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Cognitive intervention using Montessori and DementiAbility for people with mild cognitive impairment

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ABSTRACT

Background: Age-related illnesses are more prevalent with advancing age, with seniors facing more chronic diseases and disabilities. Chronic diseases that mostly older adults deal with are caused by high blood pressure, diabetes, and high cholesterol-also called noncommunicable diseases (NCDs). NCDs can cause severe chronic diseases such as heart disease, kidney failure, and cerebrovascular disease, and these can result in a high risk of Mild Cognitive Impairment (MCI). Together, brain cells shrink around 2,000 million cells when getting older, causing difficulty recalling names or words, decreased attention span, or a decreased ability to handle many tasks simultaneously. Therefore, protecting senior citizens with MCI needs to be seriously consideration.

Objectives: This quasi-experimental research aimed to study the effects of a program to reduce brain deterioration in older people with Mild Cognitive Impairment (MCI).

Materials and methods: The samples consisted of senior males and females requiring service at Songkhla Rajanagarindra Psychiatric Hospital, Songkhla, Thailand. A sample group was selected using an equivalent group design. The researcher utilized inclusion and exclusion criteria to gather 32 older adults and employed a simple random selection into experimental and control groups. For three months, the experimental group engaged in a seven-care-kit program based on Montessori's philosophy and DementiAbility methods to help protect against brain deterioration. Mann-Whitney U test and Wilcoxon Value were used to analyze the result of the program's effectiveness, which assessed cognitive ability by MoCA.

Results: The attention span domain showed a significant statistical difference at (p=0.03) after post-tests comparing the experimental and control groups. A comparison of the pre-test and post-test of the experimental group found four domains-total cognitive domain, attention span domain, delayed recall domain, and visuospatial perception domain were significant with a statistical difference of (p=0.001, p=0.002, p=0.003, and p=0.004 respectively). Moreover, two domains- the delayed recall domain and the total cognitive domain in the control group showed a significant statistically increasing difference at (p=0.001 and p=0.005, respectively).

Conclusion: The senior citizens' active daily activities may help protect against dementia in older adults with MCI. The Home-Based Protection of Brain Deterioration Program demonstrated a satisfactory program that enhanced the attention span, visuospatial domain, and delayed recall of older people with mild cognitive impairment. Hence, the program as a dementia prevention program for older adults with MCI.

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Introduction

In 2022, the world's population aged 60 and over was 779 million. This condition is because the aging population is living longer. Seniors are reaching their sixties and beyond. Thus, there is no doubt that by 2050, the number of seniors aged 60 years will double (2.1 billion), and seniors aged 80 and beyond will be 426 million. Thailand will be an aged society soon because the number of older adults has been increasing dramatically since 2018, increasing to 16.06%, 2019 up to 16.73%, and in 2020 increasing to 17.57% of the population.[1] If any country has older adults reporting 20% or above of the population, that country is called an aging society.

Age-related illnesses are more prevalent with advancing age, with seniors facing more chronic diseases and disabilities.[2] Chronic diseases that mostly older adults deal with are caused by high blood pressure, diabetes, and high cholesterol-also called noncommunicable diseases (NCDs). NCDs can cause severe chronic diseases such as heart disease, kidney failure, and cerebrovascular disease, and these can result in a high risk of Mild Cognitive Impairment (MCI).[3] Together, brain cells shrink around 2,000 million cells when getting older, causing difficulty recalling names or words, decreased attention span, or a decreased ability to handle many tasks simultaneously.[4] Farias *et al.* mentioned that a person diagnosed with MCI will have a higher risk of having dementia, around 10-15%, compared with ordinary people.[5] Therefore, protecting senior citizens with MCI needs to be seriously consideration.

Previous research found that people who stay active and have regular social interaction will have a lower risk of dementia.[6] However, during the Covid-19 pandemic, most older adults stayed at home to prevent the spread of the virus. Consequently, many older adults lost mobility and less frequently engaged in social activities. Pellecchia *et al*. found that Physical Functional Impairment (PFI) played an intermediary role in the relationship between Post-Traumatic Stress Disorder (PTSD) and Mild Cognitive Impairment (MCI).[7] The researchers mentioned that PFI may be the first sign of MCI in people with PTSD. Less physical movement increases the chances of diseases, disability, hospitalization, poorer quality of life, and death. It could imply that people with MCI stayed active in their physical, cognitive, social, and spiritual activities, their deteriorating cognition condition could be reduced, and cognition could return to normal depending on the level of engagement.[8]

In Thailand, previous research promoting cognition exercise in older adults with MCI found various results, e.g., Samael, Thaniwattananon, and Kong-In reported that attention span was reduced when reducing the number of cognition exercise appointments.[9] Jeeraya *et al*. revealed no significant difference in the cognition level, but there was a higher level of self-competency in the experimental group compared with the control group.[10] Lastly, Apichonkit *et al.* employed multi-activities to develop different domains of cognition and showed positive results in all parts of understanding except language and delayed recall.[11] The researchers claimed that these two domains are the most challenging in improving people's awareness of MCI.

