traditional brain exercise program. Then, after a three-week washout period, from week 4 to 6, these two groups were crossed over to receive different interventions. The memory performance, both subjective and objective memory were assessed four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9), by blind evaluators. This study was conducted with older adults with MCI residing in the communities of Amphoe Muang of Saraburi Province. Data were collected from June 2021 through November 2021.

Definition of terms

Older adults with mild cognitive impairment are those aged 60 years and over with MCI. For the screening of MCI, the Montreal Cognitive Assessment (MoCA) was used. It was used to assess cognitive abilities in the areas of attention and focus, executive function, memory, language, visuoconstructional skills, conceptual thinking, calculation, and orientation. Older adults who achieved scores less than 24 out of a possible 30 were considered to have MCI. Furthermore, adding one point would compensate for any individual with less than six years of education (Hemrungrojn, 2011; Vichitvejpaisal et al., 2015).

Neurobic exercise program refers to a systematic exercise program based on integrating the concepts of neurobic exercise postulated by Katz and Rubin (1999) and the literature review. Neurobic exercise program helps stimulate the brain with nonroutine or unexpected experiences using various combinations of the five physical senses (i.e., vision, smell, touch, taste, and hearing), including emotional sense to enhance the brain's natural drive to form associations between different types of information. This program contains six sessions conducted in the small group twice a week for 60 minutes per session for three weeks.

Traditional brain exercise program refers to a set of activities that the senior club of Saraburi Hospital has been doing continuously since 2004. The activities were run by a research assistant (RA), a nurse of Saraburi Hospital. The traditional brain exercise program help promote the brain for older adults. The activities focused on stimulating the brain and were done in small groups. This program contained six sessions and was conducted twice a week for 60 minutes per session for three weeks. The activity schedule was the same period as the neurobic exercise program.

Memory performance is the capacity of older adults to remember things or manipulate information encoded, stored, and retrieved when needed. It was measured in two aspects, including subjective and objective memory performance.

Subjective memory refers to how each individual older adult interprets, feels, thinks, and perceives changes in memory problems and complains about their memory problems and reports their perceived cognitive decline. Subjective memory was measured by using the short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE). This scale was developed by Jorm (1994) and translated into the Thai language by Senanarong et al. (2001).

Objective memory refers to memory or cognitive performance that is not influenced by an individual's emotional state or personal biases. Materialized cognition indicates the cognitive state of the older adult, often based on memory tests and tasks reflecting real memory/cognition. Objective memory was measured by using the Common Objects Memory Test (COMT) developed by Kempler, Teng, Taussig, and Dick (2010).

CHAPTER 2
REVIEW LITERATURE

In this chapter, the literature review is comprised of three sessions: I) Aging and the brain, II) Mild cognitive impairment in older adults, and III) Neurobic exercise for older people. The details are described as follows.

Ageing and the brain

The human brain is a remarkable organ that regulates all bodily processes, analyzes information from the outside world, and embodies the mind and soul. The brain is responsible for numerous things, including intelligence, creativity, emotion, and memory. The brain collects information from the five senses, including sight, smell, touch, taste, and hearing, sometimes from several senses simultaneously. It assembles the messages in a meaningful fashion and stores the information in memory (Katz & Rubin, 1999; Mayfield Clinic, 2018).

An overview of the brain

The human brain consists of four main structures. First, the cerebrum is the uppermost portion of the brain. The cerebrum controls memory, language, the senses, and emotional reaction. It is divided into four lobes: (1) the frontal lobe, which is responsible for thinking, making judgments, planning, decision-making, and conscious emotions; (2) the parietal lobe, which is primarily associated with spatial computation, body orientation, and attention; (3) the temporal lobe, which is concerned with hearing, language, and memory; and (4) the occipital lobe, which is primarily concerned with visual processing. Second, the cerebellum is a portion of the brain that is situated behind the cerebrum and in the region of the brain that is immediately behind the brain stem. The cerebellum is an important component in the regulation of motor activities. It does this by processing the information it gets from the body's muscles and joints, which it then utilizes to keep the body in a balanced position and to preserve its posture. Third, the pons is located in front of the cerebellum and is responsible for coordinating the actions carried out by both the cerebrum and the cerebellum. In addition to playing an important role in a variety of autonomic and sensory processes, the pons is an essential component of the brainstem. Finally, the medulla is responsible for controlling the fundamental processes of the autonomic nervous system, such as breathing, heart function, vasodilation, and reflexes like spitting up, coughing, sneezing, and swallowing (American Association of Neurological Surgeons, 2019).

Cognitive change in older adults

Usually, the human brain grows and develops during prenatal and postnatal stages, influenced by genetic, environmental, and dietary variables. By 25 years of age, an adult's brain reaches full development and maturity (Kotchabhakdi, 2014). The impacts of aging on the brain's size, chemicals, cells, vasculature, physical morphology, and cognitive processes occur as a natural consequence of getting older (Peters, 2006), and also ageing brain can develop neurodegenerative disorders, e.g., senile dementia, cognitive impairments, Alzheimer’s disease, Parkinson’s disease, mental depression, anxiety disorders, and delirium (Kotchabhakdi, 2014). The impacts of aging on the brain and cognition are extensive and have a variety of causes. The prevalence of dementia rises with age, as does the degree of memory impairment, and neurotransmitter and hormone levels fluctuate (Peters, 2006). The most widely seen cognitive change associated with ageing is that of memory. The research demonstrates a direct relationship between perception and cognition in old age, as well as their influence on task performance and age-related decline. Both sensory and cognitive deterioration are affected by standard and generic conditions. Yet, new brain cells are produced throughout an individual's lifetime. Blood flow to the brain can be increased through physical exercise, nutritious eating, and mental exertion, hence boosting cognitive reserves (Breznitz, 2010). A systematic review and meta-analysis by Yun and Ryu (2022) found that cognitive based interventions have been shown to be effective in improving cognitive function in older adults.

Beyond 60 or 65 years of age, even in a healthy individual, changes occur in all sections of the body and the brain of older adults. The aging brain and its neural circuits regress or contract, losing numerous neurons, synapses, dendritic spines, neurotransmitter receptors, brain-derived growth or neurotrophic factors (BDNFs), and regenerative and reparative capacities. Age-related neurodegenerative disorders, such as senile dementia, cognitive impairments, and Alzheimer's disease, Parkinson's disease and various movement disorders, Multiple-System Atrophy (MSA), mental depression, generalized mood and anxiety disorders, and delirium, eventually become susceptible to the aging brain (Kotchabhakdi, 2014). Memory decline is the most frequently observed cognitive alteration related with aging. There is conclusive evidence of a connection between perception and cognition in old age, as well as their influence on task performance and age-related decline. Both sensory and cognitive deterioration are affected by common and general variables. The ramifications of recent studies regarding the health of active brains on the aging process are extensive. Over an individual's lifetime, new brain cells are generated. Blood flow to the brain can be increased through physical activity, a healthy diet, and mental exertion, hence enhancing cognitive reserve capacity (Breznitz, 2010).

Memory performance in older adults

Memory performance refers to the capacity of the brain to encode facts or information, store it, and retrieve it when it is required. It has been linked to dementia and is an important factor in determining whether or not Alzheimer's disease is present (AD) (Iuliano et al., 2017; Reid & MacLullich, 2006). Memory performance declines with age in elderly individuals. Memory failures are a common complaint among older persons, and they usually experience a deterioration in their memory capacity. A deterioration in memory ability is regarded as either an early warning or a significant risk factor for AD, and enhancing cognitive functioning is regarded as an essential method for preventing AD. Several studies have identified a positive correlation between subjective memory complaints and objective memory performance, suggesting that subjective memory complaints may be an important indicator of impending cognitive impairment, such as in MCI (Bassett & Folstein, 1993; Burmester et al., 2015; Jonker et al., 1996). Subjective memory complaints are characterized as reports of memory issues that do not show up on neuropsychological tests as abnormal. These studies supported the notion that older persons may notice a decline in their memory before cognitive tests reveal any decrease in cognitive ability (Iuliano et al., 2017; Reid & MacLullich, 2006).

Subjective memory

Subjective memory refers to how each individual older adult interprets, feels, or thinks about their memory and the report of their perceived memory performance without pathological results on neuropsychological tests (Garcia-Ptacek et al., 2016) that are based on self-report from older adults or a report from an informant, a relative or friend, who may observe changes in their's cognitive functioning (Hohman et al., 2011). Subjective memory complaints offer valuable health information regarding cognitive processes associated with aging and have the potential to forecast future cognitive impairment (McDougall & Kang, 2003).

Subjective memory assessment

Subjective complaints about memory can foretell the onset of dementia in the elderly. Yim et al. (2017) found in a study of community-dwelling seniors aged 65 and older that those with subjective memory complaints demonstrated more significant cognitive impairment on neuropsychological evaluation than those without subjective memory complaints. Biological evidence supports the diagnostic predictability of subjective memory complaints in several trials. For example; A study by Laws et al. (2002) reported that older people with subject memory complaints showed significantly greater atrophy of the hippocampus than those without subjective memory complaints. In addition, the e4 allele of the APOE gene was associated with significantly greater subjective memory complaints among the elderly (Jorm et al., 1994).

There are various methods to define subjective memory complaints. Some assess subjective memory complaints using a simple yes/no question, and others use questionnaires focusing only on memory symptoms. However, subjective memory complaints have been considered less reliable because subjective memory complaints can be influenced by factors such as personality traits, mood, and anxiety at the time of the complaints (Laws et al., 2002; Yim et al., 2017). Informant-reports of memory decline predicted cognitive disorders, even before a clinical diagnosis by routine tests, and even recognized cognitive problems even in an earlier stage of the illness process, according to certain research (Storandt, Grant, Miller, & Morris, 2006; Yim et al., 2017).

The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) is a screening test for dementia that measures the informant's perception of the older adult's cognitive decline. The IQCODE has been translated and validated in other languages, including Australia, England, Spanish, Chinese, French, Italian, Dutch, Turkish, Taiwan, and Thailand. The short form of IQCODE was translated into Thai, and some adaptation for Thai culture by Senanrong et al. (2001). The short form of IQCODE is the standard tool and has sensitivity in distinguishing cognitively impaired patients from normal elderly. It has 16 items; each item is rated on a scale of 1 (much improved) to 5 (much worse). Also, the IQCODE can be administered with good diagnostic sensitivity and specificity. Therefore, subjective memory impairment would be measured using the short form of IQCODE. It can be reliably applied as a screening instrument for dementia in the Thai population with various educational levels (Senanarong et al., 2001).

In conclusion, memory complaint increases with age. Subjective memory problems are related with objective memory impairment, and research has shown that older people who have these problems have a higher risk of getting dementia (Crumley et al., 2014; Neto & Nitrini, 2016; Reed, 2010; Vale, 2012). Subjective memory complaint reported by themselves that is all useful for screening MCI and dementia in older adults. Consequently, in order to accurately anticipate memory impairment in older persons, the researcher needs to make use of the information obtained from both the subjective memory complaints and the objective memory performance measures.

Objective memory

Objective memory refers to memory or cognitive functioning that reflects the older adult's cognitive status, based on memory testing and tasks measuring actual memory or cognition by clinical interview or psychometric testing (Reed, 2010). It is not dictated by a state of emotions or personal prejudices of one's memory. Objective memory impairment can be useful in the prediction of cognitive decline in older adults (Flicker et al., 1993).

Objective memory assessment

Objective memory impairment is a substantial risk factor for Alzheimer-type dementia in older persons (Visser et al., 2000) and is indicated by using a standardized screening test. Health professionals such as general practitioners, social workers, and nurse practitioners have been vital in detecting early objective memory impairment changes. There are several standard tools to measure objective memory impairment. For example, the Wechsler Memory Scale-Revised (WMS-R) Logical Memory, the WMS-R Visual Reproduction, the Rey Osterrieth Complex Figure, the Warrington's Recognition Memory Test-Words, and the Warrington's Recognition Memory Test-Faces. However, each of these existing instruments has certain limitations. Most tests of memory show that higher education is typically correlated with greater test scores. Thus, the researcher must select the standard instrument necessary for the appropriate interpretation of the study results and suitable for the population in the study.

The Common Objects Memory Test (COMT) was created to evaluate age-related memory impairments in persons with widely varying educational, literacy, linguistic, and cultural backgrounds (Kempler et al., 2010). The COMT uses colorful photos of everyday objects as a way to screen out respondents based on their education level, as well as their gender and ethnic background. It is possible to assure both visual and verbal registration by asking the participant to name each object that is displayed during the learning trials. The COMT recall measures fared exceptionally well when compared to a battery of cognitive tests in their ability to differentiate between healthy individuals and patients with dementia (Dick, Teng, Kempler, Davis, & Taussig, 2002; Kempler et al., 2010). Therefore, objective memory impairment would be measured using the COMT because this tool is the standard instrument and has sensitivity in distinguishing healthy older people from cognitively impaired patients.

In conclusion, subjective memory impairment is frequent in the elderly, manifesting as forgetfulness or difficulty concentrating that is apparent to family and friends. Objective memory impairment refers to older adults' cognitive status, which can be derived from clinical interviews or psychometric testing and can also be helpful in the prediction of cognitive decline in the elderly (Domínguez-Chávez et al., 2018; Flicker et al., 1993). Thus, it is vital to assess both subjective and objective memory since both are essential for recognizing and treating MCI in older persons in a timely manner.

Mild cognitive impairment in older adults

In the fields of neurology and neuropsychology, the concept of mild cognitive impairment (MCI) has developed. According to the American Academy of Neurology (AAN), MCI is defined as "a condition in which individuals demonstrate focal or multifocal cognitive impairment with minimal impairment of instrumental activities of daily living that does not cross the threshold for dementia diagnosis" (Petersen, 2016). National Institute on Aging-Alzheimer's Association (NIA-AA), MCI has been defined as "Cognitive performance below the expected range for that individual based on all available information" (Jack Jr et al., 2018). Furthermore, Mayo Clinic (2019) defined MCI as "the stage between the expected cognitive decline of normal ageing and the more serious decline of dementia." MCI can involve problems with memory, language, thinking, and judgment. The severity of cognitive impairment varies from minor to severe. With moderate cognitive impairment, older adults may begin to detect a decline in cognitive skills, but are still able to perform daily tasks. In contrast, significant levels of impairment might result in the inability to comprehend the significance or meaning of something, hence rendering the individual incapable of living independently (Alzheimer's Association, 2009).

In conclusion, MCI, a transitional stage between normal aging and dementia, was utilized to define elderly individuals with demonstrable cognitive impairment who had not yet seen a significant decline in cognitive function. Typically, People with MCI have issues with memory, language, or other critical cognitive ability that are severe enough to be observable by others and to appear on cognitive tests, but do not significantly interfere with everyday activities.

Prevalence and incidence of mild cognitive impairment

According to the World Health Organization (WHO, 2019), The prevalence of MCI and dementia is rising in the aging population. The risk of this disease rises at the age of 60, and the proportion of dementia sufferers is highest among the elderly. Approximately 30-40 percent of older adults have some cognitive impairments, and approximately 10 percent of them will later develop MCI (WHO, 2019). Dementia affects between one and three percent of people aged 65 and older each year, and between ten and fifteen percent of people diagnosed with mild cognitive impairment each year progress to full-blown dementia (Mayo Clinic, 2019). In addition, a study of Mayo Clinic (2019) among aging population, reported that The incidence rate of MCI was found to be 6.36 percent throughout the entire age and sex spectrum, with the rate being significantly higher in males (7.24%) than in women (5.73%). The incidence of amnestic mild cognitive impairment was 3.77 percent, while the incidence of non-amnestic mild cognitive impairment was 1.47 percent. It is helpful for public health authorities and clinical decision-makers to have estimates of the incidence of MCI in the population as they plan for the number of older persons who have MCI (Gillis, Mirzaei, Potashman, Ikram, & Maserejian, 2019).

In Thailand, the prevalence of MCI is expanding rapidly, increasing in the ageing population. A study of the prevalence of MCI conducted in central Thailand reported ranging from 16.7 to 43.5 percent, high at 64.3 percent in northeast Thailand. The prevalence of MCI in older people was 71.4 percent, increasing with age (Griffiths, Thaikruea, Wongpakaran, & Munkhetvit, 2020). A survey in urban areas found a higher prevalence of 21.5 percent (Sukontapol et al., 2018). Therefore, practical strategies to prevent or manage the older population's cognitive decline have become a high-priority agenda in Thai geriatric care. Many studies currently view MCI as an intermediate stage between normal aging and dementia. Identification and treatment of MCI as early as possible may slow the onset of dementia. To lessen the worldwide burden of dementia, one of the research goals is the development of preventative methods for dementia. The development of ways to delay the onset of dementia in people at risk for developing it is one strategy for reducing the prevalence of dementia.

Classification of mild cognitive impairment

Objective and subjective impairment, independence in daily activities, impairment in one or more cognitive domains, varied etiology, dementia development risk factor, and reversible stage are the characteristics of MCI in older persons (Domínguez-Chávez et al., 2018; Petersen et al., 2014). The main effect of MCI is the development of dementia, which has an impact on mobility (walking) in older persons, particularly those with non-amnestic MCI (Domínguez-Chávez et al., 2018).

MCI can be divided into four subtypes of cognitive dysfunction with varied etiologies. The classification depends on the existence or absence of memory domain involvement as well as the number of cognitive domains engaged. Four MCI subtypes have been proposed: (1) Amnestic MCI-Single Domain (a-MCI-sd), which focuses on the subjective memory complaint, ideally confirmed by an informant, with objective memory impairment for age and mostly preserved general cognitive function with mostly intact functional activities; (2) Amnestic MCI-Multiple Domain (a-MCImd), which can affect language, executive functions, and visual-spatial skills to different degrees, with or without memory problems; (3) Non-amnestic MCI Single Domain (na-MCI-sd), which only affects the cognitive domains that don't involve memory, like language, executive function, or visual-spatial skills, and (4) Non-amnestic MCI-multiple domain (naMCI-md), which focuses on problems in areas other than memory, like executive function and visual-spatial skills, may have a higher chance of developing non-dementia, Alzheimer's like dementia with Lewy bodies (Basso et al., 2007; Geda, 2012; Janelidze et al., 2018). Evidence suggests that a-MCI is the most prevalent form of dementia in the aging population, and that it may develop to AD. In addition, an-MCI-md may represent normal aging or may develop to Alzheimer's disease or vascular dementia, whereas na-MCI-sd may have a variety of outcomes (Davis & Rockwood, 2004; Petersen, 2001).

MCI can be diagnosed in a number of different ways. Questioning the patient about their memories, medications, health status, and any comorbid conditions they may have is one of the ways. Conducting interviews with the patient's family members and close friends can also boost the likelihood of obtaining information concerning changes in the patient's memory, personality, and conduct. When paired with other diagnostic procedures and imaging methods for the brain, this method makes a definitive diagnosis possible (Eshkoor, Hamid, Mun, & Ng, 2015). According to the Mayo Clinic (2019), the clinical criteria for a-MCI are as follows: 1) memory complaint, 2) anomalous scores on memory tests, 3) normal general mental condition, 4) normal daily functioning, and 5) lack of dementia. Nonetheless, Petersen's criteria are widely employed in both clinical and scientific practice (Janelidze et al., 2018). The following are: 1) consistent complaints about memory that are best backed up by a close friend or family member; 2) memory loss compared to healthy people of the same age and education level; 3) preserved general cognitive function based on performance on a standard cognitive test; 4) preserved ability to do activities of daily living (ADLs), or minimal impairment if instrumental adls are considered; and 5) absence of dementia.

Causes and risk factors of mild cognitive impairment

All possible causes of MCI have not been completely discovered. Some of the possible conditions include:

It is well-established that high blood pressure, high cholesterol, diabetes, and obesity are modifiable risk factors for cardiovascular illnesses such as heart disease and stroke. For instance, older persons who suffer a stroke are nearly twice as likely to acquire dementia, with the peak risk occurring in the three years following the stroke. Any cardiovascular risk factors can enhance the risk of dementia by raising the likelihood of atherosclerosis (Ray & Davidson, 2014; Xue et al., 2019). According to a study by Campbell, Unverzagt, LaMantia, Khan, and Boustani (2013), chronic comorbid disorders such as coronary heart disease and hypertension are prevalent among older persons with cognitive impairment. Only 121 of the approximately 2100 individuals examined over a mean of 3.5 years were diagnosed with MCI. In addition, metabolic syndrome is diagnosed when at least three of the following characteristics are present: abdominal obesity, elevated plasma triglyceride levels of at least 150 mg/dL, low high-density lipoprotein cholesterol (40 mg/dL for men and 50 mg/dL for women), high blood pressure (130/85 mm Hg) or use of antihypertensive medication (Campbell et al., 2013).

Evidence suggests that increasing age and a specific type of the gene apolipoprotein E (APOE- 4) are the most important risk factors for MCI. The APOE-ε4 is a relatively strong predictor of progression from MCI to Alzheimer-type dementia. A meta-analysis of Elias-Sonnenschein, Viechtbauer, Ramakers, Verhey, and Visser (2011) reports that older adults with MCI, carriers of any APOE-ε4 allele are more than two times as likely to progress to Alzheimer-type dementia. Also, a study by Rodríguez-Rodríguez et al. (2013) found that carriers of any APOE-4 allele are more than twice as likely to develop Alzheimer's-type dementia in older persons with MCI

Age, education level, cognitive and functional condition prior to stroke, and disease history have all been cited as risk factors for dementia following a stroke in previous research. Extended, intensely stressful situations are connected with the progression of mild cognitive impairment to dementia (Chen et al., 2018; Hu & Chen, 2017). In addition, many lifestyle factors, including smoking, lack of physical activity, and infrequent engagement in mentally or socially stimulating activities, have been related to an increased risk of cognitive decline (Elias-Sonnenschein et al., 2011; Sanford, 2017; von Arnim et al., 2019). A meta-analysis conducted by Xue et al. (2019) studied factors for predicting reversion from MCI to normal cognition. The results showed that young adults with a higher education and MMSE score, no APOEe4 allele, no hypertension, and no history of stroke had a greater likelihood of reversing MCI to normal cognition.

In conclusion, several risk factors, such as elevated systolic blood pressure and high cholesterol, age, family history of dementia, diabetes, smoking, depression, stress, white-matter lesions on magnetic resonance imaging, and the presence of the APOE 4 allele, have been considered in relation to the progression of cognitive impairment in those diagnosed with MCI (Burns & Zaudig, 2002; Davis & Rockwood, 2004; Xue et al., 2019). Modifiable and non-modifiable risk variables can be distinguished for the evolution of MCI in older persons. The risk factors that can be modified include hypertension, cardiovascular risk factors, depression, and stress. Non-manipulable risk variables, such as demographic and genetic features, cannot be altered. This classification can serve as a foundation for future clinical interventions targeting modifiable risk factors to prevent the progression of MCI to dementia in the older population.

Screening tests for mild cognitive impairment

MCI represents an early and potentially treatable phase of dementing disorders. Varieties of cognitive impairment screening tests have been conducted. The commonly used cognitive impairment screening tests include the Clock Drawing Test (CDT), the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), the Mini-Mental State Examination (MMSE), and the Montreal Cognitive Assessment (MoCA). Among these screening tests, The MMSE and the MoCA are widely used as standard screening cognitive tests for MCI. Originally designed to detect delirium in general medical and surgical patients, the MMSE is now frequently used as a cognitive decline screening measure. The MMSE's limited sensitivity to MCI has been demonstrated through research, and it has been substituted by the MoCA, a screening tool intended to detect MCI. It has been observed that the MoCA is more sensitive than the MMSE to cognitive abnormalities in populations of both demented and healthy older adults (Krishnan et al., 2017; O'Caoimh, Timmons, & Molloy, 2016).

In a meta-analysis conducted by Ciesielska and colleagues, the reliability of 20 published studies assessing the MoCA and MMSE in identifying MCI in the healthy over-60 group was examined. MoCA fits the criteria for screening tests to diagnose MCI in older persons better than the MMSE, according to the study. The best cut-off point for the MoCA is 24/25 (sensitivity of 80% and specificity of 81.19%), and the best cut-off point for the MMSE is 27/28 (sensitivity of 66.34 percent and specificity of 72.94 percent) (Ciesielska et al., 2016). Therefore, the MOCA was used for screening MCI in this study.

The Montreal Cognitive Assessment

The MoCA was developed as a quick screening tool for people who present with MCI but who have typically shown normal performance on the MMSE (Nasreddine et al., 2005). The MoCA was designed to screen for less severe forms of cognitive impairment by evaluating six different cognitive domains. These cognitive domains include executive functions; visuospatial abilities; short-term memory; language; attention, concentration, working memory; and temporal and spatial orientation. MoCA administration takes approximately 10 minutes. The highest possible score is 30, whereas a score of 26 or less indicates impairment (Nasreddine, 2010). In a while, it is modified by educational level, lifestyle factors, and ethnic diversity (Jongsiriyanyong & Limpawattana, 2018). For example, the Cantonese Chinese version with a cutoff point of 22/23 had 78% sensitivity and 73% specificity in identifying MCI (Jongsiriyanyong & Limpawattana, 2018). Many studies indicate that MoCA cutoffs of 21 for dementia and 26 for MCI are the most appropriate for assessing cognitive function in Parkinson's disease (Dalrymple-Alford et al., 2010). A MoCA score of 24 demonstrates strong internal consistency (Cronbach's alpha 0.914), and it has a sensitivity and specificity of 80% for the Thai language version (Vichitvejpaisal et al., 2015). Furthermore, the addition of one point would compensate for those with less than six years of education. Thus, scores below 24 are indicated MCI (Hemrungrojn, 2011; Vichitvejpaisal et al., 2015).

Treatment of Mild Cognitive Impairment

Pharmacological and non-pharmacological treatments are the mainstays of care for people with MCI who want to keep their cognitive abilities. The best way to treat MCI is to choose the effective and right strategies for each cognitive disorder's specific etiology. The goal of MCI treatment is to reduce clinical symptoms, slow the progression of cognitive dysfunction, and prevent dementia. At this time, there is no pharmaceutical treatment that is proven to be useful for MCI. There is a growing amount of support for non-pharmacological approaches to delay the cognitive deterioration associated with MCI. This is in part due to the fact that the therapeutic effects of pharmacological treatment for MCI patients' cognition are unclear (Song, Doris, Li, & Lei, 2018).

Pharmacological treatments

MCI is not being treated with any one medicine in particular. Nonetheless, it is necessary for a clinician who works with patients who have MCI to be aware of the various treatment choices that are beneficial to patients who have MCI (Geda, 2012). The use of pharmacotherapy should ideally be restricted to MCI patients who are at a higher risk of developing Alzheimer's disease. The pharmacological treatment of MCI is restricted due to a number of factors, including a lack of treatment alternatives, the adverse effects of drugs, an unclear prognosis, and improper social, psychological, and ethical ramifications (Eshkoor et al., 2015).

Cholinomimetics medications were used to treat AD patients. However, it has side effects, e.g., bradycardia, increased gastric acid secretions, and gastrointestinal motility (Geda, 2012). There have been several trials of cholinesterase inhibitors in people with amnestic-type MCI. The results have been disappointing in treating patients with mild dementia due to AD having tangible but modest benefits. Also, The U.S. Food and Drug Administration has not authorized any MCI treatments (Knopman & Petersen, 2014).

Cooper, Li, Lyketsos, and Livingston (2013) evaluated the findings of nine clinical trials involving Cholinesterase inhibitors in a systematic review. Reduced incidence of Alzheimer's disease has not been demonstrated by four high-quality trials (two evaluated galantamine, one donepezil, and one rivastigmine). In one study, donepezil with galantamine improved global cognitive performance. In five further large-scale studies of Cholinesterase inhibitors, global cognition did not improve. Donepezil improved immediate memory and slowed the course of Alzheimer's disease in depressed MCI patients without changing depressive symptoms.

According to a study by Eshkoor et al. (2015), antioxidants such as vitamin E, vitamin C, Ginkgo biloba, and curcumin (from turmeric) may postpone the advancement of moderate to severe Alzheimer's disease (AD) by reducing oxidative stress levels and age-related effects. However, some studies have indicated that vitamin E is not efficacious in treating or preventing AD or MCI (Geda, 2012; Lloret et al., 2009). In one study, the effects of high-dose vitamin E (2000 IU daily) or donepezil on individuals with MCI were investigated. The results demonstrated that donepezil considerably decreased the risk of Alzheimer's disease development during the first 12 months but had no effect on the risk of Alzheimer's disease after 36 months. In addition, vitamin E did not diminish the probability of advancement at any time point evaluated (Petersen, 2011). In addition, Cochrane's review of the use of vitamin E to treat MCI and AD found no evidence that alpha-tocopherol reduces MCI progression or improves cognitive performance in individuals with MCI owing to AD (Farina, Llewellyn, Isaac, & Tabet, 2017).

Another study, the Alzheimer's Disease Cooperative Study (ADCS) conducted a three-arm randomized, double-blind, placebo-controlled research to investigate the safety and efficacy of high-dose vitamin E with donepezil. Donepezil lowered the chance of developing Alzheimer's disease for the first 18 months of the experiment, whereas vitamin E had no therapeutic impact. Secondary cognitive assessments backed up the overall group progression rates. There were no unexpected negative events (Geda, 2012).

In a few clinical trials, the function of B vitamins was examined. The evidence regarding the effect of vitamin Bs on general cognitive function, executive function, and attention in individuals with MCI is insufficient. Likewise, B vitamins cannot stabilize or decrease the loss of AD patients' cognition, function, behavior, or global change (Janelidze et al., 2018).

Ginkgo biloba is a natural medicine that is extensively used to improve memory. DeKosky et al. (2006) conducted the Ginkgo evaluation of memory study.

Following the completion of the six-year observation period, the results revealed that Ginkgo biloba had no meaningful influence on the incidence of dementia. However, a meta-analysis of randomized clinical trials on Ginkgo biloba for the treatment of MCI or Alzheimer's disease was conducted. It was discovered that Ginkgo biloba mixed with conventional therapy improved MMSE scores for people with MCI and Alzheimer's disease more effectively than conventional medicine alone (Janelidze et al., 2018; Zhang et al., 2016).

In conclusion, The US Food and Drug Administration has not approved any evidence for the treatment of MCI at this time. In a number of studies, there was no substantial reduction in the rates of progression to dementia in MCI patients treated with Alzheimer's disease medications.

Non-pharmacological treatments

Non-pharmacological interventions were used more; some people prefer non-pharmacological strategies to maintain cognitive function and independence rather than pharmacological approaches. Also, non-pharmacological methods have less risk than pharmacological strategies (Rodakowski, Saghafi, Butters, & Skidmore, 2015).

Cognitive intervention is a non-pharmacological approach used to treat older people with MCI and improve cognitive function in one or more cognitive domains (Chaikham et al., 2016; Kelly et al., 2014). Cognitive interventions are typically classified into three types (Ray & Davidson, 2014).

Cognitive stimulation is the involvement in non-specific group activities that attempt to enhance cognitive and social performance. Talks, supervised leisure activities, list memorizing without additional assistance, and more structured exercises such as reality orientation or remembrance are examples (Belleville, 2008), which attempt to promote general cognitive and social functioning and may involve family caregivers. As contrast to training in a specific modality, interventions must provide exposure to general cognitive activity (Woods, Aguirre, Spector, & Orrell, 2012).

A systematic review of cognitive stimulation therapy for older adults with mild to moderate dementia concluded that cognitive stimulation therapy is a functionally-oriented, supportive strategy designed to help individuals with mild to moderate dementia remain meaningfully engaged in their lives and environments. Occupational therapists are well-suited to administer cognitive stimulation therapy because it aligns with the profession's fundamental principles and goals (Yuill & Hollis, 2011). Moreover, the outcomes of a meta-analysis conducted by Karssemeijer, Aaronson, Bossers, Smits, and Kessels (2017) demonstrate the potential for cognitive and physical therapy to improve global cognitive function, ADL, and mood in older individuals with MCI or dementia. Cognitive and physical exercise interventions had a small-to-moderate impact on the global cognitive function of older individuals with MCI or dementia. These results may suggest a mediation effect of increased global cognitive function on improved ADL and mood function, highlighting the potential clinical utility of combination therapy.

Cognitive rehabilitation is a personalized way to help people who have problems with their minds. Those who are affected and their families work with health care professionals to set goals that are important to them and come up with plans for achieving them (Wilson, 2002). The focus is not just on getting better at cognitive tasks, but also on getting better at doing things in everyday life (Clare & Woods, 2003). Recent research on cognitive rehabilitation programs for patients diagnosed with MCI, which included data from randomized clinical trials, demonstrated a significant improvement in cognitive function as a result of participating in the training (Jean, Bergeron, Thivierge, & Simard, 2010; Petersen, 2011).

Cognitive training often consists of guided practice on a set of standardized tasks designed to reflect various cognitive processes, such as memory, attention, language, or executive function. These activities may be performed alone or in groups. Cognitive training can be delivered in the form of individual or group sessions, or it can even be carried out by family members with the help of a therapist. The tasks could be depicted on paper and pencil, on a computer screen, or as representations of activities that are part of normal life (Clare & Woods, 2004; Woods, Aguirre, Spector, & Orrell, 2012).

Cognitive training has been examined the most of these three interventions, presumably because it is the most specialized and susceptible to experimental investigation. Numerous research has been conducted on cognitive training, which includes social support, everyday activities, tailored cognitive treatment, sophisticated technical aid, and caregiver support. In addition, the variety of intervention types is substantial. Numerous systematic reviews and meta-analyses have assessed the efficacy of cognitive training in healthy older adults and those with MCI (Jean et al., 2010; Kelly et al., 2014; Li et al., 2011; Reijnders, van Heugten, & van Boxtel, 2013; Zehnder, Martin, Altgassen, & Clare, 2009). Cognitive training has been shown to improve numerous aspects of objective cognitive functioning, including memory performance, executive functioning, processing speed, attention, fluid intelligence, and subjective cognitive performance. Cognitive training has been shown in several studies to be more effective on objective and subjective memory measures, as well as quality of life and mood, than on objective cognitive domain tests. In other words, the benefits of cognitive training were somehow transmitted to the patients' daily functioning and mood, which is the ultimate goal of any cognitive program.

In addition, physical exercise is a form of cognitive training that has been linked to positive effects on neuronal survival and function, neuroinflammation, vascularization, neuroendocrine response to stress, and brain amyloid burden. Additionally, physical activity improves cardiovascular risk factors (Janelidze et al., 2018). Several studies have found that elderly adults with MCI, cognitive decline, or dementia benefit from regular physical activity (Ainslie et al., 2008; Chaudhary et al., 2010; Janelidze et al., 2018; Lam et al., 2018; Sanford, 2017; Song et al., 2018). Physical exercise has positive impacts on cognition, mainly on global cognition, executive function, and attention (Song et al., 2018). Significant evidence supports the use of physical exercise to increase strength, step length, balance, mobility, and walking endurance. Strong evidence argues against using nonspecific exercise alone to improve quality of life. Individuals with MCI or mild-to-moderate dementia who participated in supervised multimodal exercise for around 60 minutes per day, two or three times per week, exhibited improved physical functioning. The study has helped us learn more about how aerobic exercise improves brain health in other ways. This conclusion may be because aerobic exercise is a major factor in improving cardiovascular fitness (Chaudhary et al., 2010). This leads to more blood flow to the brain, which improves the availability of neurotransmitters and the efficiency of neurons (Ainslie et al., 2008).

In conclusion, all non-pharmacological therapies may improve cognitive test performance, ADL, and mood in older people with MCI or dementia, as well as those with healthy aging, for the trained domain, according to the available data. Due to the high methodological diversity in intervention characteristics and included research samples among studies, the current findings should be interpreted with caution.

Neurobic exercise for older adults

The term “neurobic” was first introduced by neurobiologist Katz & Rubin, 1999. Neurobic exercise is one of the cognitive training that refers to brain exercises to enhance brain performance (Scotts, 2013). The activities of neurobic exercise are designed to stimulate the brain and are performed via the five physical senses and emotional sense. Neurobic exercise provides a stimulus for the brain cells, which in turn assists in their continual growth and improves blood supply. The purpose of the activity is to promote a healthy and active brain. Also, it assists in keeping a healthy level of mental fitness, physical strength, and flexibility as one ages (Kurz et al., 2009; Rapp et al., 2002).

The scientific basis of neurobic exercises

The brain receives information from the body and the senses, processes it, and then transmits messages back to the body. The brain takes in, sorts, and sends out information to help us decide what to do. It also stores important information for use later. The human cerebrum is the most developed portion of the brain. It is accountable for thinking, perceiving, producing and comprehending language. The cerebral cortex does most of the processing of information. A network of many smaller regions works together to process information as it comes in from the senses. Also, some parts of the cortex are especially good at putting together information from two or more senses. There are areas for feeling and areas for moving in the cerebral cortex. The thalamus is responsible for transmitting information to the parts of the brain that are responsible for processing sensory data. They are located in the occipital lobe's visual cortex, temporal lobe's auditory cortex, parietal lobe's gustatory cortex, and occipital lobe's parietal lobe's somatosensory cortex, respectively. There are regions inside the sensory areas known as "association areas," and it is these regions that give sensations meaning and attach them to certain stimuli. Movement is controlled by specialized regions of the brain known as motor areas, such as the main motor cortex and the premotor cortex (Crick & Asanuma, 1986; Lashley, 1933).

The hippocampus is an extension of the temporal cortex. On the margin of the temporal lobe, it appears externally as a layer of tightly packed neurons that curve into an S-shaped pattern. The hippocampal area of the brain is mostly connected to memory. The hippocampus works with the cortex to organize and coordinate the sensory information that is used to make memories. The hippocampus acts as a central hub that decides what will be stored in long-term memory and brings it back when needed. The cortex and hippocampus are wired so that different sensory representations of the same thing, event, or behavior can be linked or associated with each other (Anand & Dhikav, 2012). The cortex and hippocampus, which are in the temporal lobe, are directly stimulated by neurobic exercise. The hippocampus serves as a temporary repository for information, which subsequently progressively moves to the cortex for permanent storage (Raj et al., 2020). The exercise creates patterns of brain activity that make more connections between different parts of the brain. It also causes nerve cells to make neurotrophs, which improve the health of nerve cells, make them bigger and more complex, and help people remember things better. Additionally, neurotrophins make surrounding cells more robust and age-resistant (Katz & Rubin, 1999; Scotts, 2013). The neurobic exercise presents the combinations of physical senses, including vision, hearing, taste, smell, and touch, as well as an emotional sense, in addition to altering the daily routine and breaking a regular activities. Neurobic exercise is recommended as a healthy, balanced, comfortable, and fun technique to stimulate the brain. Turn regular activities into brain training by making minor modifications to daily behaviors (Katz & Rubin, 1999). For example, change to writing left-handed, shower with close the eyes, and brush teeth with non-dominant hand, eyes closed while getting dressed, eating a meal with the family in silence, and listening to music while smelling an aroma. Katz and Rubin (1999) suggested that the activities should employ one or more senses in a novel setting by dulling the sense of regular use and using other senses to complete an everyday task. This was one of the recommendations made by the researchers. An action needs to be distinctive, enjoyable, surprising, and engaging emotions in order to attract attention. This will cause the brain to switch into an attentive state. Likewise, shake up a usual activity in an unexpected and significant way, such as by going to work through a different route or going shopping at a different store.

Five physical senses and emotional sense

The process of aging has an impact on a person's molecules, cells, vasculature, physical morphology, and cognition. The cerebral cortex and the hippocampus are involved in the symptoms of forgetfulness and difficulties in learning new things, which are typical in elderly persons (Peters, 2006). The brain takes in information from the five senses and puts it all together into one big picture. Even though it seems like each sense works on its own, they are actually a team that works together. The brain takes in, sorts, and sends out information to help direct actions. It also stores important information for later use.

The neurobic exercise employs the five physical and emotional senses in unique ways to boost the brain's innate propensity to establish associations between various sorts of information. The brain considers a variety of factors while deciding whether to form these mental links. Once such connections are created, they are stored as long-term memories in the brain, which can be recalled by reliving the initial event (Katz & Rubin, 1999; Scotts, 2013).

The visual cortex of the occipital lobe processes visual information in the sense of vision. The occipital lobe analyzes visual information that the cortex generates, and it is crucial in sending sensory information to the cerebral cortex (Kanthamalee & Sripankaew, 2014). The auditory cortex is located in the temporal lobe and is responsible for processing sound and the sense of hearing. The temporal lobe is the primary region responsible for interpreting information from the ears in the form of sounds. The temporal lobe has a role in language comprehension and interpretation, as it receives and interprets varied frequencies, sounds, and pitches. The sense of smell is essential to memory. The olfactory cortex of the temporal lobe processes odors. The olfactory cortex is essential for the processing and perception of odor, and it is interconnected with other limbic system regions like the amygdala, hippocampus, and hypothalamus. The amygdala generates emotional responses and memories, whereas the hippocampus indexes and stores memories and the hypothalamus controls emotional responses (Sarafoleanu, Mella, Georgescu, & Perederco, 2009). The sensation of taste is processed in the gustatory cortex in the parietal lobe, which integrates sensory information from many modalities, cognition and information processing of time, place orientation, and memory (Bailey, 2019). The sense of touch is regarded to be the first sense developed by humans. Touch sensations are processed in the parietal lobe's somatosensory cortex (Bailey, 2019). Thus, integrating two or more senses activates the function of the brain, which is involved in the memory process and involves the frontal, parietal, temporal, occipital, diencephalon, and limbic systems.

Emotional sense combined with five physical senses to stimulate the brain is an excellent way to help the brain be healthy and active. Emotional sense will stimulate diencephalon, especially the hypothalamus, which controls emotions and stores memories by laying down memory attention. It also stimulates the limbic system. The limbic system is made up of the amygdala and the hippocampus, and it helps form memories by combining emotional states with memories of physical sensations. The amygdala is in charge of deciding what memories are stored and where in the brain they are stored. It also helps control how emotional memories are stored. The hippocampus is a very important part of making new memories and linking feelings and senses, like smell and sound, to memories. In response to stress, the hypothalamus sends hormones to the pituitary gland, which then acts on the pituitary gland. This helps control emotional responses to sensory information (Bailey, 2019; Kanthamalee & Sripankaew, 2014).

In conclusion, Neurobic exercise is a scientifically-based program that assists senior citizens in modifying their behavior by introducing the unexpected to the brain and stimulating all senses throughout the day. Neurobic exercise is advocated as a healthy lifestyle option. It can assist seniors in making tiny adjustments to their daily lives, changing routines into brain-healthy mental workouts.

Neurobic exercise program among older people

Recent evidence has suggested using neurobic exercise as an alternative way of doing things that continuously stimulate the human brain. Neurobic exercises don't require paper and pen but use five physical and emotional senses to change some activities' everyday routines. The goal of neurobic exercise is to stimulate the production of neurotrophic factors, which are essential for the maintenance, repair, and expansion of brain cells (Katz & Rubin, 1999). The evidence demonstrates that neurobic exercise helps strengthen nerve connections and keeps nerve cell receptors (dendrites) youthful and robust. In addition, it can engage various parts of the brain in various challenging activities to keep the brain working, improve neural connections, increase the grey matter and improve several cognitive tasks- primarily memory and learning (Katz & Rubin, 1999).

The beneficial effects of neurobic exercise in delaying cognitive function decline have been reported. Many studies confirm that stimulation of the five physical and emotional senses used in novel ways helps enhance brain function and improve memory performance. Non-systematic review by Singh and Arya (2012) found that the concept of neurobic exercise was used to develop the activities and protocol to modify the lifestyles of the varied population to improve their quality of life. A randomized clinical trial (RCT) was conducted on a total of 268 elderly patients who were scheduled to have major surgery that did not involve the cardiovascular or neurological systems. According to the findings, patients in the group that participated in neurobic exercise had a decreased incidence of delirium seven days after surgery compared to the controls (Humeidan et al., 2021). In a small randomized controlled trial including 40 stroke patients, neurobic exercise significantly improved cognitive function and quality of life four weeks after completion of the intervention compared to controls (Patani, 2020). A two-group post-test design with 62 older adults. Six weeks later, participants who received a combination of weight-bearing and neurobic exercise interventions had better bone health and physical function (Dighe, Anandh, & Varadharajulu, 2020). Specifically, in a non-randomized post-test design including two groups, one of which consisted of older people with various comorbidities (N=60). According to the findings, the neurobic exercise program was associated with lower levels of depression one month after the conclusion of the intervention as compared to the controls (Raj et al., 2020).

In Thailand, the concept of neurobic exercise was used to develop an intervention program to improve mental health and cognitive function. A few neurobic exercise studies have been previously tested with older adults during hospital admission and in the communities. In a single-blind randomized controlled trial (RCT), the effects of neurobic exercise on cognitive function and serum brain-derived neurotrophic factor (BDNF) in normal to mildly cognitively impaired elderly (N=51) were to be evaluated. Six months following the conclusion of the intervention, participants in the neurobic exercise intervention group had better cognitive performance and serum brain-derived neurotrophic factor (BDNF) than controls (Napatpittayatorn et al., 2019). The effect of neurobic exercise on memory enhancement in female older persons with dementia (N = 22) was investigated using a design with a single group performing a posttest. One month after finishing a four-week neurobic exercise program, the results showed that the experimental group exhibited an improvement of memory as measured by the Mini Mental State Examination (MMSE) score. These results were discovered after the neurobic exercise program was administered to the group (Kanthamalee & Sripankaew, 2014). Another quasi-experimental research of older adults with mild dementia (N=34), after receiving the brain-training program based on neurobics exercise theory, the participants had significant short-term memory improvement at 3-month follow-up (Kriengkaisakda & Chadcham, 2012). Further, using a non-randomized post-test design with 120 people with type 2 diabetes mellitus, the neurobic exercise intervention group's short-term memory scores were significantly better than the control group at 3 months follow-up (Wongkhamchai & Pantong, 2017). Another study with older people who lived in the community and had MCI (N = 60). Two months after the end of the neurobic exercise intervention, the experimental group receiving the brain exercise program based on neurobic exercise theory had lower depression scores (Kansri et al., 2018).

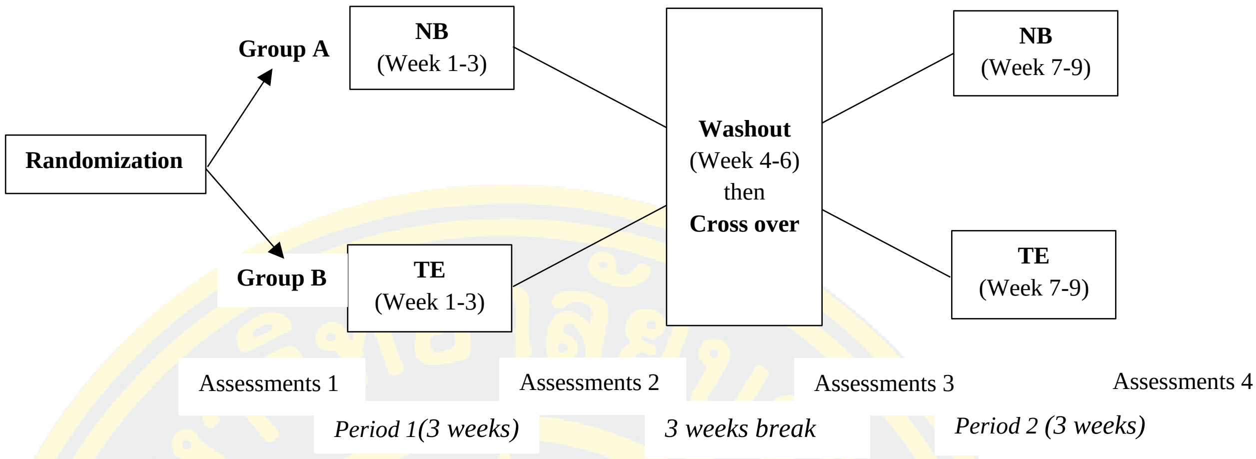
However, only one study was a randomized controlled trial design, which Napatpittayatorn and colleagues (2019) conducted. The intervention in this study was not explicitly developed for older adults with MCI. In addition, most studies were conducted using a quasi-experimental design, and some studies used a single-group design (e.g., Kansri et al., 2018; Kanthamalee & Sripankaew, 2014; Kriengkaisakda et al., 2012; Wongkhamchai, 2017). The majority of previous studies have been hampered by methodological limitations, such as non-randomization, lack of placebo intervention, and evaluator and participant visibility of data. Some previous studies targeted healthy ageing and elderly with dementia and also older adults with chronic illness (e.g., diabetes mellitus, hypertension) (Kanthamalee & Sripankaew, 2014; Kriengkaisakda & Chadcham, 2012; Wongkhamchai & Pantong, 2017). It is possible to demonstrate that the empirical nursing literature on interventions to improve health and memory in older adults, particularly those with MCI, is extremely limited. Therefore, this research would develop a neurobic exercise intervention to improve the objective and subjective memory performance of community-dwelling older adults with MCI. The objective was to identify an alternative method to prevent cognitive decline or reduce the risk of dementia in older adults with MCI.

CHAPTER 3
RESEARCH METHODS

This chapter covered the research design, population and sample, instrumentation, human subject protection, data collection procedures, and data analysis.

Research design

The research design was performed in a randomized, controlled, two-period crossover design to investigate the effects of the neurobic exercise program on memory performance in community-dwelling older adults with MCI. This study employed a single-blind method; two research assistants (RA_{1-2}) conducted the screenings and collected the outcome data without knowing who sampled into the neurobic exercise or the traditional brain exercise group. The researcher provided the neurobic exercise program, while RA_3 provided the traditional brain exercise program in order to minimize bias. The trial consisted of two interventions, the neurobic exercise and the traditional brain exercise program, which were crossed over. First, participants were randomized to receive either the neurobic exercise or the traditional brain exercise program during the first period. Then, after a three-week washout period, the groups were crossed over to receive different intervention from the first period. Memory performance was evaluated four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). The overall details are summarized in Figure 2.



Note: NB= Neurobic exercise program; TE= Traditional brain exercise program

Figure 2 Research design

Study setting

Saraburi province was selected as the study setting for this study. Most of the elderly in this province applied to be members of the Senior clubs. There are approximately 95 senior clubs in this province. The senior clubs usually organize the activities for the members of the clubs to participate in every month. Most of the senior club members usually come to participate in the senior clubs' activities, according to the schedule that each senior club offers. Saraburi province was chosen to be the place of this study setting due to the high number of seniors in each club, the regular meeting that the elderly usually come to participate in, and the need for the clubs to develop proper activities suitable for them. Approximately one thousand older adults live in this Tambon Pak Phriao, Mueang Saraburi district. There are two senior clubs in this Tambon, including Saraburi Hospital's senior club and Thesaban Mueang Saraburi's senior club. Usually, the older adults in the community are members of a senior club located in their residential area. Both senior clubs in Tambon Pak Phriao had activities or interventions once a month, such as physical exercise, occupational, recreational activities, and brain exercise, which nurses of Saraburi hospital ran. Saraburi Hospital's senior club was randomly selected to be the setting for this study. However, due to the COVID-19 situation, activities in this senior club have been suspended since January 2021. Therefore, the activities in this study were conducted after older people in the senior club of Saraburi hospital got vaccinated. The researcher ran the activities based on the standard protocols of Saraburi hospital.

Population and sample

Target population

The target population of this study was older adults whose ages range from 60 years and older living in the communities located in Amphoe Muang of Saraburi province.

Sample

The sample of this study included older adults with MCI in the senior club of Saraburi Hospital residing in Tambon Pak Phriao, Amphoe Muang of Saraburi province. The sample was recruited from the target population and screened for MCI. The participants from the senior club of Saraburi Hospital, which was under the management of Saraburi Hospital, were randomly assigned to either group A which received the neurobic exercise program, or group B, which allocated the traditional brain exercise program. After a three-week washout period, the groups were crossed over to receive different treatments from the first period for the other three weeks. The inclusion and exclusion criteria were as follows:

Inclusion criteria:

1. Males and females aged 60 years or older have MCI as screened using the Montreal Cognitive Assessment (MoCA); persons with scores less than 24 and 25 for those with less than six years of education are considered to have MCI.

2. Being independent as screened by using Modified Barthel ADL index (BAI); BAI score should be at least 12, indicating independence.

3. Body Mass Index (BMI) score ranges from 18.49 to 34.90 kg/m^2; this value indicates normal to obesity Class I for Thai people.

4. No history of psychiatric disorder or neurological condition (e.g., epilepsy, stroke, dementia, head injury, depression)

5. No hearing or visual impairment as diagnosed by a physician.

6. Ability to write and read as well as communicate well.

7. Willingness to participate in the study throughout the program.

Exclusion criteria:

1. The participants were excluded if they had severe neurological conditions and were dependent, making them unable to participate in the intervention.

2. Older adults with a history of food or flower allergies that were used in the neurobic exercise activities were excluded.

Discontinuation criteria

1. The participants who had severe complications or neurological severe or musculoskeletal conditions and serious conditions from comorbidity (e.g., diabetes mellitus, hypertension, stroke, cardiovascular disease, etc.), which make them unable to continuously participate in the intervention.

2. Participants who did not participate in all sessions of intervention were excluded.

Sample size

The G*Power 3.1.9.2 (Faul, Erdfelder, Buchner, & Lang, 2009) was used to calculate the sample size. The statistical test was the F tests ANOVA repeated measure, within and between factors the sample size of two groups has been identified as having a set power of .80 and a level of significance less than .05. The set effect size from a previous study of Napatpittayatorn et al. (2019) was d = .50, then transforming the effect size to F tests by the converting effect size program equal to .25 (Lenhard & Lenhard, 2016). Thus, the total sample size was 24 participants. In order to adjust for the participants, drop-out, or data attrition, an additional 30 percent was added to the sample size for a total of 32 participants. Thus, an adequate sample size of 16 participants in each group was required.

Sampling Procedure

The simple random sampling method was used to obtain a qualified sample in this study. A research assistant performed randomization. One Tambon of all Tambons in Amphoe Mueang Saraburi province was randomly selected by random of drawing a lot number. From one Tambon, the number of senior clubs located in this Tambon was identified and then randomly selected for one senior club by the coin tossing method. The trained research assistant met with a group of older adults at the senior club to explain the study. Once older adults agreed to participate, the research assistant (RA) conducted screening according to inclusion criteria. Those who met the eligibility requirements were enrolled and provided written permission to participate in the study. Using a random of drawing a lot number, each participant was randomly assigned to either group A (N=16) or group B (N=16). The overall details are summarized in Figure 3.

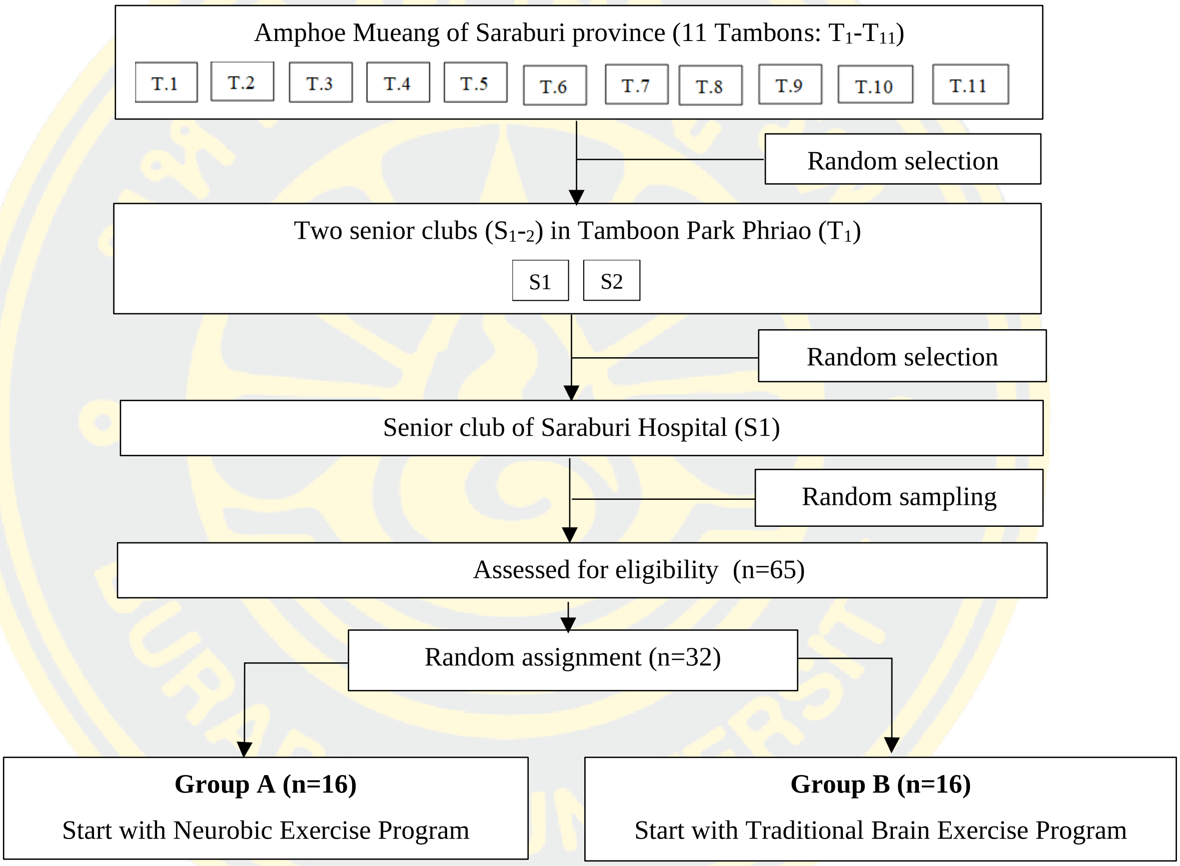


Figure 3 Summary of sample recruitment

Instrumentations

The research instruments for this study were divided into three parts: screening instruments, data collection instruments, and intervention instruments as follows:

1. Screening Instruments

Two screening tools were used to screen for identifying MCI, the Montreal Cognitive Assessment (MoCA) and the other for the functional capacity or independence (ADLs)

1.1 The Montreal Cognitive Assessment (MoCA) developed by Nasreddine et al. (2005) and translated into the Thai language by Hemrungrojn (2011) was used for screening MCI. This tool was used to measure the cognitive functions in the domains of attention and concentration, executive function, memory, language, visuoconstructional skills, conceptual thinking, calculation, and orientation. The total possible score was 30 points; a score of 24 or above was considered normal. Older adults who achieved scores less than 24 out of a possible 30 were considered to have mild cognitive impairment. Furthermore, adding one point would compensate for any individual with less than six years of education. The Cronbach's alpha coefficient of the MoCA-Thai version is .91. Both sensitivity and specificity were well accepted, with a value of .80 (Vichitvejpaisal et al., 2015).

1.2 Modified Barthel ADL index (BAI) was the functional capability of the elderly to carry out the daily activities necessary for living in the community. The BAI developed by Collin, Wade, Davies, and Horne (1988) and translated into the Thai language by Jitapunkul, Kamolratanakul, Chandraprasert, and Bunnag (1994) was used to screen the participants' level of independence. This instrument captures the capacities of older adults in performing 1) feeding, 2) grooming, 3) transfer, 4) toilet use, 5) mobility, 6) dressing, 7) stairs, 8) bathing, 9) bowels, and 10) bladder. The scores from all items were summed up to generate the total score indicating the older adults' capacities in performing ADLs. Possible total scores ranged from 0 to 20, with higher scores indicating a better functional ability. The total scores could also be classified into four levels, namely total dependence (0-4), severe dependence (5-8), moderate dependence (9-11), and no dependency burden (12-20). Therefore, the older adults who participated in the study should have BAI scores ranging from 12 to 20, indicating independence. Its Cronbach's alpha coefficient was .79 (Jitapunkul et al., 1994).

2. Data Collection Instruments

2.1 The researcher developed the personal demographics and health status questionnaire. It consisted of information concerning age, gender, marital and living status, education level, occupation, and underlying diseases.

2.2 Subjective memory was measured by using the short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), which was developed by Jorm (1994) and translated into the Thai language by Senanarong et al. (2001). The short form of the IQCODE consists of 16 items. This test measures the informant's perception of the older person's cognitive decline. Older adults are required to compare their performance today with their performance ten years ago. Informants were asked to indicate the change on a 16 items scale from 1 (much improved) to 5 (much worse). The cutoff scores were determined by dividing the total score by the number of questions (average item score range 1-5). Lower scores indicated superior subjective memory function. A score below 3.00 indicates improvement, a score of 3.00 indicates no change, a score of 3.01 to 3.50 indicates a slight decline, and a score of 3.51-4.00 indicates a moderate decline.

2.3 Objective memory was measured using the Common Objects Memory Test (COMT), developed by Kempler et al. (2010). The COMT was one of the instruments used to assess memory impairment that was developed as part of the larger Cross-Cultural Neuropsychological Battery (CCNB) by Dick et al. (2002). The COMT was created to assess age-related memory impairments in individuals with varying levels of education, language, and culture. The author and a bilingual researcher used a translation and back-translation technique to translate the COMT manual instructions into Thai (Brislin, Brislin, Lonner, & Thorndike, 1973). The translation received complete inter-rater agreement. The COMT (Thai version) was tested with 5 older adults to ensure that they were familiar with the common objects and distracters.

The COMT was administered in three steps. In the first step (the learning step), RA presented each picture individually and asked the participant to name the objects aloud and attempt to recall them. The RA then confirmed or corrected the participant's response. The RA then recorded the correctly recalled objects. The object recalls were then repeated three times. Thus, the possible score range was between 0 and 30.

In the second step, recall and recognition tests were administered with a five-minute delay between unrelated activities (i.e. coloring the pictures). Each participant was asked to recall the 10 objects once more, and the research assistant recorded the number of recall corrections. Then, the RA displayed 20 photographs of 10 original objects and 10 newly created objects (hairbrush, purse, comb, lock, matches, spoon, book, telephone, fan, and cloth pin). The participant viewed 20 pictures and indicated whether or not an object had been viewed before. The final score represents the number of correctly identified objects. The possible score range was between 0 and 30, including 10 for recalls and 20 for recognitions.

In the third step, another recall and recognition test was given after a 30-minute interval filled with unrelated test activities. The procedure and scoring system were identical to those described in the second step. The total sub-score was 30, which included 10 recall scores and 20 recognition scores. The total COMT scores were then added together across these three steps; the possible range was 0-90, with higher scores indicating better objective memory performance.

Translation for data collection instruments

The COMT was in the English language used for this study. Therefore, translation of this instrument into Thai was needed. The COMT was translated by the researcher using the back-translation method proposed by Brislin et al. (1973). This method was widely used for translating research instruments across cultures. There are three stages to the translation process.

In the first stage, the COMT instruments from the original English version (E1) were translated into Thai by two experts who were both fluent in Thai and English and were familiar with the context. At this point, the translators would work independently (T1 and T2). Following that, both translators would discuss the translated versions and come up with a final Thai version (T3) translation that was equivalent to the English version.

In the second stage, two bilingual translators back-translated the Thai version (T3) instruments from Thai to English (E2 and E3).

In the third stage, the researcher and advisor compared the back-translated English versions of the instruments (E2 and E3) to the original English versions (E1). If the back-translated version differed from the original version (E1), the researcher revised it until the final Thai instrument matched the original English version.

Reliability

Both the COMT and the short form of the IQCODE were administered to 30 older participants with similar characteristics to the actual study sample but who did not receive the intervention. Using Cronbach's alpha coefficient, the obtained data was used to determine reliability. The minimum acceptable reliability value for the scales is 0.70 (Polit & Beck, 2004). After being tested, all instruments demonstrated acceptable reliability. In this study, the Cronbach's alpha for the COMT was 0.80 and for the IQCODE short form, it was 0.94.

3. Intervention Instruments

Instruments for intervention were the neurobic exercise program and the traditional brain exercise program.

3.1 The neurobic exercise program

The neurobic exercise program used various combinations of physical senses (i.e., vision, smell, touch, taste, and hearing), including the emotional sense. It involves exposing the brain to new sensations or challenges that are outside of its normal routine in order to get the brain out of its comfort zone. The neurobic exercise program contained six sessions conducted twice a week for 60 minutes per session for three weeks. Each week, activities focused on brain stimulation for one or two senses. The intervention used the sense stimulation to break out of everyday routines in a novel way. The researcher ran the neurobic exercise activities. The activities were done in a group to stimulate the participants' brains and help them enjoy time with others. The program manual and all relevant information on this program were developed and validated by the experts before using it in the actual study. The details were summarized as follows:

For week 1, 2 sessions of program activities were conducted as follows:

Session 1: Stimulation of visual sense through a tray game

This session had two activities. First, the researcher provided thirty minutes of psychoeducation on “Neurobic exercise for older adults with MCI.” The researcher also discussed with the participants how they could apply it in their daily lives. Second, the researcher invited all participants to play the tray game. This game involves using a tray containing a selection of random items commonly found in the house or in everyday usage. The researcher placed the selected items on the tray and asked all participants to look at these items within a limited time, then covered them with a cloth. After that, the participants were asked to recall all the items they saw on the serving tray. Pictures of items were provided for participants. The participants chose what they saw, picked the pictures to put on the provided table sheet, and saw who could remember the most. Then, later on for two times, some of the items that were on the tray were taken off while covered with cloth, and the participants were asked to list all the things they saw again. They were asked to select the pictures of their chosen to put on the provided table sheet. The activities stimulate the occipital lobe and involve the thalamus and hypothalamus, which leads to memory enhancement.

Session 2: Stimulation of smell sense through the use of natural aroma

All participants stimulated their brains by using the sense of smell while they were blindfolded so they could not see and then smell the objects. This session had two activities. First, the researcher used the natural aroma to help participants relax while sitting comfortably and closing their eyes. They were guessing what the thing was that they were smelling and remembered it. Second, the participants smelled objects that included flowers and Thai herbs within the time set. Again, they guessed what the thing was that they were smelling and remembered it. They were asked to write their answers on paper with their non-dominant hand within the time set. The winner was the one who correctly guessed the most object. After finishing the activities, the researcher and participants shared and discussed their favorite natural aroma. This activity enhances memory in older people because the sense of smell plays a vital role in memory that directly connects to the cortex, hippocampus, and other parts of the limbic system involved in processing emotions and storing memories. After completing the activities in the 2nd session, the researcher summarized the use of visual and smelled stimulation of the brain and discussed with the participants how they could apply it in their daily lives towards the stimulation of these senses. In addition, to promote continuity of brain exercise, the homework activities were given to the participants to do on their own at homes. The assigned activities for these MCI older adults were not so complicated but useful in stimulating the brain. In session 1 of the 1st week, the older participants were asked to see the significant or famous people appeared in the news. In the 2nd session, they were asked to close their eyes and smelled things around their houses. The participants were assigned for doing homework and later on they were asked to share their experiences and discussed in the next week during the conduct of activities with the group at the hospital.

Week 2, 2 sessions (sessions 3 & 4) of program activities were conducted as follows:

Session 3: Stimulation of hearing sense through listening and identifying nature sounds

This session had two activities. First, the researcher turned on nature sounds at the same time. The participants were asked to listen attentively and guess what the natural sound was. The researcher asked all participants, “What natural sounds were there?” the participants wrote their answers on paper with their non-dominant hand within the time set. Second, all participants listened to music with several natural sounds and then guessed what natural sound was in the music. After that, the researcher asked all participants, “How many sounds of nature did you hear in this song?” and “What natural sounds are there?” Then all participants listened to the music again. After the music stopped, the participants wrote their answers on paper with their non-dominant hand within the time set. After that, participants listened to the music again, and the researcher explained how many natural sounds there were and what the natural sounds were in the song. The sense of hearing involves both the temporal lobe and limbic systems involved in emotion, motivation, and emotional association with memory. Music can have a profound effect on both emotions and the brain. Music influences mood by stimulating the production of specific brain chemicals. Additionally, music increases the neurotransmitter dopamine.

Session 4: Stimulation of touch sense through the writing and guessing game and a puzzle box game

This session had two activities. First, all participants were divided into three groups, and one member of the group received one word from the researcher. After the first participant from each group had read and remembered the word, they used a finger to write the word on the back of the next person in the group, and the next person did this until the last person. The last person of the group guessed what the word was and wrote that word on paper with their non-dominant hand within the time set. Second, all participants were blindfolded, and they touched items inside a box to guess what they had touched and need to remember what they had touched. Each participant touched one object in the box. After touching objects by all participants, each group summarized all the objects they touched within the time set. This intervention activated the frontal and parietal lobes. The frontal lobe was required for cognitive functions as well as the control of voluntary movement or activity. It is also involved in the processing of short-term memories and the retention of longer-term memories, whereas the parietal lobe processes information about temperature, taste, touch, and movement. After completing the activities in the 4^{th} session, the researcher summarized the use of hearing and touching stimulation of the brain and discussed with the participants how they could apply in their daily lives towards the motivation of these senses. In week 2, all of the participants were also asked to do the activities on their own at home. In session 3, they listened to and tried to identify sounds from nature. In session 4, they touched objects with their non-dominant hand to keep stimulating their brains. The participants were given homework, which they shared with the group and talked about the following week.

Week 3, 2 sessions (sessions 5 & 6) of program activities were conducted as follows:

Session 5: Stimulation of taste sense by tasting the fruit, food, and desserts

This session had two activities. First, all participants were divided into two groups and tasted the fruit and vegetables in several tastes: sweet taste, sour taste, flavorless, salty, and bitter taste while blindfolded and then guessed what it was. Second, all participants tasted food and desserts while blindfolded and then guessed what each food was. After that, the participants were asked, “What was the name of the food or dessert?” and “What ingredients were in the food or dessert?” then, the participants wrote down the name of the food or dessert on paper with their non-dominant hand within the time set. For the ingredients of the food or dessert, they could mark the crosses on the answer sheet. Finally, the researcher summarized the use of stimulating the brain through taste sense. Then, the researcher and all participants together discussed how to apply this in their daily life. The effects of taste were associated with emotions and the ability to retrieve memories. The gustatory cortex was the area of the brain responsible for the sensation of taste. In addition, the activities were stimulated the frontal lobe that controls essential cognitive skills in humans, such as emotional expression, problem-solving, memory, language, judgment, and sexual behaviors. Also, the participants were asked to keep doing things at home. In week 3, session 5, they tried the food with their eyes closed. The participants were given homework, which they shared and talked about at the next group meeting.

Session 6: Integration of multi-senses; Application in daily day usage

Activities aimed at stimulating multi-senses were conducted. This session had two activities. First, this session used a cooking game to stimulate the brain. All participants were divided into two groups to compete in cooking. They used multi-senses to create a menu, plan and manage the time and money within the time set after completing the multi-sense activities. The combination of two or more senses stimulates the brain's function, which involves the memory system and the frontal, parietal, temporal, and occipital lobes, as well as the diencephalon limbic system. In addition, it can improve executive function, decision-making, and planning. Second, the researcher provided thirty minutes for psychoeducation on "How to use the neurobic exercise in your daily life” The researcher demonstrated how to incorporate the nuerobic exercise into one’s daily day. After completing the last week of intervention, all participants were asked for their feedback regarding the overall activities and their satisfaction with the intervention.

3.2 The traditional brain exercise program

This program contained six sessions, which were conducted twice a week for three weeks. Each session took around 60 minutes. The activities were done in small groups and run by a research assistant (RA_3), a registered nurse who worked in the senior club and was trained to run the activities. The activities included 1) Psychoeducation “Brain exercise to prevent Dementia for the elderly” 2) Drawing and coloring 3) Folding paper 4) Singing a song 5) Photo hunt, and 6) The calculation games. The experts validated the program manual and all relevant information on this program before using it in the actual study. The details were described in the following:

Session 1: Psychoeducation "Brain exercise to prevent Dementia for the elderly"

The RA_3 provided thirty minutes for psychoeducation "Brain exercise to prevent Dementia for the elderly" using PowerPoint and a video recorder. Then, all participants watched a video recorder about brain exercises (Jeep-L and Pond-Koi). Next, the RA demonstrated, and all participants practiced following the video.

Session 2: Brain exercise by drawing and coloring

All participants drew and colored "My Family" within the time set. Then, participants were divided into three groups to share the story of the picture. After finishing activities, the RA_3 summarized the stimulation of the brain by using drawing and coloring.

Session 3: Brain exercise by folding paper

The participants were given paper of various colors, with each person designing their folding shape. Next, they could teach each other to fold the paper within groups. Then, all participants were divided into three groups to share their stories about their folding paper. After finished activities, the RA_3 summarized the stimulation of the brain by folding paper.

Session 4: Brain exercise by singing a song

All participants were divided into two groups to compete in singing a song and dancing. After that, all participants would sing a song and dance together. After finished activities, the RA_3 summarized the stimulation of the brain by singing a song and dancing.

Session 5: Brain exercise by photo hunt

All participants were divided into two groups to play the photo hunt. First, the RA_3 displayed two identical photographs with five minor differences. The goal was to locate and identify the differences between the photos within the allotted time. Then, the participants selected potential differences and marked the crosses in the picture. The winner was the group that gave correct answers. After finishing the activities, the RA_3 summarized the stimulation of the brain by photo hunting.

Session 6: Brain exercise by calculation games

The participants were divided into three groups to play calculator games. They calculated the numbers within the time set. The winner was the group that answered the questions correctly and used the least time. After completing the last week of the intervention, all participants were asked for their feedback regarding the overall activities they participated in and their satisfaction with the intervention.

Quality of intervention instruments

The content validity and the feasibility of the intervention instruments were the two categories of quality measuring equipment.

1. Content validity

The validity of the neurobic exercise program was validated for content, process, and arrangement by five experts consisting of one psychiatrist, one psychologist, one neurologist, and two nursing instructors in the fields of gerontological, psychiatric, and mental health nursing. They reviewed, critiqued, and suggested the neurobic exercise program. After that, the researcher revised the neurobic exercise intervention according to the suggestions from the five experts with the principal advisor and the co-advisor. The traditional brain exercise program was validated for content, process, and arrangement by the nurse working and running the activities in the senior club of Saraburi hospital.

2. Feasibility of the intervention

Following the experts' comments and suggestions, the researcher and major advisor revised the content and other parts of the intervention and conducted a pilot intervention with twenty people with MCI to test the feasibility of the neurobic exercise program.

Pilot Study

The purpose of the pilot study was to assess the feasibility and acceptability of the neurobic exercise program. It was carried out from February to April 2021, with approval from Burapha University's Research Ethics Committee and Saraburi Hospital's Subject Committee. This study enlisted the participation of twenty older adults who met the study's inclusion criteria. All participants were randomly assigned to either the intervention (n=10) or control (n=10) groups. Participants in the control group received usual care. Because of the COVID-19 pandemic. The senior club of Saraburi Hospital did not have activities for the member. Thus, the participants stay home. The participants in the intervention group received usual care and the neurobic exercise program, which participated twice a week for 60 min per session for three weeks. Following completion of this program, participants were asked to complete the IQCODE and COMT post-tests at intervention completion (week 3) and the follow-up test (week 6). They also evaluated and reflected on the program.

The results showed that participants in the intervention group had a significant higher COMT relative change score indicating improvement on cognitive performance at 3-week, t = -7.13 (p <.001) and 6-week, t = -5.43 (p <.001). In addition, there were a significant reduction on IQCODE relative change score indicating improvement on cognitive decline at 3-week, t = 3.67 (p <.001) and 6-week, t = 4.29 (p <.001). The feasibility of the neurobic exercise program was also determined by the retention of participants and the lessons learned from the program's implementation. Twenty older adults signed the informed consent to participate and completed the study at the 3-week follow-up (100% enrollment rate). During program implementation (three weeks for six sessions), no participants from either group withdrew, indicating a retention rate of 100 percent. The majority of respondents reported positive feedback. The activities were suitable and beneficial for them. All participants had an excellent level of satisfaction at 80 percent and a good level of satisfaction at 20 percent. Participants indicated via open-ended questions that all activities were suitable for their age and health conditions. They reported enjoying time spent with others in small group settings. During the game sessions, they supported one another, which improved their memory. For example, one participant said, "*I feel excited and enjoy the activities with my friend*", and another participant said, "*I think the activities are appropriate for my group and make me alert to do something new*." However, some participants reported that using their non-dominant hand and identifying objects with their eyes closed were difficult. For example: "*It was hard trying to mark the answers on paper with my left (non-dominant) hand*." Another example was, "*It was hard to guess while closing my eyes and touching an object with a non-dominant hand in the time set*" Another suggestion was that after the researcher summarized each activity, a document should be provided for the participants to take home in order to practice by themselves. Participants were pleased with the neurobic exercise; they enjoyed group participation and found it beneficial for brain stimulation and memory improvement. They shared experiences and challenges (which were the components of the intervention). Some participants requested a copy of their answers as references and were enthused to see their improvement over time.

Protection of human subjects

The research proposal and all research instruments were submitted and approved for experimentation in human subjects by the Research Ethics Committee of Burapha University and the Subject Committee of Saraburi Hospital concerning the protection of the rights of human subjects. In addition, the study was registered with the Thai Clinical Trials Registry (TCTR). Before obtaining their consent, the participants were informed of the objectives, procedures, benefits, and risks of the study. They could refuse to answer any questions that made them feel uneasy and withdraw from the study at any time. The participants were also assured that their decision to participate in the study would not affect the quality of health care services they received during the course of the research. Their decision to withdraw from the study would not affect their relationship with health care providers or their ability to receive health services. They had access to all available hospital services as usual. Participants' privacy was protected, and no personal information was shared with any third parties. All information was stored in a secure location and was only used for research purposes; names were replaced with code numbers. The outcomes were reported as group statistics. Within one year of the study's publication, all personal information would be removed.

Data collection procedures

The data collection procedure was carried out after approval by the Burapha University Research Ethics Committee and the Saraburi Hospital Subject Committee in Saraburi province, Thailand. In this study, the data collection procedure consisted of three phases.

Phase 1: Preparing the research assistants

This study had three research assistants (RAs), including two research assistants who conducted the screenings and collected the outcome data (RA_{1-2}), and another RA_3 was running the traditional brain exercise program. Two Ras (RA_{1-2}) who are registered nurses with at least two years of experience in geriatric care were selected from Saraburi Hospital. The researcher trained two Ras (RA_{1-2}) to collect accurate and consistent data from both groups blindly by not knowing which group was the neurobic exercise program or the traditional brain exercise program. Another RA_3, a registered nurse who works in the senior club, was trained to run the traditional brain exercise program.

Phase 2: Intervention phase

After receiving IRB approval and permission from Saraburi Hospital, data collection began. Following the screening for eligible participants, participants were informed about the study and their consent was explained. Before beginning the study, all volunteers were asked to sign a consent form. Two RAs (RA_{1-2}) collected the demographic data and outcome variables from the participants in both groups (baseline). The allocation sequence was created independently and kept secret until the patients entered the trial. The trial consisted of a three-week cross-over program. Participants were assigned to group A during the first period. This group received the neurobic exercise program or group B, which received the traditional brain exercise program. Following a three-week washout period, the groups were switched to receive different treatments for the next three weeks. The memory performance was evaluated four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9) by the evaluator blinded to the intervention type. Brief details of the neurobic exercise program and the traditional brain exercise program are as follows:

The neurobic exercise program

The neurobic exercise program consisted of six sessions 1) Stimulation of visual sense through a tray game, 2) Stimulation of smell sense through the use of natural aroma, 3) Stimulation of hearing sense through listening and identifying nature sounds, 4) Stimulation of touch sense through the writing and guessing game and a puzzle box game, 5) Stimulation of taste sense by tasting the fruit, food, and desserts, and 6) Integration of multi-senses stimulation; Application in daily day usage. The researcher conducted the intervention twice a week for 60 minutes per session for three weeks. The activities were done in a group to stimulate the participants' brains and help them enjoy time with others. Also, five homework assignments that were simple brain stimulation activities and not complicated stimulated the brain by themselves.

The traditional brain exercise program

The traditional brain exercise program was a set of activities that the senior club of Saraburi hospital has been doing continuously since 2004. The activities based on the empirical evidence were used to promote the brain for older adults. All activities in this program were run by a research assistant, a nurse of Saraburi hospital. The activities were done in small groups and focused on the stimulation of the brain. This program contained six sessions and was conducted twice a week for 60 minutes per session for three weeks. The activity schedule was the same period as the neurobic exercise program. The activities included 1) Psychoeducation “Brain exercise to prevent Dementia for the elderly” 2) Drawing and coloring, 3) Folding paper, 4) Singing a song, 5) Photo hunt, and 6) Calculation games.

Phase 3: The evaluation phase

The research assistants evaluated the outcome variables four times without knowing who sampled into the neurobic exercise program or the traditional brain exercise program at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). The short form of the IQCODE took about 5 minutes, and the COMT took about 45 minutes.

Data Analysis

The data for the proposed study were analyzed using statistical software with the alpha level for significance set to .05. In addition, data were double-checked for any errors. Finally, the data analyses were performed according to the study research hypotheses and summarized as follows:

1. Descriptive statistics were used to describe the characteristics of the participants.

2. Chi-square, Fisher’s exact test, and independent t-test were used to examine the differences in demographic data between those two groups.

3. Repeated measures ANOVA was used to compare the differences in mean scores of memory performance between two groups and compare within both groups across the four measured periods at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9).

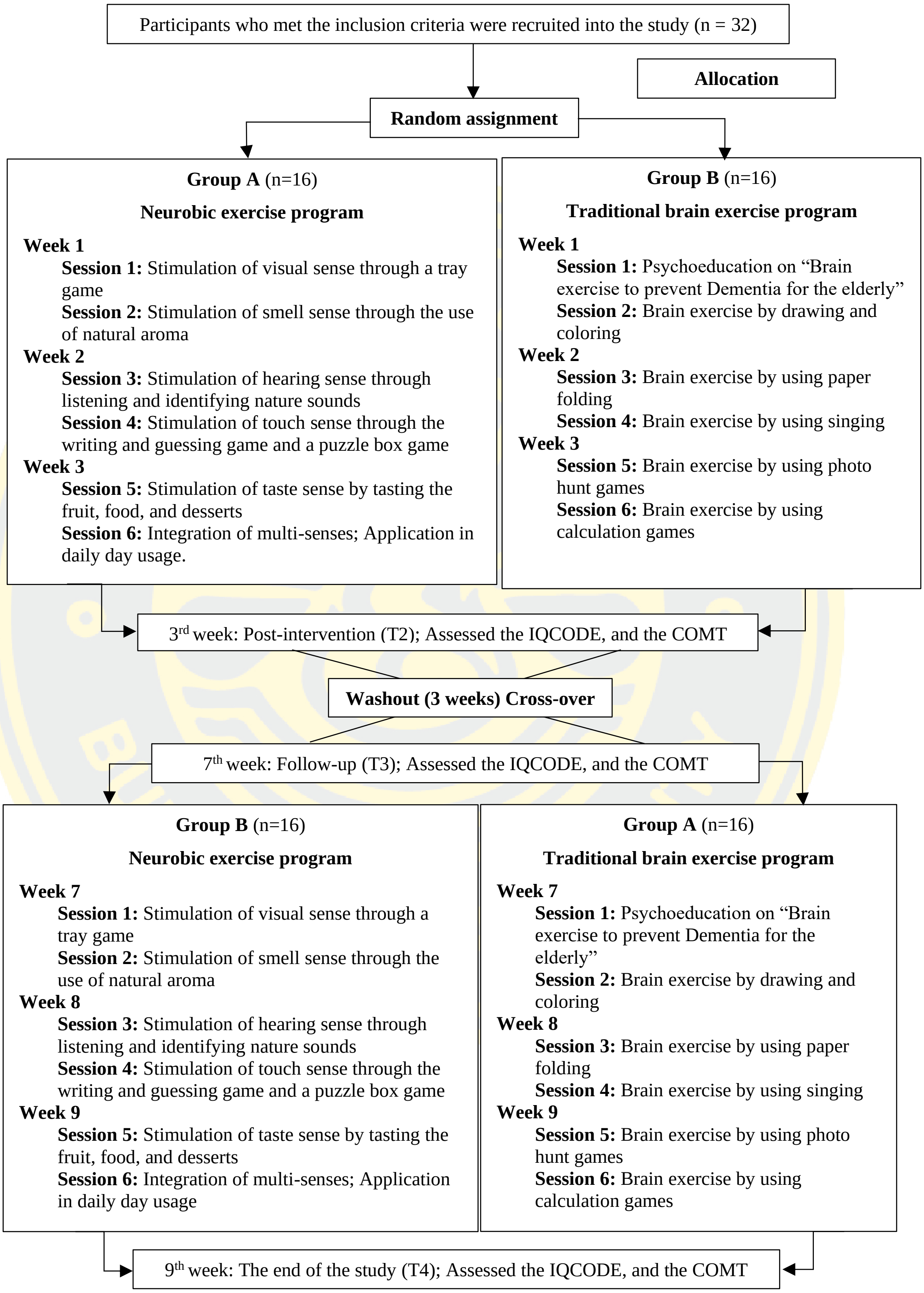


Figure 4 Summary of data collection procedures

CHAPTER 4
RESULTS

This chapter presents the research findings, including participant characteristics, descriptive statistics for dependent variables, assumption evaluation, and research hypothesis testing.

Summary of the sample allocation

A total of 78 older adults were eligible to be invited to the study. Thirteen older adults were not meet the inclusion criteria in this study. Of these, 32 older adults were randomly selected and consented to participate in this study. These 32 older adults were randomly assigned 16 into group A and 16 into group B. A single-blind, randomized, controlled, two-period crossover design was used in the study. All the participants received two interventions (the neurobic exercise program and the traditional brain exercise program) separated by three weeks washout period. In the first period, group A received the neurobic exercise program, and group B received the traditional brain exercise program. After a three-week washout period, the participants were crossed over to receive the different interventions for three weeks; group A received the traditional brain exercise program, while group B received the neurobic exercise program in the second period. The study investigates the effect of the neurobic exercise program on memory performance. Blinded evaluators measured the outcome four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). This study had three research assistants (RA_{1-3}), including two research assistants (RA_{1-2}) who conducted the screenings and collected the outcome data and another RA_3 who runs the traditional brain exercise program. The first RA_1 collected data with group A while another RA_2 collected data with group B. Subjective memory was measured using the short form of IQCODE, which took about 5-10 minutes, and objective memory was measured using the COMT, which took about 45-60 minutes. No participants dropped out of this study while collecting the data. Both group A and group B participants attended all sessions.

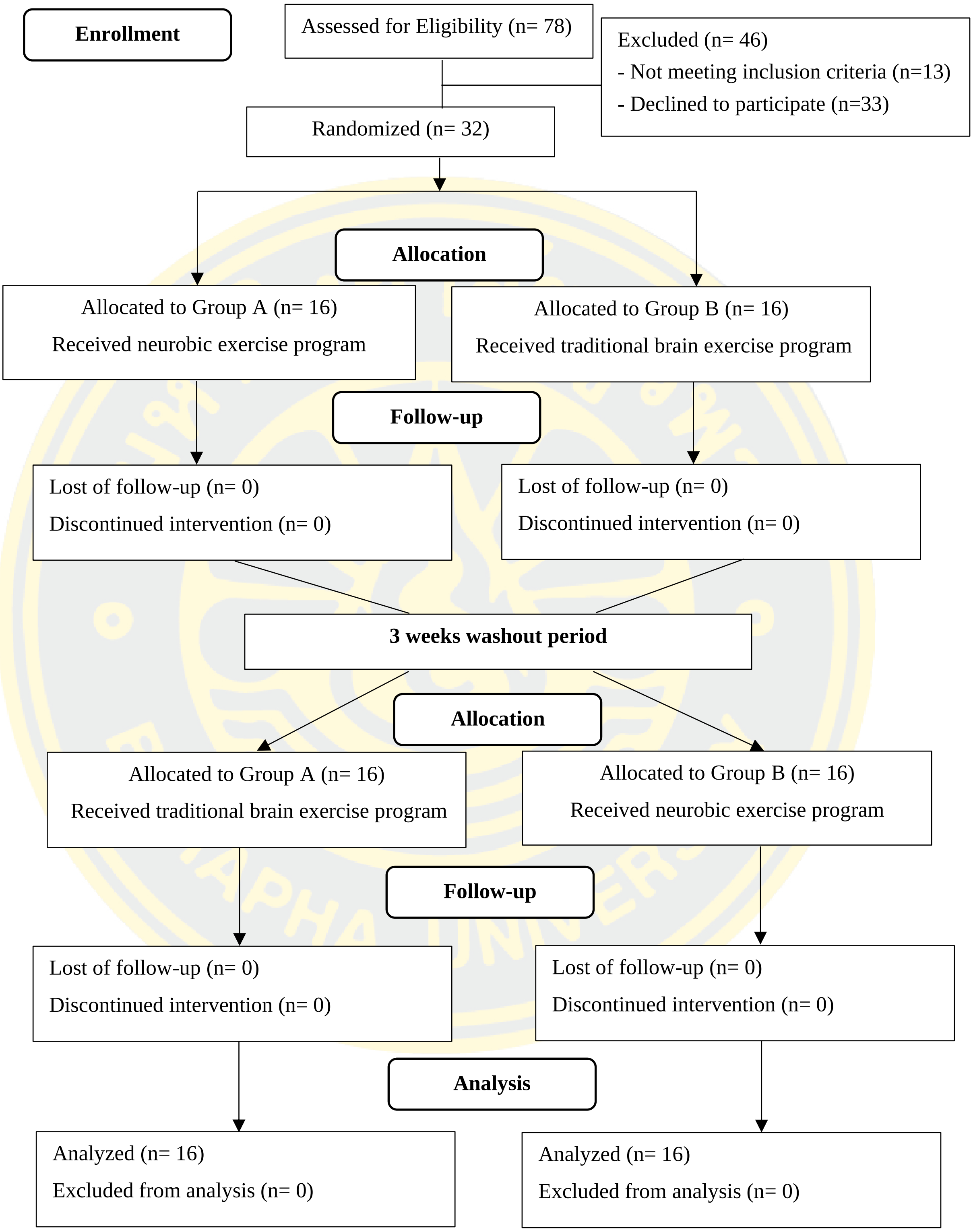


Figure 5 Consort flow diagram showing the flow of participants through each stage of the randomized crossover trial

Characteristics of participants

Descriptive statistics were used to analyze the characteristics of study participants, which included frequencies, percentages, means, and standard deviations. Thirty-two participants were analyzed, and the initial background data of 32 participants were summarized in Table 1.

In terms of baseline demographics, there was no statistical significance between groups A and B. All participants met the screening criteria, the overall mean of MoCA score was 21.13 (SD = 2.01, range 16-23), ADL score was 19.91 (SD = .29, range 19-20), and BMI was 24.56 (SD= 3.61, range 16.01-34.52). Participants mean age was 67.53 years (SD = 4.43, range 60-78), 93.8% (n=30) were female, 46.9 % (n=15) were married, and 87.5% (n=28) lived with family members at home. Of 32 participants, 87.5% (n=28) had primary education. 81.3% (n=26) reported having other chronic illness conditions such as hypertension 68.8% (n=22), dyslipidemia 46.9% (n=15), diabetes 21.9% (n=7), and heart disease 3.1% (n=1) whereas 43.75% (n= 14) reported more than one condition.

In group A, 16 older adults with a mean age of 67 years (SD = 3.46, range 60-74), 93.8 % (n=15) were female, and one-half (n=8) married. Only 12.5% (n=2) live alone. Of 16 participants, 87.5 % completed primary education level (n=14), 62.5% (n=10) had no work and had a monthly income of 600 – 10,000 Thai Baht, 81.3 %(n=13) had a chronic illness condition such as hypertension 75% (n=12), dyslipidemia 43.8% (n=7), and diabetes 31.3% (n=5).

In group B, participants' mean age was 68.06 years (SD = 5.29, range 60-78), 93.8% (n=15) were female, 43.8 % (n=7) were married, and 87.5% (n=14) lived with family members at home. Of 16 participants, 87.5 % (n=14) completed primary education level, and 75 % (n=12) had no work and had a monthly income of 600 – 10,000 Thai Baht, 81.3%(n=13) had a chronic illness condition such as hypertension 62.5% (n=10), dyslipidemia 50% (n=8), diabetes 12.5% (n=2), and heart disease 3.1% (n=1).

Comparing the characteristics of participants in groups A and B using the Chi-square test for categorical data. If the expected count was less than 5 per cell by more than 20%, Fisher's exact test was used to determine their differences, and the t-test was used for continuous data. No statistically significant difference was found in baseline characteristics between those two groups (*p* > .05). The details of demographic characteristics of the participants are shown in table 1.

Table 1 Baseline demographic data of older adults with MCI

Characteristic	Group A (n=16)		Group B (n=16)		t/ X^2/F	*p*-value
	n	%	n	%		
Age						
Range	60-74		60-78		-.671[a]	.507
Mean (SD)	67(3.46)		68.06(5.29)			
Sex						
Male	1	6.3	1	6.3	.000[b]	.999
Female	15	93.8	15	93.8		
Marriage status						
Single	3	18.8	4	25.0	.210[c]	.901
Married	8	50.0	7	43.8		
Divorced/widowed	5	31.3	5	31.3		
Living status						
Living alone	2	12.5	2	12.5	.000[b]	.999
Living with other	14	87.5	14	87.5		
Education level						
Less than high school	14	87.5	14	87.5	.000[b]	.999
Completed high school	2	12.5	2	12.5		
Occupation						
Not work	10	62.5	12	75.0	2.186[b]	.624
Work	6	37.5	4	25.0		
Income (Baht/month)						
Range	600-10,000		600-10,000		-.417[a]	.679
Mean (SD)	1393.75 (2320.47)		1737.50 (2338.91)			
Chronic illness						
No	3	18.8	3	18.8	.000[b]	.999
Yes	13	81.3	13	81.3		

a = t-test, b = Fisher’s exact test, c = Chi-square

Descriptive statistics of outcome measures

In this study, subjective memory and objective memory were assessed at baseline (pre-intervention [week 0]), post-intervention (week 3), follow-up (week 7) and at the end of the study (week 9). This variable was characterized by its means and standard deviations.

In group A, means score of subjective memory at baseline (pre-intervention [week 0]), post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9), as measured by IQCODE were 3.415 (SD = .291), 3.188 (SD = .264), 3.265 (SD = .214) and 3.253 (SD = .177), respectively. In addition, mean score of objective memory at baseline (pre-intervention [week 0]), post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9), as measured by COMT were 76.94 (SD = 6.475), 83.19 (SD = 4.293), 78.19 (SD = 4.086), and 78.50 (SD = 3.759), respectively.

In group B, means score of subjective memory at baseline (pre-intervention [week 0]), post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9), as measured by IQCODE were 3.301 (SD = .406), 3.433 (SD =.369), 3.371 (SD =.258), and 3.070 (SD = .205), respectively. In addition, mean score of objective memory at baseline (pre-intervention [week 0]), post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9), as measured by COMT were 77.25 (SD = 6.990), 77.31 (SD = 6.710), 75.31 (SD = 6.374) and 81.56 (SD = 4.546), respectively. Details are presented in Table 2.

Table 2 Means and standard deviations of IQCODE and COMT for both groups among 4-time measures

Variables	**Time**	**Group A (n =16) Mean (SD)**	**Group B (n = 16) Mean (SD)**
IQCODE	Baseline	3.415 (.291)	3.301 (.406)
	Week 3	3.188 (.264)	3.433 (.369)
	Week 7	3.265 (.214)	3.371 (.258)
	Week 9	3.253 (.177)	3.070 (.205)
COMT	Baseline	76.94 (6.475)	77.25 (6.990)
	Week 3	83.19 (4.293)	77.31 (6.710)
	Week 7	78.19 (4.086)	75.31 (6.374)
	Week 9	78.50 (3.759)	81.56 (4.546)

IQCODE=Subjective memory, higher score = more cognitive decline
COMT = Objective memory, higher scores = better objective memory performance

Outcome measures at baseline

In this study, the outcome variable was memory performance, which was measured in two aspects, including subjective and objective memory.

1. Subjective memory was a self-report of each older adult's interpretation, feelings, thoughts, and perceptions of changes in memory problems. The 16-item Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) was used to assess it. Higher scores of IQCODE indicated greater subjective performance towards cognitive impairment or memory decline.

2. Objective memory refers to memory or cognitive functioning that was based on memory testing and tasks measuring actual memory or cognition. It was measured using a standardized Common Objects Memory Test (COMT). Higher scores indicate better objective memory performance.

Before evaluating the program's effect, the difference in subjective and objective memory between two groups of older adults with MCI was examined at pre-intervention. Independent t-tests were used to compare variables between two groups. Results showed no significant difference in all variables (subjective memory and objective memory) at baseline between these two groups ($p > .05$) indicating no significant towards outcome variables between group A and group B at pre-intervention. Details are presented in Table 3.

Table 3 Between-group comparisons of outcome measures at baseline (Pre-test)

Variables	**Group**	**Mean (SD)**	***t***	***p-value***
IQCODE	A	3.41 (.29)	.909	.371
	B	3.30 (.40)		
COMT	A	76.94 (6.47)	-.131	.897
	B	77.27 (6.99)		

IQCODE=Subjective memory, higher score = more cognitive decline
COMT = Objective memory, higher scores = better objective memory performance

The initial step of the analysis was to identify carryover effects between the two study periods. To exclude carryover effects, the sum of each participant's measured values across the periods was calculated and compared between the two groups using an independent t-test. The results showed no significant difference in all variables (subjective memory and objective memory) at the end of washout period in week 7 ($p > .05$). It demonstrated that there were no carryover effects and that the washout phase (3 weeks) was long enough. Details are presented in Table 4. As the next step, the researcher looked for significant differences between the effects of neurobic exercise intervention and traditional brain exercise programs.

Table 4 Between-group comparisons of outcome measures at week 7

Variables	**Group**	**Mean (SD)**	***t***	***p-value***
IQCODE	A	3.26 (.21)	-1.255	.219
	B	3.37(.25)		
COMT	A	78.19 (4.08)	1.519	.139
	B	75.31(6.37)		

IQCODE=Subjective memory, higher score = more cognitive decline
COMT = Objective memory, higher scores = better objective memory performance

Examination of the effectiveness of the neurobic exercise program on memory performance among community-dwelling older adults with MCI

Repeated-measures ANOVA was used to examine the differences in each outcome variable (subjective memory and objective memory) within-subject, between-subject, and across the periods of four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). There were no missing data and outliers in the data file. Before proceeding with the analysis, the statistical assumptions were tested. To ensure the accuracy of statistical calculations, the following assumptions were examined.

1. Normality distribution

The normality distribution of subjective memory of both groups was tested. Subjective memory at baseline in the neurobic exercise group was accepted as a normal distribution by Kolmogorov-Smirnov test of normality which showed non-statistically significance. On the other hand, the subjective memory of the traditional group was rejected for normality distribution. According to the Kolmogorov-Smirnov test of normality, the objective memory of both groups at baseline exhibited a normal distribution. Fisher's measures of skewness and kurtosis demonstrated a normal distribution for both subjective and objective memory. Value is above -1.96 and below +1.96 indicated that the distribution is significantly normal.

2. Homogeneity of variance

Levene's test assessed the homogeneity of variance assumption for the between-subjects design. The between-subjects homogeneity of variance test had to be insignificant ($p > .05$), indicating that heterogeneity of variance among the dependent variable groups was equal. The Homogeneity of variance assumption was met.

3. Independence of observation

Durbin-Watson examined observational independence. The Durbin-Watson coefficient was between 1.5 and 2.5, indicating that the data exhibited observational independence or lacked autocorrelation. The results showed that all data were between 1.5 to 2.5. It could be interpreted that this assumption was met.

4. Randomness

Randomness was evaluated using the Runs test, which indicated that probability sampling was greater than.05 ($p > .05$). Therefore, the data of the dependent variables could be interpreted as a random sample. The results demonstrated that the sampling probability of variables is greater than 0.05 ($p > .05$). Therefore, it could be interpreted that this assumption was met.

5. Additionally, compound symmetry was examined. On Mauchly's test of sphericity, both subjective memory ($p < .001$) and objective memory ($p < .001$) were significant, indicating that the assumption of compound symmetry was violated. Therefore, the multivariate results with Greenhouse-Geisser were reported for correction of both variables.

Subjective memory

Repeated-measures ANOVA was used to determine whether there were any significant differences between the two groups. The results show that the mean score comparison between and within groups showed the statistically significant differences of within-subject ($F_{1.437, 43.113} = 9.324$, $p < .05$) and interaction effect (time*group) ($F_{1.437, 43.113} = 12.313$, $p < .05$). The comparisons of mean scores measured at different time points found non-significant difference of between subjects ($F_{1,30} = .023$, $p > .05$) (Table 5). It could be interpreted that IQCODE (subjective memory) score shows a significant difference within groups. However, groups A and B showed no significant difference (Table 6).

Table 5 Repeated measures ANOVA of subjective memory (IQCODE)

Source	***SS***	***df***	***MS***	***F***	***p*-value**
Within-subject					
Time	.711	1.437	.495	9.324	.001
Time*Group	.938	1.437	.653	12.313	.000
Error time	2.286	43.113	.053		
Between subject					
Group	.006	1	.006	.023	.879
Error	7.363	30	.245		

SS = Sum Square; df = degree of freedom; MS = Mean Square; Greenhouse-Geisser was used to report the results of subjective memory; IQCODE=Subjective memory, higher score = more cognitive decline

Table 6 Comparisons of estimated marginal mean differences of IQCODE between groups

Group	*Mean*	*SE*	*M diff (SE)*	*p*-value
Total estimated marginal mean scores				
Group A (NB+TE)	3.281	.062	-.013(.088)	.879
Group B (TE+NB)	3.294	.062		

SE = Standard error; NB= Neurobic exercise program; TE= Traditional brain exercise program
IQCODE=subjective memory, higher score = more cognitive decline

A post hoc t-test was then conducted. The significance level was adjusted for this test by dividing it by the number of comparisons (0.05/4 = 0.0125; Bonferroni correction). Results showed no significant difference between groups A and B at baseline, week 3, and week 7 ($p > .0125$). However, it showed a significant difference in week 9 between the two groups
($p < .0125$). Details are presented in Table 7.

Table 7 Comparisons of subjective memory (IQCODE) between groups in each time

Group	Time							
	Baseline		**Week 3**		**Week 7**		**Week 9**	
	Mean (SD)	*p*-value	Mean (SD)	*p*-value	Mean (SD)	*p*-value	Mean (SD)	*p*-value
A (NB+TE)	3.415 (.291)	.371	3.188 (.264)	.039	3.265 (.214)	.219	3.253 (.177)	.011
B (TE+NB)	3.301 (.406)		3.433 (.369)		3.371 (.258)		3.070 (.205)	

$p < .0125$; NB= Neurobic exercise program; TE= Traditional brain exercise program
IQCODE=Subjective memory, higher score = more cognitive decline

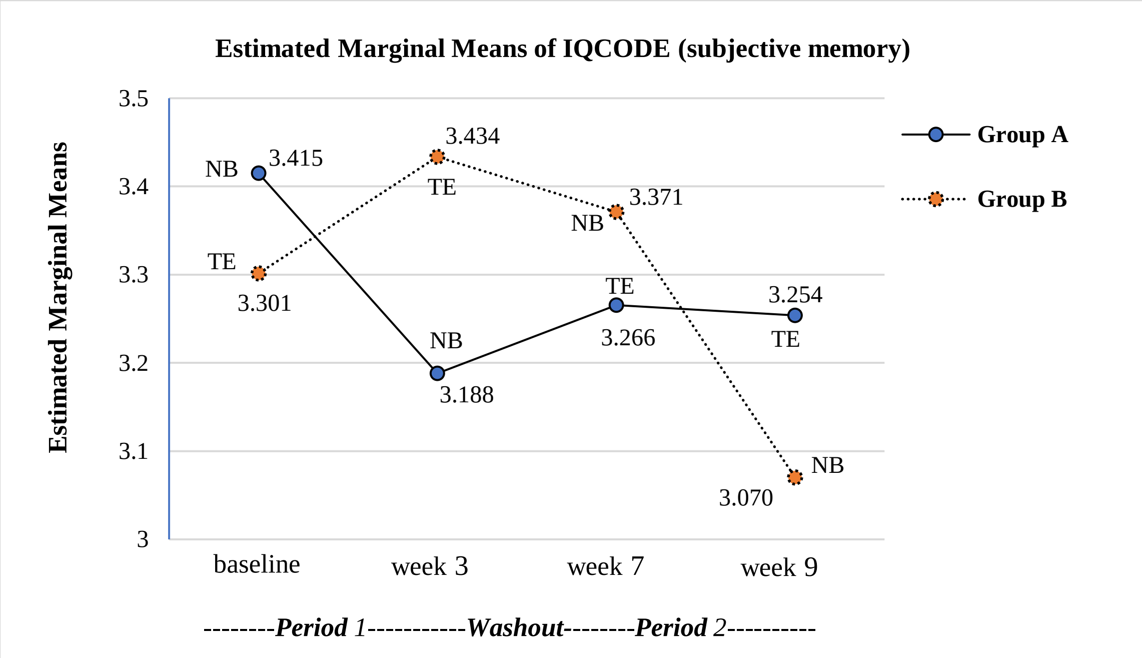
For within group, when comparing each pair of times for Group A, pairwise comparisons of the mean differences of IQCODE (subjective memory) revealed significant differences at baseline and week 3 ($p < .05$). After a washout period, there were no significant differences in week 7 and week 9 ($p > .05$). In group B, the mean differences of IQCODE revealed significant differences at baseline and week 3 ($p < .05$). After a washout of 3 weeks, there were significant differences at week 7 and week 9 ($p < .05$). Details are presented in Table 8.

Table 8 Pairwise comparisons of mean differences of IQCODE in each group

Group	*Time*	*Mean Difference*	*SE*	*p-value*
Group A	baseline vs. week 3	.227	.042	.000
NB (week1-3) + TE (week7-9)	baseline vs. week 7	.149	.071	.308
	baseline vs. week 9	.161	.073	.262
	Week 3 vs. 7	-.077	.074	1.000
	Week 3 vs. 9	-.066	.072	.308
	Week 7 vs. 9	.021	.020	1.000
Group B	baseline vs. week 3	-.132	.020	.000
TE (week1-3) + NB (week7-9)	baseline vs. week 7	-.070	.057	1.000
	baseline vs. week 9	.231	.067	.022
	Week 3 vs. 7	.063	.048	1.000
	Week 3 vs. 9	.363	.060	.000
	Week 7 vs. 9	.301	.029	.000

$p < .05$; SE = Standard error; NB= Neurobic exercise program; TE= Traditional brain exercise program
IQCODE=Subjective memory, higher score = more cognitive decline

In the graph, the IQCODE (subjective memory) scores of group A were consistently significant decreased in the first period from 3.415 (SD = .088) to 3.188 (SD = .080) after receiving the neurobic exercise program and then slightly decreased in the second period from 3.266 (SD = .059) to 3.254 (SD = .048) after receiving the traditional brain exercise program. In contrast, those in group B were significantly increased in the first period from 3.301 (SD = .008), 3.434 (SD = .080) after receiving the traditional brain exercise program and slightly decreased from 3.371 (SD = .059) to 3.318 (SD = .525) in the second period after receiving the neurobic exercise program. The IQCODE mean scores of both groups in each time point illustrated in Figure 6 with a higher score indicate greater subjective performance towards cognitive impairment or memory decline. After a 3-week washout period, the IQCODE score in group A showed a slight increase from post-intervention at week 3. In group B there are slightly decreased from post-intervention at week 3. However, no statistically significant differences were found between the two groups. Therefore, it could be interpreted that older adults with MCI who received the neurobic exercise program had IQCODE scores decreased than those who received the traditional brain exercise program, indicating better or improvement in subjective memory.



IQCODE=Subjective memory, higher score = more cognitive decline
Group A received NB+TE; Group B received TE+NB
NB= Neurobic exercise program; TE= Traditional brain exercise program

Figure 6 Change in subjective memory between two groups at four times

Objective memory

Repeated-measures ANOVA was used to examine the differences in COMT (objective memory) within-subject, between-subject, and across the periods of four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). The results show that the mean score comparison between and within groups showed the statistically significant differences of within-subject ($F_{1.794,53.811}$ = 28.931, p < .05) and interaction effect (time*group)

($F_{1.794, 53.811}$ = 31.190, $p < .05$). The comparisons of mean scores measured at different time points found no significant difference of between subjects ($F_{1,30}$ = .518, $p > .05$) (Table 9). It could be interpreted that the COMT (objective memory) score significantly differs within groups. However, groups A and B showed no significant difference (Table 10).

Table 9 Repeated measures ANOVA of objective memory (COMT)

Source	*SS*	*df*	*MS*	*F*	*p*-value
Within-subject					
Time	334.187	1.794	186.310	28.931	.000
Time*Group	360.281	1.794	200.857	31.190	.000
Error time	346.531	53.811	6.440		
Between subject					
Group	57.781	1	57.781	.518	.477
Error	3349.094	30	111.636		

SS = Sum Square; df = degree of freedom; MS = Mean Square; Greenhouse-Geisser was used to report the results of Subjective memory; COMT = objective memory, higher scores = better objective memory performance

Table 10 Comparisons of estimated marginal mean differences of COMT between groups

Group	*Mean*	*SE*	*M $_{diff}$ (SE)*	*p*-value
Total estimated marginal mean scores				
Group A (NB+TE)	79.203	1.321	1.344(1.868)	.477
Group B (TE+NB)	77.859	1.321		

SE = Standard error; NB= Neurobic exercise program; TE= Traditional brain exercise program
COMT = objective memory, higher scores = better objective memory performance

Post Hoc tests were conducted using the Bonferroni test. The significance level was adjusted by dividing it by the number of comparisons (0.05/4 (times of comparisons) = 0.0125; Bonferroni correction). Results showed a significant difference in week 3 between the two groups ($p < .0125$). However, groups A and B showed no significant difference at baseline, week 7, and week 9 ($p > .0125$). Details are presented in Table 11.

Table 11 Comparisons of mean COMT score between groups in each time

Group	**Time**							
	Baseline		**Week 3**		**Week 7**		**Week 9**	
	Mean (SD)	*p*-value	Mean (SD)	*p*-value	Mean (SD)	*p*-value	Mean (SD)	*p*-value
A (NB+TE)	76.94 (6.47)	.897	83.19 (4.29)	.006	78.19 (4.08)	.139	78.50 (3.75)	.046
B (TE+NB)	77.25 (6.99)		77.31 (6.71)		75.31 (6.37)		81.56 (4.54)	

$p < .0125$; NB= Neurobic exercise program; TE= Traditional brain exercise program
COMT = Objective memory, higher scores = better objective memory performance

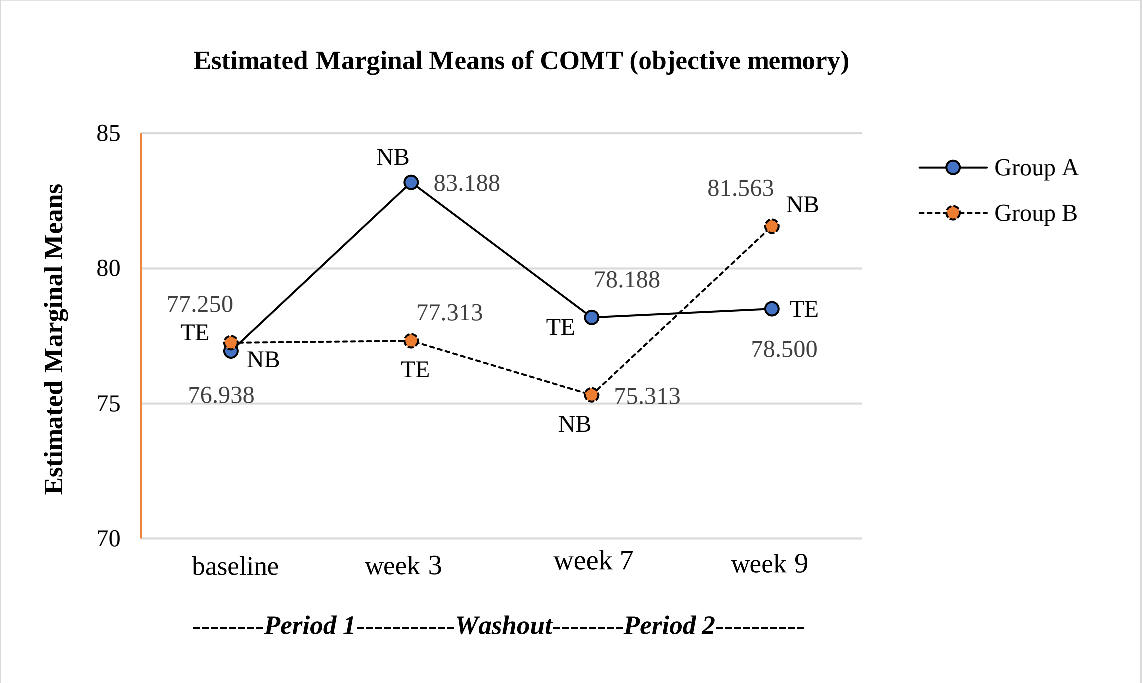
In group A, when comparing each pair of times, pairwise comparisons of the mean differences of COMT (objective memory) revealed significant differences at baseline and week 3 ($p < .05$). However, there were no significant differences in week 7 and week 9 ($p > .05$) after a washout period. In group B, the mean differences of COMT (objective memory) showed no significant difference at baseline and week 3 ($p > .05$). However, there were significant differences in COMT scores at 7 and week 9 ($p < .05$). Details are presented in Table 12.

Table 12 Pairwise comparisons of mean differences of COMT in each group

Group	*Time*	*Mean Difference*	*SE*	*p-value*
Group A	baseline vs. week 3	-6.250	.873	.000
NB (week1-3) + TE (week7-9)	baseline vs. week 7	-1.250	1.051	1.000
	baseline vs. week 9	-1.562	1.190	1.000
	Week 3 vs. 7	5.000	.665	.000
	Week 3 vs. 9	4.688	.694	.000
	Week 7 vs. 9	-.312	.270	1.000
Group B	baseline vs. week 3	-.062	.335	1.000
TE (week1-3) + NB (week7-9)	baseline vs. week 7	1.938	.309	.000
	baseline vs. week 9	-4.312	.705	.000
	Week 3 vs. 7	2.000	.274	.000
	Week 3 vs. 9	-4.250	.636	.000
	Week 7 vs. 9	-6.250	.559	.000

$p < .05$; SE = Standard error; NB= Neurobic exercise program; TE= Traditional brain exercise program
COMT = Objective memory, higher scores = better objective memory performance

In the graph, the COMT (objective memory) scores of group A were consistently showed a significant increase in the first period from 76.938 (SD = 1.684) to 83.188 (SD = 1.408) after receiving the neurobic exercise program and also slightly increased in the second period from 78.188 (SD = 1.338) to 78.500 (SD = 1.043) after receiving the traditional brain exercise program. In contrast, those in group B was a slight increase in the first period from 77.250 (SD = 1.684) to 77.313 (SD = 1.408) and then significantly increased in the second period from 75.313 (SD = 1.338) to 81.563 (SD = 1.043) after receiving the neurobic exercise program. The COMT (objective memory) mean scores of both groups were illustrated at each time point, with a higher score indicating better objective memory performance (Figure 7). After a 3-week washout period, the COMT score in group A showed a significant increase from post-intervention at week 3. Also, in group B there are a significant increase from post-intervention at week 3. However, no significant differences were seen between the two groups. Therefore, it could be interpreted that older adults with MCI who received the neurobic exercise program had COMT (objective memory) scores more increased than those who received the traditional brain exercise program, indicating better in objective memory performance.



Note: COMT = Objective memory, higher scores = better objective memory performance
NB= Neurobic exercise program; TE= Traditional brain exercise program
Group A received NB+TE; Group B received TE+NB

Figure 7 Change in objective memory between two groups at four times

CHAPTER 5
DISCUSSION AND CONCLUSIONS

This chapter provides information in three sections. The first section provides an overview of the study, including the objectives, hypotheses, methodology, data analysis procedures, and results. The findings are discussed, interpreted, and generalized in the second section. The final part presents suggestions and recommendations for nursing practice implications and future research.

Summary of the study

The primary purpose of this study was to examine the effects of a neurobic exercise program on memory performance (subjective and objective memory) among older adults with MCI who resided in the community. The neurobic exercise program was developed based on the concepts of the neurobic exercise postulated by Katz and Rubin (1999) and related literature reviews. The traditional brain exercise program was a set of brain exercises that the senior club of Saraburi Hospital has been doing continuously since 2004. A pilot study was conducted to determine whether the neurobic exercise program was feasible. After that, this study tested the effectiveness of the neurobic exercise program using a single-blind, randomized, controlled, two-period crossover design (two 3-week treatment phases followed by a 3-week washout period). The study was conducted in the community of Tambon Pak Phriao, Amphoe Mueang Saraburi province, Thailand. Thirty-two participants who met the inclusion criteria were randomly assigned using simple randomization to either group A or B. During the first period, participants in group A were randomized to receive the neurobic exercise program, and group B received the traditional brain exercise program. After a three-week washout period, all participants were crossed over to receive the different interventions for three weeks. Group A received the traditional brain exercise program, and group B received the neurobic exercise program in the second period. No participants dropped out during the study. Data collection and implementation were conducted from June 2021 through November 2021. Because of the COVID-19 pandemic, the activities in this study were done after older people got vaccinated. The researcher also ran the activities based on the standard protocols of Saraburi hospital. The outcome variable was memory performance, which was measured in two aspects. First, subjective memory was measured by using the IQCODE. Higher scores of IQCODE indicated greater subjective performance towards cognitive impairment or memory decline. Second, objective memory was measured using the COMT. Higher scores indicate better objective memory performance. The outcome variable was measured four times at baseline, post-intervention (week 3), follow-up stage (week 7), and the end of the study (week 9). Descriptive statistics, independent t-test, Chi-square, and repeated measured ANOVA were used to analyze the data. There were no significant differences in demographic characteristics at baselines. In addition, subjective and objective memory had no significant differences between the two groups at pre-intervention (baselines). Moreover, statistical analysis revealed no carryover effects for the outcome. Therefore, it could be concluded that a 3-week washout period was long enough.

In conclusion, the findings showed that the participants who received the neurobic exercise program had lower mean scores of the IQCODE than those in the traditional brain exercise program at post-intervention (week 3) and the end of the study (week 9). Therefore, it could be interpreted that older adults with MCI who received the neurobic exercise program would have a lower score on the IQCODE, indicating better or improvement in subjective memory.

Further, the participants who received the neurobic exercise program had higher mean scores of the COMT than those in the traditional brain exercise program at post-intervention (week 3) and the end of the study (week 9). Therefore, it could be interpreted that older adults with MCI who received the neurobic exercise program would have more improvement in cognitive performance.

Discussion

The study findings in accordance with research hypotheses as follows:

The first hypothesis was supported. Older adults with MCI who received the neurobic exercise program had lower mean scores of subjective memory (IQCODE) than those in the traditional brain exercise program at post-intervention (week 3) and the end of the study (week 9). In addition, the second hypothesis was supported by the findings that older adults with MCI who received the neurobic exercise program had higher mean scores of objective memory (COMT) than those in the traditional brain exercise program at post-intervention (week 3) and the end of the study (week 9). On the basis of the neurobic exercise concepts postulated by Katz and Rubin (1999) and relevant research, these results could be explained by the fact that the neurobic exercise program was designed to improve memory performance, both subjective and objective memory, in older persons with MCI. The researcher builds the neurobic exercise program by employing the fundamental aspects of neurobic exercise to strengthen and improve participants' memory performance. In each session, the fundamental components and techniques of neurobic exercise were utilized to stimulate the brain. If the brain is stimulated by using a variety of physical sense combinations and deviating from a usual activity. The nerve impulses and interconnections between various facts within the brain can assist the brain in maintaining a constant degree of mental fitness, strength, and flexibility (Katz & Rubin, 1999; Scotts, 2013).

Stimulating the five physical and emotional senses can help activate the prefrontal association cortex, which is responsible for memory formation, as well as stimulating the hippocampus and limbic system to improve memory function (Katz & Rubin, 1999; Napatpittayatorn et al., 2019). According to neurobic exercise, through trying to do new things or unexpected experiences and break a routine activity, these would help strengthen nerve cell stimulation whereas routine activities use the same brain pathways that could be brain deadening (Scotts, 2013). The novel or unexpected experience can stimulate neurons to produce neurotrophins, which have a chemical effect on nerve cell growth, increase nerve fiber branching, slow nerve cell degeneration, and increase blood supply to the brain (Katz & Rubin, 1999). The emotional sense is essential to a healthy brain and an active memory. The emotional sense stimulates the diencephalon, particularly the hypothalamus, which regulates emotion and encodes memory by focusing attention on memory. In addition, it stimulates the limbic system, which contributes to memory formation by integrating emotional states with stored memories of physical sensations (Kanthamalee & Sripankaew, 2014; Katz & Rubin, 1999). Specifically, neurobic exercise increased synaptic connections between neurons in the brain by stimulating one or more senses in a novel context outside of the participants' daily routine. Each sense stimulated brain functions and nerve connections, which played a role in memory formation. As new experiences accumulated and the brain accelerated the formation of permanent connections and pathways.

These results were consistent with previous research studies that the neurobic exercise effectively enhanced memory and maintains cognitive functions in older adults. Patani (2020) discovered that four weeks after the completion of the neurobic exercise intervention, patients' cognitive function and quality of life were significantly better than controls. A study by Kriengkaisakda and Chadcham (2012) reported significant short-term memory improvement among patients with mild dementia at a 3-month follow-up after completing the neurobic exercise program. Kanthamalee and Sripankaew (2014) found that the Mini-Mental State Examination (MMSE) score improved memory in 22 females with dementia one month after completing the neurobic exercise intervention. Napatpittayatorn et al. (2019) discovered that participants in the neurobic exercise intervention group had better cognitive function and serum brain-derived neurotrophic factor (BDNF) at 6 months than controls. At 3 months follow-up, Wongkhamchai and Pantong (2017) found that patients with type 2 diabetes mellitus in the neurobic exercise intervention group had significantly better short-term memory scores than the control group. Therefore, previous studies supported our results, indicating that memory performance, both subjective and objective memory was enhanced by neurobic exercise program. However, this study differed from previous studies on the neurobic exercise program by including several activities that used more than one sense to stimulate the brain. Some activities combine two or more senses to stimulate the brain's function and change routine daily life. For example, the participants close their eyes and smell food before tasting it. Then guess what is it and write the name of the food by using their non-dominant hand within the time set. The activities directly involve the temporal lobe's cortex and hippocampus, which act as temporary storage areas for information to help improve memory (Patani, 2020). Also, the researcher combined emotional sense in the activities in order to help the participants enjoy time with others. The activities were done in the game form and in small groups. Some activities have competitions to encourage participants to be active and teamwork. Using the emotional sense combined with the five senses will motivate the hypothalamus, which regulates emotion and encode memory. It also stimulates the limbic system, which contributes to memory formation by integrating emotional states with stored memories of physical sensations (Kanthamalee & Sripankaew, 2014). In addition, the activities presented the brain with non-routine or changed daily activities. These activities can enhance the memory retention of older people and delay the deterioration of the brain. For example, the participants tried using a non-dominant hand and closing their eyes when doing activities. This intervention utilized the five senses and added the emotional sense to each activity, as well as encouraged non-routine daily activities, in order to boost nerve cells' continued growth and strength. Moreover, combining two or more senses stimulates the memory-related regions of the brain, including the frontal, parietal, temporal, occipital, diencephalon, and limbic. It enhanced the short-term and long-term memory-related neural network activity.

The last hypothesis was supported by the findings that there are differences in mean scores of subjective memory (IQCODE) and objective memory (COMT) across the four times in both groups. The IQCODE (subjective memory) scores at four times were significant differences in both groups. The IQCODE scores of group A were consistently significant decreased in the first period from 3.415 (SD = .088) to 3.188 (SD = .080) after receiving the neurobic exercise program and then slightly decreased in the second period from 3.266 (SD = .059) to 3.254 (SD = .048) after receiving the traditional brain exercise program. In group B who received the traditional brain exercise program were significantly increased in the first period from 3.301 (SD = .008), 3.434 (SD = .080), and slightly decreased from 3.371 (SD = .059) to 3.318 (SD = .525) in the second period after they receive the neurobic exercise program. Subjective memory based on self-report often results in a referral for a neuropsychological examination. The short form of IQCODE was used to measure subjective memory impairment among older adults. It is a self-ratings questionnaire assessing short-term and long-term memories, time and place orientation, financial awareness, learning skills, and executive functions. Lower scores on IQCODE indicated better subjective memory performance.

Subjective memory was a self-report of how each older adult interpreted, felt, thought, and perceived changes in memory problems, complained about memory problems, and reported perceived cognitive decline. Subjective memory complaints in an older population can predict conversion to dementia. Several studies showed that older adults with cognitive complaints have a high rate of progression to MCI or dementia (Hohman et al., 2011; Neto & Nitrini, 2016; Reed, 2010; Steinberg et al., 2013). Subjective memory complaints are required for MCI classification because they can reflect a deterioration in objective memory function (Petersen, 2004). The finding of this study showed that the elderly who received the neurobic exercise program had a significant reduction in IQCODE score, indicating better or improved subjective memory. In other words, the elderly felt their memory improved after participating in the neurobic exercise program. Our study found that the subjective memory scores of groups A and B change over time. All participants of both groups assess their memory as a slight decline (score range 3.01 – 3.50). The results show that subjective memory tests can be useful for finding people who are likely to get dementia. A study by Yim et al. (2017) found that in a neuropsychological assessment, community-dwelling elderly aged 65 and older with subjective memory complaints had more significant cognitive impairment than older persons without subjective memory complaints. Laws et al. (2002) reported that older individuals with subjective memory complaints had significantly more hippocampal atrophy than those without subjective memory problems. In addition, many studies indicate that older persons with subjective memory complaints are at a higher risk for acquiring dementia and gray matter degeneration over time, and subjective memory complaints are also connected with objective memory decline (Crumley et al., 2014; Neto & Nitrini, 2016; Reed, 2010; Vale, 2012).

Due to how important it is to find the early signs of dementia, subjective memory impairment is getting more attention in science. This is so that early and preventive treatments for dementia in older people can be found. In this study, subjective memory impairment was reported by older people. All of them reported their memory as a slight decline after receiving the neurobic exercise program. Subjective memory impairment was found to predict the transition from normal cognition to dementia in older persons. It also has a direct influence on older persons because they are associated with distress, deterioration of mental health, and low quality of life (Park et al., 2019). In addition, subjective memory impairment was associated with impaired performance on memory tests in older people. Early detection of cognitive impairment allows older persons and their families to plan for future care and family concerns. According to the evidence, subjective memory complaints are linked to objective memory deterioration. Therefore, our study measured both subjective memory and objective memory.

This study found that the COMT (objective memory) scores at four times were significantly different in both groups. The objective memory scores of group A were consistently significantly increased in the first period from 76.938 (SD = 1.684) to 83.188 (SD = 1.408) after receiving the neurobic exercise program and slightly increased in the second period from 78.188 (SD = 1.338) to 78.500 (SD = 1.043) after they received the traditional brain exercise program. In contrast, those in group B who received the traditional brain exercise program was a slight increase in the first period from 77.250 (SD = 1.684) to 77.313 (SD = 1.408) and then significantly increased in the second period from 75.313 (SD = 1.338) to 81.563 (SD = 1.043) after receiving the neurobic exercise program. Higher scores of COMT indicated better objective memory performance. Therefore, it could be interpreted that older adults with MCI who received the neurobic exercise program had a significant higher COMT score indicating improvement on cognitive performance. The results in this study were similar to the study conducted on healthy senior and dementia patients in the US that was conducted on Chinese elderly (76.7, SD = 10.3), Vietnamese elderly (77.3, SD = 8.9), Hispanic elderly (76, SD = 11), and Caucasian elderly (75, SD = 7.8) (Kempler et al., 2010).

The results of the previous studies were concordant with this study. Tsai, Yang, Lan, and Chen (2008) found that cognitive training and cognitive stimulation can enhance general subjective memory in older adults. McEwen et al. (2018) found that the memory training program significantly improves general cognitive functioning in older adults with subjective memory impairments. A meta-analysis by Wang et al. (2020) showed that non-pharmacological therapies effectively improved the subjective memory of patients with MCI. In addition, cognitive training has been shown to improve cognitive functioning, memory performance, executive functioning, processing speed, attention, fluid intelligence, and subjective cognitive performance, according to numerous systematic reviews and meta-analyses (Jean et al., 2010; Kelly et al., 2014; Li et al., 2011; Reijnders et al., 2013; Zehnder et al., 2009). Several investigations discovered that changes in subjective memory complaints were related to changes in objective cognitive function (Crumley et al., 2014; Neto & Nitrini, 2016; Reed, 2010; Vale, 2012).

Objective memory is cognitive functioning that reflects the older adult's cognitive status based on memory testing. Evidence shows that subjective memory impairment strongly correlates with objective cognitive performance, especially in older adults with Parkinson's disease (Hong, Lee, Sunwoo, Sohn, & Lee, 2018). Our finding found that objective memory among older adults with MCI consistently significantly increased after receiving the neurobic exercise program. The activities of this program assist activate neuronal pathways that aren't being used very much and generate direct connections in the cerebral cortex, both of which can improve memory. Neurobic activities consist of multiple activities in small groups, positive emotions, and changing daily living may benefit cognitive functioning and memory in older people. Therefore, this program has been demonstrated to be useful, is simple, and has no negative implications. Our results were similar to previous studies (Kanthamalee & Sripankaew, 2014; Kriengkaisakda & Chadcham, 2012; Napatpittayatorn et al., 2019). Moreover, the activities in the neurobic exercise program used game form and were done in the small group, which help the participants feel relaxed and have fun with their group. Previous research on group activities has shown that users can improve cognitive function in older people with dementia. Music therapy also improved cognitive function and reduced depressive symptoms in older people with dementia (Kim, 2015). Small groups offer a great opportunity to share with others and a good place to learn new things with their group. In addition, positive emotions have an effect on the brain, increasing awareness, attention, and memory. Those of a senior age who experience a variety of happy feelings throughout their days are more likely to report higher levels of happiness, greater health, enhanced cognitive function, and favorable relationships with their peers. Evidence shows that using music in memory training has demonstrated improved memory and attention (Thaut et al., 2009). Therefore, these findings indicated that the neurobic exercise program could enhance memory performance among older adults with MCI. Therefore, nurses can apply the program to improve memory performance in community-dwelling older adults with MCI.

Upon completion of the program, the participants in both groups were asked to completed a 7-item Likert-type assessment to rate their satisfaction with the neurobic exercise and the traditional brain training program. Example questions included: (1) Are you content with the intervention? (2) Did you find the intervention sessions beneficial? Response choices ranged from extremely unsatisfied/not helpful (Score = 1) to extremely satisfied/useful (Score = 5). The possible score range was between 7 and 35. At the conclusion of the survey, participants were asked to provide their responses to free-form questions. "Please describe how the intervention was advantageous. If helpful, please kindly explain why?"

The mean satisfaction scores for the neurobic exercise program and the traditional brain exercise program were 34.63 (SD = .50) and 33.94 (SD = 1.61), respectively. There were no statistically significant differences in satisfaction between the neurobic exercise program and the traditional brain exercise program ($p > .05$). Eighty percent of the participants expressed high levels of satisfaction with the neurobic exercise program, while twenty percent indicated good levels of satisfaction. In response to open-ended questions, participants indicated that all neurobic exercise program activities were suitable for their age and their health conditions. The program activities were suitable and beneficial to them. In addition, participants enjoy the neurobics exercise program since it is easy to practice independently and requires no specialist equipment to stimulate the brain. For the traditional brain exercise program, 70% of participants were highly satisfied and 30% reported a good level of satisfaction.

Strengths and limitations

Three points constitute this study's strengths. Firstly, this study is strong in terms of research design. The researcher used a randomized, controlled, two-period crossover design to compare the neurobic exercise program to the traditional brain exercise program. In this design, participants received both interventions, randomizing participants to a sequence of treatments. As a result, there are numerous benefits, such as determining the clinical relevance and eliciting patient preferences, intra-individual comparisons, greater statistical power, quicker completion, lower costs, and equality. In addition, this design can minimize the risk of confounding because all interventions are measured on the same participants, and every participant receives both treatments. The participants serve as their control (Nanta & Patumanond, 2008). Secondly, this study used single-blind research assistants who collected data using random processes. They weren't offered any intervention components. Therefore, they did not know the participants who received the neurobic exercise or who received the traditional brain exercise program. This helps in protecting the bias. Thirdly, the neurobic exercise program is a new alternative nursing intervention approach, which was found to be effective in enhancing significant memory performance among older adults with MCI who are living in the community. Applying available Thai herbs, aroma and foods for stimulating brain was useful. Moreover, the neurobic exercise program is easy for older adults to use to stimulate their brains. It can also help older people make small changes in daily life, transforming routines into mind-building exercises.

The limitation of this study was conducted at only one senior club under Saraburi Regional Hospital. These senior club members were more likely to be active and receptive to learning new programs that were provided to them. This study was conducted from June 2021 through November 2021 due to the COVID restriction. Thus, only participants who received full vaccination were enrolled in this study.

Suggestions and recommendations

The neurobic exercise program is an effective nursing intervention for enhancing memory performance, both subjective and objective memory, among community-dwelling older adults with MCI. In addition, the research findings will serve to affirm the effectiveness of the neurobic exercise program that represents a new innovative approach to enhancing memory performance among older adults with MCI. Therefore, nurses should be trained to have adequate competency to provide the neurobic exercise program. This program contains six sessions which were conducted twice a week for 60 minutes per session for three weeks. The activities were done in small groups and in game forms. Therefore, nurses need to build and enhance positive interactions with older adults. Besides, the nurse needs to promote a fun, relaxed, and trusted environment, respect for beliefs, and competency of the elderly.

However, the results showed that objective memory (COMT) score slightly decreased in the washout period when the participants did not continue the activities to stimulate their brains. Promoting continuous activities by the older adults themselves to stimulate the brain should be conducted. Inaddition, further research should also examine the sustainable effects of the neurobic exercise intervention among older adults with MCI. It is possible to study the long-term effects of increased memory function on life satisfaction, quality of life, healthy living, fall events, and hospitalization or emergency department visits. Testing the effects of neurobic brain exercise on other cognition apart from memory are also recommended. In addition, future research should examine the neurobic exercise program in other settings. Other methods apart from memory test questionnaires to test brain function such as brain imaging to indicate the change in brain function are recommended.

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APPENDIX

APPENDIX A

Invitation letter

บันทึกข้อความ

ส่วนงาน บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา โทร. ๒๗๐๐ ต่อ ๗๐๕, ๗๐๗
ที่ อว ๘๑๓๗/ ๒๔๒๘ วันที่ ๑๗ พฤศจิกายน พ.ศ. ๒๕๖๓
เรื่อง ขอเรียนเชิญเป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย

เรียน ดร.พีร วงศ์อุปราช (วิทยาลัยวิทยาการวิจัยและวิทยาการปัญญา)

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์ เรื่อง "Effectiveness of Neurobic Exercise Program on Memory Performance in Community-Dwelling Older Adults with Mild Cognitive Impairment: A Randomized Controlled Crossover Trial" โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอท่าน เป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย นั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญท่านซึ่งเป็นผู้ที่มีความรู้ ความสามารถ และประสบการณ์สูง เป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย (ดังแนบ) ทั้งนี้ สามารถติดต่อนิสิต ดังรายนามข้างต้น ได้ที่หมายเลขโทรศัพท์ ๐๙๒-๕๐๔-๖๘๘๘ หรือที่ E-mail: viyakan@bcns.ac.th

จึงเรียนมาเพื่อทราบและโปรดพิจารณา

(รองศาสตราจารย์ ดร.นุจรี ไชยมงคล)
คณบดีบัณฑิตวิทยาลัย

บันทึกข้อความ

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คณบดีบัณฑิตวิทยาลัย

ที่ อว ๘๑๓๗/๘๖๗

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
๑๖๙ ถ.ลงหาดบางแสน ต.แสนสุข
อ.เมือง จ.ชลบุรี ๒๐๑๓๑

๑๓ พฤศจิกายน ๒๕๖๓

เรื่อง ขอเรียนเชิญเป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย

เรียน คณบดีคณะพยาบาลศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย กรุงเทพมหานคร

สิ่งที่ส่งมาด้วย ๑. เค้าโครงดุษฎีนิพนธ์ (ฉบับย่อ)
๒. เครื่องมือวิจัย

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ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญรองศาสตราจารย์ ดร.จิราพร เกศพิชญวัฒนา ซึ่งเป็นผู้ที่มีความรู้ ความสามารถ และประสบการณ์สูง เป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย (ดังแนบ) ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่หมายเลขโทรศัพท์ ๐๙๒-๕๐๔-๖๘๘๘ หรือที่ E-mail: viyakan@bcns.ac.th

จึงเรียนมาเพื่อทราบและโปรดพิจารณา

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อธิการบดีมหาวิทยาลัยบูรพา

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เรียน รองศาสตราจารย์ ดร.จุฑามาศ แหนจอน (คณะศึกษาศาสตร์)

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คณบดีบัณฑิตวิทยาลัย

ที่ อว ๘๑๓๗/๘๖๘

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
๑๖๙ ถ.ลงหาดบางแสน ต.แสนสุข
อ.เมือง จ.ชลบุรี ๒๐๑๓๑

๑๗ พฤศจิกายน ๒๕๖๓

เรื่อง ขอเรียนเชิญเป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย

เรียน คณบดีคณะพยาบาลศาสตร์ วิทยาลัยวิทยาศาสตร์การแพทย์เจ้าฟ้าจุฬาภรณ์ ราชวิทยาลัยจุฬาภรณ์ กรุงเทพมหานคร

สิ่งที่ส่งมาด้วย ๑. เค้าโครงดุษฎีนิพนธ์ (ฉบับย่อ)
๒. เครื่องมือวิจัย

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์ เรื่อง "Effectiveness of Neurobic Exercise Program on Memory Performance in Community-Dwelling Older Adults with Mild Cognitive Impairment: A Randomized Controlled Crossover Trial" โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอบุคลากรในสังกัดของท่าน คือ รองศาสตราจารย์ ดร.รุ้งนภา ผาณิตรัตน์ อาจารย์ประจำภาควิชาสุขภาพจิตและการพยาบาลจิตเวช เป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย นั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญรองศาสตราจารย์ ดร.รุ้งนภา ผาณิตรัตน์ ซึ่งเป็นผู้ที่มีความรู้ ความสามารถ และประสบการณ์สูง เป็นผู้ทรงคุณวุฒิตรวจสอบความตรงของเครื่องมือวิจัย (ดังแนบ) ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่หมายเลขโทรศัพท์ ๐๙๒-๕๐๔-๖๘๘๘ หรือที่ E-mail: viyakan@bcns.ac.th

จึงเรียนมาเพื่อทราบและโปรดพิจารณา

ขอแสดงความนับถือ

(รองศาสตราจารย์ ดร.นุจรี ไชยมงคล)
คณบดีบัณฑิตวิทยาลัย ปฏิบัติการแทน
อธิการบดีมหาวิทยาลัยบูรพา

สำเนาเรียน รองศาสตราจารย์ ดร.รุ้งนภา ผาณิตรัตน์

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
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สำเนา

ที่ อว ๘๑๓๗/๕๖๗

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
๑๖๙ ถ.ลงหาดบางแสน ต.แสนสุข
อ.เมือง จ.ชลบุรี ๒๐๑๓๑

๒๗ สิงหาคม พ.ศ. ๒๕๖๓

เรื่อง ขอเรียนเชิญบุคลากรในสังกัดเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย

เรียน คณบดีคณะพยาบาลศาสตร์ มหาวิทยาลัยมหาสารคาม

สิ่งที่ส่งมาด้วย ๑. เครื่องมือวิจัย จำนวน ๑ ชุด
๒. สำเนาหลักฐานการได้รับอนุญาตให้แปลและใช้เครื่องมือวิจัย จำนวน ๑ ชุด

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์ เรื่อง Effectiveness of Neurobic Exercise Program on Memory Performance in Community - Dwelling Older Adults with Mild Cognitive Impairment: A Randomized Controlled Crossover Trial โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอบุคลากรในสังกัดของท่านเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย นั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญบุคลากรในสังกัดท่าน คือ ผู้ช่วยศาสตราจารย์ ดร.ชูชาติ วงศ์อนุชิต ซึ่งเป็นผู้ที่มีความรู้ ความสามารถ และประสบการณ์สูงเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัยจากภาษาไทยเป็นภาษาอังกฤษ (ดังแนบ)

ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่เบอร์โทร ๐๙-๒๕๐๔-๖๘๘๘ หรือที่ E-mail: Viyakan@bcns.ac.th

จึงเรียนมาเพื่อโปรดทราบและโปรดพิจารณา

ขอแสดงความนับถือ

(รองศาสตราจารย์ ดร.นุจรี ไชยมงคล)
คณบดีบัณฑิตวิทยาลัย ปฏิบัติการแทน
อธิการบดีมหาวิทยาลัยบูรพา

สำเนาเรียน: ผู้ช่วยศาสตราจารย์ ดร.ชูชาติ วงศ์อนุชิต

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
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สำเนา

ที่ อว ๘๑๓๗/๕๖๘

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
๑๖๙ ถ.ลงหาดบางแสน ต.แสนสุข
อ.เมือง จ.ชลบุรี ๒๐๑๓๑

๒๗ สิงหาคม พ.ศ. ๒๕๖๓

เรื่อง ขอเรียนเชิญเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย

เรียน คณบดีคณะพยาบาลศาสตร์ มหาวิทยาลัยนเรศวร

สิ่งที่ส่งมาด้วย ๑. เครื่องมือวิจัย จำนวน ๑ ชุด
๒. สำเนาหลักฐานการได้รับอนุญาตให้แปลและใช้เครื่องมือวิจัย จำนวน ๑ ชุด

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์ เรื่อง Effectiveness of Neurobic Exercise Program on Memory Performance in Community - Dwelling Older Adults with Mild Cognitive Impairment: A Randomized Controlled Crossover Trial โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอบุคลากรในสังกัดของท่านเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย นั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญบุคลากรในสังกัดท่าน คือ ผู้ช่วยศาสตราจารย์ ดร.ดวงพร ปิยะคง ซึ่งเป็นผู้ที่มีความรู้ ความสามารถ และประสบการณ์สูงเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัยจากภาษาไทยเป็นภาษาอังกฤษ (ดังแนบ)

ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่เบอร์โทร ๐๙-๒๕๐๔-๖๘๘๘ หรือที่ E-mail: Viyakan@bcns.ac.th

จึงเรียนมาเพื่อโปรดทราบและโปรดพิจารณา

ขอแสดงความนับถือ

(รองศาสตราจารย์ ดร.นุจรี ไชยมงคล)
คณบดีบัณฑิตวิทยาลัย ปฏิบัติการแทน
อธิการบดีมหาวิทยาลัยบูรพา

สำเนาเรียน: ผู้ช่วยศาสตราจารย์ ดร.ดวงพร ปิยะคง

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
โทร ๐๓๘-๒๗๐-๐๐๐ ต่อ ๗๐๑, ๗๐๕
E-mail: grd.buu@go.buu.ac.th

สำเนา

บันทึกข้อความ

ส่วนงาน มหาวิทยาลัยบูรพา บัณฑิตวิทยาลัย โทร. ๒๗๐๐ ต่อ ๗๐๕, ๗๐๗
ที่ อว ๘๑๓๗/๑ ๓๖๙ **วันที่** ๑๗ กรกฎาคม พ.ศ. ๒๕๖๓
เรื่อง ขอเรียนเชิญเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย

เรียน ดร. พีร วงศ์อุปราช (วิทยาลัยวิทยาการวิจัยและวิทยาการปัญญา)

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิตสาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์ เรื่อง Effectiveness of neurobic exercise program on memory performance in community-dwelling older adults with mild cognitive impairment: A randomized controlled crossover trial โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอท่านเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย นั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญท่านซึ่งเป็นผู้ที่มีความรู้ความสามารถ และประสบการณ์สูง เป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัยจากภาษาอังกฤษเป็นภาษาไทย (ดังแนบ) ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่เบอร์โทร ๐๙-๒๕๐๔-๖๘๘๘ หรือที่ E-mail: viyakan@bcns.ac.th

จึงเรียนมาเพื่อโปรดพิจารณา จะเป็นพระคุณยิ่ง

(ผู้ช่วยศาสตราจารย์ ดร.โสรัตน์ วงศ์สุทธิธรรม)
รองคณบดีบัณฑิตวิทยาลัย รักษาการแทน
คณบดีบัณฑิตวิทยาลัย

สำเนา

ที่ อว ๘๑๓๗/๔๗๕

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
๑๖๙ ถ.ลงหาดบางแสน ต.แสนสุข
อ.เมือง จ.ชลบุรี ๒๐๑๓๑

๓๑ กรกฎาคม ๒๕๖๓

เรื่อง ขอเรียนเชิญบุคลากรในสังกัดเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย

เรียน คณบดีคณะพยาบาลศาสตร์ มหาวิทยาลัยขอนแก่น

สิ่งที่ส่งมาด้วย เครื่องมือวิจัย จำนวน ๙ หน้า

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิตสาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์ เรื่อง Effectiveness of neurobic exercise program on memory performance in community-dwelling older adults with mild cognitive impairment: A randomized controlled crossover trial โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอท่านเป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัย นั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขอเรียนเชิญบุคลากรในสังกัดท่าน คือ ผู้ช่วยศาสตราจารย์ ดร.สมรภพ บรรหารักษ์ ซึ่งเป็นผู้ที่มีความรู้ ความสามารถ และประสบการณ์สูง เป็นผู้ทรงคุณวุฒิแปลเครื่องมือวิจัยจากภาษาอังกฤษเป็นภาษาไทย (ดังแนบ) ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่เบอร์โทร ๐๙-๒๕๐๔-๖๘๘๘ หรือที่ E-mail: viyakan@bcns.ac.th

จึงเรียนมาเพื่อโปรดทราบและโปรดพิจารณา

ขอแสดงความนับถือ

(ผู้ช่วยศาสตราจารย์ ดร.โสรัตน์ วงศ์สุทธิธรรม)
รองคณบดีบัณฑิตวิทยาลัย รักษาการแทน
คณบดีบัณฑิตวิทยาลัย ปฏิบัติการแทน
อธิการบดีมหาวิทยาลัยบูรพา

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
โทร ๐๓๘ ๒๗๐ ๐๐๐ ต่อ ๗๐๗, ๗๐๕
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(สำเนาเรียน ผู้ช่วยศาสตราจารย์ ดร.สมรภพ บรรหารักษ์)

APPENDIX B

IRB approved

เลขที่ IRB3-011/2564

เอกสารรับรองผลการพิจารณาจริยธรรมการวิจัยในมนุษย์
มหาวิทยาลัยบูรพา

คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยบูรพา ได้พิจารณาโครงการวิจัย

รหัสโครงการวิจัย : G-HS 106/2563
โครงการวิจัยเรื่อง : ประสิทธิผลของโปรแกรมการบริหารสมองแบบนิวโรบิคส์ต่อประสิทธิภาพหน่วยความจำในผู้สูงอายุที่อยู่อาศัยในชุมชนที่มีความจำบกพร่องเล็กน้อย: การศึกษาทดลองแบบสลับกลุ่ม
หัวหน้าโครงการวิจัย : นางสาววิยะการ แสงหัวช้าง
หน่วยงานที่สังกัด : นิสิตระดับบัณฑิตศึกษา คณะพยาบาลศาสตร์

คณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยบูรพา ได้พิจารณาแล้วเห็นว่า โครงการวิจัยดังกล่าวเป็นไปตามหลักการของจริยธรรมการวิจัยในมนุษย์ โดยที่ผู้วิจัยเคารพสิทธิและศักดิ์ศรีในความเป็นมนุษย์ ไม่มีการล่วงละเมิดสิทธิ สวัสดิภาพ และไม่ก่อให้เกิดภยันตรายแก่ตัวอย่างการวิจัยและผู้เข้าร่วมโครงการวิจัย

จึงเห็นสมควรให้ดำเนินการวิจัยในขอบข่ายของโครงการวิจัยที่เสนอได้ (ดูตามเอกสารตรวจสอบ)

1. แบบเสนอเพื่อขอรับการพิจารณาจริยธรรมการวิจัยในมนุษย์	ฉบับที่ 2 วันที่ 11 เดือน กุมภาพันธ์ พ.ศ. 2564
2. เอกสารโครงการวิจัยฉบับภาษาไทย	ฉบับที่ 2 วันที่ 11 เดือน กุมภาพันธ์ พ.ศ. 2564
3. เอกสารชี้แจงผู้เข้าร่วมโครงการวิจัย	ฉบับที่ 1 วันที่ 21 เดือน มกราคม พ.ศ. 2564
4. เอกสารแสดงความยินยอมของผู้เข้าร่วมโครงการวิจัย	ฉบับที่ 1 วันที่ 21 เดือน มกราคม พ.ศ. 2564
5. เอกสารแสดงรายละเอียดเครื่องมือที่ใช้ในการวิจัย	ฉบับที่ 1 วันที่ 21 เดือน มกราคม พ.ศ. 2564
6. เอกสารอื่นๆ (ถ้ามี)	ฉบับที่ - วันที่ - เดือน - พ.ศ. -

วันที่รับรอง : วันที่ 25 เดือน กุมภาพันธ์ พ.ศ. 2564
วันที่หมดอายุ : วันที่ 25 เดือน กุมภาพันธ์ พ.ศ. 2565

ลงนาม

(ผู้ช่วยศาสตราจารย์ แพทย์หญิงรมร แย้มประทุม)
ประธานคณะกรรมการพิจารณาจริยธรรมการวิจัยในมนุษย์ มหาวิทยาลัยบูรพา
สำหรับโครงการวิจัย ระดับบัณฑิตศึกษา และระดับปริญญาตรี
ชุดที่ 3 (กลุ่มคลินิก/ วิทยาศาสตร์สุขภาพ/ วิทยาศาสตร์และเทคโนโลยี)

คณะกรรมการจริยธรรมการวิจัยในมนุษย์โรงพยาบาลสระบุรี กระทรวงสาธารณสุข

18 ถนนเทศบาล 4 อำเภอเมือง จังหวัดสระบุรี โทร. 036-343500 ต่อ 1551

เอกสารรับรองโครงการวิจัยแบบ Full board

คณะกรรมการจริยธรรมการวิจัยในมนุษย์โรงพยาบาลสระบุรี ดำเนินการให้การรับรองโครงการวิจัยตามแนวทางหลักจริยธรรมการวิจัยเกี่ยวกับคนที่เป็นมาตรฐานสากล ได้แก่ Declaration of Helsinki, The Belmont Report, CIOMS Guideline และ International Conference on Harmonization in Good Clinical Practice หรือ ICH-GCP

ชื่อโครงการ: **ประสิทธิผลของโปรแกรมการบริหารสมองแบบนิวโรบิคส์ต่อประสิทธิภาพหน่วยความจำในผู้สูงอายุที่อยู่อาศัยในชุมชนที่มีความจำบกพร่องเล็กน้อย: การศึกษาทดลองแบบสลับกลุ่ม**

เลขที่โครงการวิจัย : SRBR63-055 **เลขที่หนังสือรับรอง : EC002/2564**

ผู้วิจัยหลัก: **นางสาว วิยะการ แสงหัวช้าง**

สังกัดหน่วยงาน : โรงพยาบาลสระบุรี

ส่งรายงานความก้าวหน้า : รายงานความก้าวหน้าภายใน 6 เดือน หรือเมื่อสิ้นสุดโครงการ

เอกสารรับรอง :

1. **โครงร่างงานวิจัย**
2. **เครื่องมือที่ใช้เก็บรวบรวมข้อมูล**
3. **Inform Consent form**

ลงนาม : .... **ลงนาม :** ....

(นายแพทย์ณรงค์ศักดิ์ วัชโรทน) **(นางสมศิริ พันธุ์ศักดิ์ศิริ)**

ประธานกรรมการ **กรรมการและเลขานุการ**

วันที่รับรอง : 26 มกราคม 2564 **วันหมดอายุ : 26 มกราคม 2565**

ทั้งนี้ การรับรองนี้มีเงื่อนไขดังที่ระบุไว้ด้านหลังทุกข้อ (ดูด้านหลังของเอกสารรับรองโครงการวิจัย)

APPENDIX C

Permission letter

ที่ จว. ๗๑๑ /2563

ภาควิชาจิตเวชศาสตร์ คณะแพทยศาสตร์
จุฬาลงกรณ์มหาวิทยาลัย
1873 ถนนพระราม 4 ปทุมวัน
กรุงเทพฯ 10330

21 สิงหาคม 2563

เรื่อง ตอบกลับการขอใช้เครื่องมือวิจัย แบบประเมิน Montreal Cognitive Assessment (MoCA) ฉบับภาษาไทย

เรียน คณบดีบัณฑิตวิทยาลัย

ตามที่ นางสาววิยะการ แสงหัวช้าง รหัสประจำตัว 61810023 นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ จะดำเนินการทำโครงการวิจัยเรื่อง "Effectiveness of Neurobic Exercise Program on Memory Performance in Community – Dwelling Older Adults with Mild Cognitive Impairment: A Randomized Controlled Crossover Trial" โดยมี รองศาสตร์ตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ มีความประสงค์ขออนุญาตใช้แบบประเมิน Montreal Cognitive Assessment (MoCA) ของ Z.Nasreddine, MD. ซึ่งพัฒนาเป็นฉบับภาษาไทยโดย รองศาสตราจารย์ แพทย์หญิงโสฬพัทธ์ เหมรัญช์โรจน์ และคณะนั้น

ในการนี้ ภาควิชาจิตเวชศาสตร์ คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย และรองศาสตราจารย์ แพทย์หญิงโสฬพัทธ์ เหมรัญช์โรจน์ ได้พิจารณาแล้ว มีความเห็นว่า สมควรอนุญาตให้ใช้แบบประเมิน Montreal Cognitive Assessment (MoCA) ฉบับภาษาไทย ในการทำโครงการวิจัยเรื่องดังกล่าว

จึงเรียนมาเพื่อทราบ

ขอแสดงความนับถือ

[signature]

รองศาสตราจารย์ แพทย์หญิงโสฬพัทธ์ เหมรัญช์โรจน์
ผู้พัฒนาแบบประเมิน MoCA ฉบับภาษาไทย

ศูนย์ฝึกสมอง ฝ่ายจิตเวชศาสตร์
โทร. 02 256 4000 ต่อ 70710, 70711

เรียน คณบดี
เพื่อโปรดทราบ

คณะแพทยศาสตร์ศิริราชพยาบาล
มหาวิทยาลัยมหิดล
ฝ่ายวิจัย
2 ถนนวังหลัง บางกอกน้อย กรุงเทพ 10700
โทร. 0 2419 2680

ที่ อว 78.07/05633
วันที่ 27 ตุลาคม 2563
เรื่อง ยินดีให้ความอนุเคราะห์ใช้เครื่องมือวิจัย ของ นางสาววิยะการ แสงหัวช้าง

เรียน อธิการบดี
มหาวิทยาลัยบูรพา
อ้างถึง หนังสือ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา ที่ อว 8137/628 ลงวันที่ 11 กันยายน 2563

ตามที่ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพาได้ขอความอนุเคราะห์ให้ นางสาววิยะการ แสงหัวช้าง รหัสประจำตัว 61810023นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ)คณะพยาบาลศาสตร์ ใช้เครื่องมือวิจัย คือ แบบประเมิน Informant Questionnaire on Cognitive Decline in the Elderly (IQDODE) ฉบับสั้น จากงานวิจัยของ รศ.พญ.วรพรรณ เสนาณรงค์ เรื่อง TheIQCODE: An Alternative Screening Test for Dementia for Low Educated ThaiElderly ค.ศ.2001 เพื่อเป็นข้อมูลประกอบการทำดุษฎีนิพนธ์ เรื่อง “Effectivenessof Neurobic Exercise Program on Memory Performance in Community – DwellingOlder Adults with Mild Cognitive Impairment: A Randomized Controlled CrossoverTrial” ความละเอียดดังแจ้งแล้วนั้น

คณะแพทยศาสตร์ศิริราชพยาบาลมหาวิทยาลัยมหิดล พิจารณาแล้วยินดีอนุมัติให้ นางสาววิยะการ แสงหัวช้าง ใช้เครื่องมือวิจัยได้ตามที่ขอความอนุเคราะห์มา ทั้งนี้รายละเอียดขอให้ประสานงานโดยตรงได้ที่ สาขาประสาทวิทยา ภาควิชาอายุรศาสตร์คณะแพทยศาสตร์ศิริราชพยาบาล มหาวิทยาลัยมหิดล โทร.0 2419 7101-2

จึงเรียนมาเพื่อโปรดทราบ

ขอแสดงความนับถือ

ประสิทธิ์ วัฒนาภา
(ศาสตราจารย์ ดร. นายแพทย์ประสิทธิ์ วัฒนาภา)
คณบดีคณะแพทยศาสตร์ศิริราชพยาบาล
ลงนามผ่านระบบ Electronic Document

ที่ อว ๘๑๓๗/ ๑๑๔๐

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
๑๖๙ ถ.ลงหาดบางแสน ต.แสนสุข
อ.เมือง จ.ชลบุรี ๒๐๑๓๑

๓๑ พฤษภาคม ๒๕๖๔

เรื่อง ขออนุญาตเก็บข้อมูลเพื่อดำเนินการวิจัย

เรียน ผู้อำนวยการโรงพยาบาลสระบุรี จังหวัดสระบุรี

สิ่งที่ส่งมาด้วย ๑. เอกสารรับรองจริยธรรมการวิจัยของมหาวิทยาลัยบูรพา
๒. เครื่องมือที่ใช้ในการวิจัย

ด้วยนางสาววิยะการ แสงหัวช้าง รหัสประจำตัว ๖๑๘๑๐๐๒๓ นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ) คณะพยาบาลศาสตร์ ได้รับอนุมัติเค้าโครงดุษฎีนิพนธ์เรื่อง " Effectiveness of Neurobic Exercise Program on Memory Performance in Community - Dwelling Older Adults with Mild Cognitive Impairment: A Randomized Controlled Crossover Trial" โดยมี รองศาสตราจารย์ ดร.ภรภัทร เฮงอุดมทรัพย์ เป็นประธานกรรมการควบคุมดุษฎีนิพนธ์ และเสนอหน่วยงานของท่านในการเก็บข้อมูลเพื่อดำเนินการวิจัยนั้น

ในการนี้ บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา จึงขออนุญาตให้นิสิตดังรายนามข้างต้นดำเนินการเก็บรวบรวมข้อมูลภายในกลุ่มงานการพยาบาลชุมชน จากกลุ่มตัวอย่างที่เป็นผู้สูงอายุที่อาศัยอยู่ในชุมชนที่มีภาวะความจำบกพร่องเล็กน้อยและเป็นสมาชิกชมรมผู้สูงอายุโรงพยาบาลสระบุรี ตำบลปากเพรียว อำเภอเมือง จังหวัดสระบุรี จำนวน ๓๒ คน ในระหว่างวันที่ ๑ สิงหาคม พ.ศ. ๒๕๖๔ - ๒๖ มกราคม พ.ศ. ๒๕๖๕ ทั้งนี้ สามารถติดต่อนิสิตดังรายนามข้างต้น ได้ที่หมายเลขโทรศัพท์ ๐๙๒-๕๐๔-๖๘๘๘ หรือที่ E-mail: viyakan@bcns.ac.th

จึงเรียนมาเพื่อทราบและโปรดพิจารณา

ขอแสดงความนับถือ

(รองศาสตราจารย์ ดร.นุจรี ไชยมงคล)
คณบดีบัณฑิตวิทยาลัย ปฏิบัติการแทน
อธิการบดีมหาวิทยาลัยบูรพา

บัณฑิตวิทยาลัย มหาวิทยาลัยบูรพา
โทร ๐๓๘ ๑๐๒ ๗๐๐ ต่อ ๗๐๑, ๗๐๕, ๗๐๗
E-mail: grd.buu@go.buu.ac.th

APPENDIX D

Intervention

สำหรับผู้วิจัย

คู่มือการจัดกิจกรรม
การบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์
สำหรับผู้สูงอายุที่มีสมรรถภาพสมองบกพร่องเล็กน้อย

จัดทำโดย

- นางสาววิยะการ แสงหัวช้าง
  นิสิตหลักสูตรปรัชญาดุษฎีบัณฑิต
  สาขาวิชาพยาบาลศาสตร์ (หลักสูตรนานาชาติ)
  คณะพยาบาลศาสตร์ มหาวิทยาลัยบูรพา
  092-5046888 viyakan@bcns.ac.th
- รศ. ดร. ภรภัทร เฮงอุดมทรัพย์ อาจารย์ที่ปรึกษาหลัก
- รศ. ดร. นุจรี ไชยมงคล อาจารย์ที่ปรึกษาร่วม
- รศ. ดร. นัยพินิจ คชภักดี ผู้ทรงคุณวุฒิภายนอก

คำนำ

ภาวะสมรรถภาพสมองบกพร่องเล็กน้อยถือว่าเป็นปัญหาสาธารณสุขที่สำคัญ อย่างไรก็ตาม ภาวะนี้สามารถฟื้นฟูให้กลับสู่ภาวะปกติได้ หรือถ้าปล่อยให้มีอาการเพิ่มมากขึ้น ไม่ได้รับการดูแลรักษาฟื้นฟูภาวะนี้ก็จะกลายเป็นโรคสมองเสื่อมได้ ดังนั้นการมีความรู้ความเข้าใจเกี่ยวกับภาวะนี้ตลอดจนการมีแนวทางการชะลอการเปลี่ยนแปลงของการรู้คิดในผู้สูงอายุจึงมีความสำคัญสำหรับบุคลากรทางสุขภาพ คู่มือเล่มนี้ผู้วิจัยจัดทำขึ้นเพื่อใช้เป็นแนวทางการจัดกิจกรรมสำหรับผู้สูงอายุที่มีภาวะสมรรถภาพสมองบกพร่องเล็กน้อย โดยพัฒนามาจากแนวคิดนิวโรบิคส์เอ็กเซอร์ไซส์ ของ Katz and Rubin (1999) และการทบทวนวรรณกรรม ซึ่งเป็นความรู้ทางวิทยาศาสตร์เกี่ยวกับการกระตุ้นการทำงานของสมองส่วนต่าง ๆ โดยเกิดจากการกระตุ้นให้ประสาทสัมผัสทั้ง 5 (Sensory Organs) ซึ่งได้แก่ การได้ยิน การมองเห็น การได้กลิ่น การลิ้มรส และการสัมผัส รวมไปถึงส่วนที่ 6 คือ อารมณ์ (Emotional Sense) ทำงานเชื่อมโยงกัน ด้วยการเปลี่ยนแปลงวิธีการดำเนินกิจกรรมในชีวิตประจำวันของผู้สูงอายุเป็นตัวช่วย เน้นการทำกิจกรรมใหม่ๆ และทำกิจกรรมหลากหลายรูปแบบเพื่อกระตุ้นสมองและส่งเสริมทำงานของสมองอย่างมีประสิทธิภาพมากขึ้น ซึ่งจะส่งผลให้ความจำของผู้สูงอายุดีขึ้น รวมถึงยังสามารถชะลอการเปลี่ยนแปลงของการรู้คิดในผู้สูงอายุได้ อีกทั้งยังส่งผลให้ผู้สูงอายุมีคุณภาพชีวิตที่ดีขึ้น

สารบัญ

การบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์

โปรแกรมการบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์ฉบับนี้ประยุกต์มาจากแนวคิดนิวโรบิคส์เอ็กเซอร์ไซส์ของ Katz and Rubin (1999) และการทบทวนวรรณกรรม ซึ่งผู้วิจัยจัดทำขึ้นเพื่อเป็นแนวทางในการจัดกิจกรรมสำหรับผู้สูงอายุที่มีสมรรถภาพสมองบกพร่องเล็กน้อย โดยมีเป้าหมายเพื่อกระตุ้นสมองและช่วยเพิ่มความจำ ลักษณะของกิจกรรมเน้นการกระตุ้นการทำงานของประสาทสัมผัสทั้ง 5 ประกอบด้วย กิจกรรมกระตุ้นสมองด้วยการมองเห็น การรับรส การดมกลิ่น การได้ยิน และการสัมผัสทางกาย ร่วมกับการใช้กิจกรรมกระตุ้นอารมณ์ กิจกรรมการบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์นี้สามารถช่วยเพิ่มความจำ ทำให้สมองคงความแข็งแรง และชะลอความเสื่อมของสมองก่อนเวลาอันควร

ผู้ดำเนินกิจกรรม

ผู้วิจัย ซึ่งเป็นนิสิตปริญญาเอก คณะพยาบาลศาสตร์ มหาวิทยาลัยบูรพา และมีประสบการณ์ในการสอนและการดูแลผู้สูงอายุมากกว่า 5 ปี

กลุ่มเป้าหมาย

ผู้สูงอายุที่อยู่อาศัยในชุมชนที่มีสมรรถภาพสมองบกพร่องเล็กน้อย ซึ่งผ่านการคัดกรองภาวะสมองเสื่อมด้วยแบบประเมินพุทธิปัญญา (The Montreal Cognitive Assessment, MoCA) คะแนนน้อยกว่า 24 และผ่านการประเมินความสามารถในการดำเนินชีวิตประจำวันด้วยแบบประเมินความสามารถในการปฏิบัติกิจวัตรประจำวัน (The Modified Barthel Activities Daily Living Index, BAI) คะแนนมากกว่าหรือเท่ากับ 12 คะแนน

สถานที่

ห้องประชุมย่อย โรงพยาบาลสระบุรี เลขที่ 18 ถนนเทศบาล 4 ตำบลปากเพรียว อำเภอเมืองสระบุรี จังหวัดสระบุรี 18000

คำชี้แจง

โปรแกรมการบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์ ประกอบด้วย กิจกรรมการกระตุ้นสมองจำนวน 6 ครั้ง ในระยะเวลา 3 สัปดาห์ ๆ ละ 2 ครั้ง ๆ ละ 60 นาที ดำเนินกิจกรรมโดยผู้วิจัยในรูปแบบกิจกรรมกลุ่ม นอกจากนี้ยังมีการบริหารสมองด้วยตนเองที่ผู้สูงอายุสามารถทำได้ด้วยตนเองที่บ้านจำนวน 5 กิจกรรม ดังรายละเอียดต่อไปนี้

กิจกรรมการบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์

สัปดาห์	ครั้งที่	กิจกรรมหลัก	กิจกรรมย่อย	ระยะเวลา
1	1	การให้ความรู้เรื่องนิวโรบิคส์เอ็กเซอร์ไซส์และการกระตุ้นสมองด้านการมองเห็น	1.1 การสอนให้ความรู้เรื่องการบริหารสมองแบบนิวโรบิคส์เอ็กเซอร์ไซส์ 1.2 การทายสิ่งของในถาด	30 นาที 30 นาที
	2	การกระตุ้นสมองด้านการดมกลิ่น	2.1 การทายกลิ่นเทียนหอม 2.2 การทายกลิ่นดอกไม้และสมุนไพร	30 นาที 30 นาที
2	3	การกระตุ้นสมองด้านการฟัง	3.1 การระบุเสียงธรรมชาติ 3.2 การฟังเพื่อแยกเสียงธรรมชาติ	30 นาที 30 นาที
	4	การกระตุ้นสมองด้านการสัมผัส	4.1 การเขียนหลังทายคำ 4.2 การปิดตาสัมผัสของในกล่อง	30 นาที 30 นาที
3	5	การกระตุ้นสมองด้านการรับรสชาติ	5.1 การชิมผักและผลไม้ที่หลากหลายรสชาติ 5.2 การชิมอาหารและขนมหวานที่หลากหลายรสชาติ	30 นาที 30 นาที
	6	การบูรณาการประสาทสัมผัสทั้ง 6 และการประยุกต์ใช้ชีวิตประจำวัน	6.1 การประกอบอาหาร 6.2 บทสรุปกิจกรรมและแนวทางการนำนิวโรบิคส์เอ็กเซอร์ไซส์ใช้ในชีวิตประจำวัน	60 นาที 30 นาที

กิจกรรมการบริหารสมองด้วยตนเองที่บ้าน

สัปดาห์	ครั้งที่	ใบงาน	กิจกรรม
1	1	1.1 บุคคลสำคัญในข่าว	ผู้สูงอายุดูข่าวจากโทรทัศน์แล้วเลือกบุคคลสำคัญในข่าว 1 คน จดบันทึกข้อมูลสำคัญของบุคคลนั้นตามแบบบันทึก เพื่อนำมาแลกเปลี่ยนเรียนรู้ภายในกลุ่มในการทำกิจกรรมครั้งที่ 2
	2	1.2 กลิ่นหอมชวนให้คิดถึง	ผู้สูงอายุดมกลิ่นวัตถุสิ่งของที่มีอยู่ในบ้าน ซึ่งมีกลิ่นที่ท่านชอบอย่างน้อย 2 อย่าง แล้วบันทึกลงในแบบบันทึก เพื่อนำมาแลกเปลี่ยนเรียนรู้ภายในกลุ่มในการทำกิจกรรมครั้งที่ 3
2	3	2.1 เสียงแห่งความประทับใจ	ผู้สูงอายุฟังเพลง ฟังเสียงธรรมชาติ และฟังเสียงสัตว์อย่างละ 1 เสียง แล้วบันทึกลงในแบบบันทึก เพื่อนำมาแลกเปลี่ยนเรียนรู้ภายในกลุ่มในการทำกิจกรรมครั้งที่ 4
	4	2.2 สัมผัสจับด้วยมือ	ผู้สูงอายุสัมผัสวัตถุสิ่งของที่มีรูปทรงแตกต่างกัน 2 อย่าง (ทรงกลม และทรงเหลี่ยม) แล้วบันทึกลงในแบบบันทึก เพื่อนำมาแลกเปลี่ยนเรียนรู้ภายในกลุ่มในการทำกิจกรรมครั้งที่ 5
3	5	3.1 เมนูหลากหลายรสชาติ	ในหนึ่งสัปดาห์ที่ผ่านมาผู้สูงอายุชอบรับประทานอาหารเมนูใดมากที่สุด ให้เลือกมาเพียง 1 เมนูแล้วบันทึกข้อมูลลงในแบบบันทึก เพื่อนำมาแลกเปลี่ยนเรียนรู้ภายในกลุ่มในการทำกิจกรรมครั้งที่ 6

สำหรับผู้ช่วยวิจัย

คู่มือการจัดกิจกรรม

การบริหารสมองสำหรับกลุ่มเปรียบเทียบ

จัดทำโดย

- นางสาววิยะการ แสงหัวช้าง
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- รศ. ดร. นุจรี ไชยมงคล อาจารย์ที่ปรึกษาร่วม
- รศ. ดร. นัยพินิจ คชภักดี ผู้ทรงคุณวุฒิภายนอก

คำนำ

ภาวะสมรรถภาพสมองบกพร่องเล็กน้อยเป็นปัญหาสุขภาพที่สำคัญและพบได้บ่อยในกลุ่มผู้สูงอายุ ซึ่งมีผลกระทบต่อผู้สูงอายุและครอบครัวรวมถึงส่งผลกระทบต่อสังคม ถึงแม้ว่าอาการของภาวะสมรรถภาพสมองบกพร่องเล็กน้อยจะไม่เป็นอุปสรรคในการดำเนินชีวิตของผู้สูงอายุมากนัก แต่อย่างไรก็ตามภาวะสมรรถภาพสมองบกพร่องเล็กน้อยนี้จะเพิ่มความเสี่ยงต่อการเป็นโรคสมองเสื่อม ซึ่งจะส่งผลกระทบต่อผู้สูงอายุ ครอบครัว และสังคมเพิ่มมากขึ้น ดังนั้นการป้องกันและการชะลอความจำเสื่อมจึงมีความสำคัญ ปัจจุบันมีการจัดกิจกรรมการบริหารสมองเพื่อป้องกันภาวะสมองเสื่อมสำหรับผู้สูงอายุหลากหลายรูปแบบ โดยมีเป้าหมายเพื่อป้องกันและชะลอการเกิดภาวะสมองเสื่อมรวมทั้งการคงศักยภาพสมอง

คู่มือเล่มนี้จัดทำขึ้นเพื่อใช้เป็นแนวทางในการจัดกิจกรรมการบริหารสมองสำหรับผู้สูงอายุที่มีภาวะสมรรถภาพสมองบกพร่องเล็กน้อย โดยผู้วิจัยได้รวบรวมกิจกรรการบริหารสมองทั้งหมดของชมรมผู้สูงอายุโรงพยาบาลสระบุรี เพื่อส่งเสริมให้ผู้สูงอายุมีความจำที่ดี ทำให้สมองคงความแข็งแรงและชะลอความเสื่อมของสมองก่อนวัยอันควร

สารบัญ

โปรแกรมการบริหารสมองสำหรับกลุ่มเปรียบเทียบ

โปรแกรมการบริหารสมองสำหรับกลุ่มเปรียบเทียบนี้ ผู้วิจัยได้รวบรวมกิจกรรการบริหารสมองทั้งหมดของชมรมผู้สูงอายุโรงพยาบาลสระบุรี ซึ่งทางโรงพยาบาลสระบุรีได้ดำเนินการจัดกิจกรรมสำหรับผู้สูงอายุเป็นประจำทุกเดือนตั้งแต่ ปี พ.ศ. 2547 เป็นต้นมา โดยมีพยาบาลวิชาชีพชำนาญการ โรงพยาบาลสระบุรี เป็นผู้รับผิดชอบดำเนินกิจกรรม เป้าหมายเพื่อส่งเสริมให้ผู้สูงอายุในชมรมผู้สูงอายุโรงพยาบาลสระบุรีมีสุขภาพที่แข็งแรง ส่งเสริมความจำ ทำให้สมองคงความแข็งแรงและชะลอความเสื่อมของสมองก่อนวัยอันควร

ผู้ดำเนินกิจกรรม

ผู้ช่วยวิจัย ซึ่งเป็นพยาบาลวิชาชีพที่มีประสบการณ์ในการดูแลผู้สูงอายุอย่างน้อย 5 ปี

กลุ่มเป้าหมาย

ผู้สูงอายุที่อยู่อาศัยในชุมชนที่มีสมรรถภาพสมองบกพร่องเล็กน้อย ซึ่งผ่านการคัดกรองภาวะสมองเสื่อมด้วยแบบประเมินพุทธิปัญญา (The Montreal Cognitive Assessment, MoCA) คะแนนน้อยกว่า 24 และผ่านการประเมินความสามารถในการดำเนินชีวิตประจำวันด้วยแบบประเมินความสามารถในการปฏิบัติกิจวัตรประจำวัน (The Modified Barthel Activities Daily Living Index, BAI) คะแนนมากกว่าหรือเท่ากับ 12 คะแนน

สถานที่

ห้องประชุมย่อย โรงพยาบาลสระบุรี เลขที่ 18 ถนนเทศบาล 4 ตำบลปากเพรียว อำเภอเมืองสระบุรี จังหวัดสระบุรี 18000

คำชี้แจง

โปรแกรมการบริหารสมองสำหรับกลุ่มเปรียบเทียบ ประกอบด้วย กิจกรรมการบริหารสมอง จำนวน 6 ครั้ง ในระยะเวลา 3 สัปดาห์ ๆ ละ 2 ครั้ง ๆ ละ 60 นาที กิจกรรมจะดำเนินในรูปแบบของกิจกรรมกลุ่ม โดยมีรายละเอียดดังนี้

โปรแกรมการบริหารสมองสำหรับกลุ่มเปรียบเทียบ

สัปดาห์	ครั้งที่	กิจกรรม	ระยะเวลา	รูปแบบ
1	1	การสอนให้ความรู้เรื่อง "การบริหารสมองเพื่อป้องกันสมองเสื่อมสำหรับผู้สูงอายุ"	60 นาที	รายกลุ่ม
	2	การวาดภาพระบายสี	60 นาที	รายกลุ่ม
2	3	การพับกระดาษ	60 นาที	รายกลุ่ม
	4	การร้องเพลง	60 นาที	รายกลุ่ม
3	5	การจับผิดภาพ	60 นาที	รายกลุ่ม
	6	การคำนวณเลข	60 นาที	รายกลุ่ม

BIOGRAPHY

NAME	Ms. Wiyakarn Sanghuachang	
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PLACE OF BIRTH	Roi Et Province, Thailand	
PRESENT ADDRESS	18/64 Tessabarn 4 Road, Tambon Pakpriaw, Ampur Muang, Saraburi 18000, Thailand	
POSITION HELD	2001-2011	Registered Nurse Cardiac Care Unit of Rajavithi Hospital
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	2018-2022	Doctor of Philosophy (Nursing Science) Burapha University, Chonburi Province, Thailand