Previous research implied that activities for improving aging people's cognition with MCI are needed, and various activities to improve different cognitive domains and consistency of engaging in activities played significant roles in designing a stimulating cognitive program. As a result, this research utilized the Montessori philosophy and DementiAbility to develop a cognition exercise program. Both theoretical concepts are derived from a person-centered concept. For example, Montessori focuses on systematic activity presentation to help a person achieve in activity, resulting in increased self-value. DementiAbilty designs activities based on people's needs, interests, and experiences relevant to each culture and religion; therefore, it helps people engage in activities consistently by enhancing their abilities. Moreover, activities are designed to help older people participate at home to prevent the spread of COVID-19. Hence, it could assist older adults in learning even during the lockdown during the COVID pandemic or even due to their physical functioning limitations.

Materials and methods

This research was conducted as a quasi-experimental design to study the effect of intervention activities on participants' cognitions. The Montreal Cognitive Assessment (MoCA) assessed it, consisting of visuospatial/executive, naming three kinds of animal, memory, attention span, language, abstraction, delayed recall, and orientation domains. A simple random sampling and an equivalent group design were employed to select a sample group with no different abilities into an experimental group and a control group equally. Ethical approval was obtained from the Suan Saranrom Psychiatric Hospital (DMH.IRB 004/2564). Procedures were explained to get informed consent before participants joined the research. All participants signed an informed consent form after reading it and agreeing to join the study.

Participants

Purposive sampling was applied to select participants for this research. The participants were those using a service at the Songkhla Rajanagarindra Psychiatric Hospital, Thailand, specializing in neurological disorders. The sample was (N=32) aged between 60 and 70 years with MCI identified by a Thai version of the MoCA and with an assessment range between ≥17 to ≤24. Thirty-two people were randomly distributed into an experimental group and a control group. Both experimental and control groups reported spending life typically and could read, understand, and write in Thai. Interviews were conducted to gather personal data on physical health, motivation, ability, daily routine, fears, worries, and needs to design activities matching their interests and abilities. People who were diagnosed as clinically depressed were excluded from the research samples. The experimental group participated in a program protecting against the deterioration of cognitive impairment, which designed

activities based on Montessori and DementiAbility and focused on individual needs, abilities, and interests. Seven home care kits were sent to the experimental group's homes. A video presentation and Line, a messaging application, were utilized to follow up on the activity's participation. There was no extra activity from researchers for the control group. They spent their daily routine typically.

Measurement

Two measurements were used for the exclusion and inclusion of participants participating in the research, which were TGDS-15 and MoCA. Moreover, the MoCA was employed to be an outcome measurement. The detail was described as follows:

1) The Thai Geriatric Depression Scale, TGDS-15-Short version created by Shiekh, Yesavage[12] translated into Thai version by Wongpakaran, Wongpakaran, Reekum.[13] Each question is scored as 0 or 1 point; the maximum score is 15. A score above five is used as the cut-off point for detecting depression and has a sensitivity of 86.0% and specificity of 91.0%. The measurement presented good reliability, as shown by the score of Cronbach's alpha at 0.85.
2) Nasreddine *et al*. created the Montreal Cognitive Assessment Thai-version (MoCA). The MoCA Thai version was translated and tested for the reliability in 2007.[14] Eleven questions testing capability comprised Visuospatial, Naming, Attention Span, Language, Delayed recall, Orientation, and Total cognitive ability. The questionnaire took about 10 minutes to complete. A total score of 30 points and a score of more than or equal to 17 and less than or similar to 24 indicated that the subject had mild cognitive impairment. The measurement presented good reliability, shown by a Cronbach's alpha score of 0.80.[15] MoCA was utilized to measure outcomes by assessing before and after implementing the treatment program. MoCA assessor was two persons. One person was a psychologist who gained certification as an administrator from MoCA Test Inc., and one was a nurse with experience using MoCA for more than ten years at a psychiatric hospital.

The process of samples' inclusion and exclusion and outcome assessment is illustrated in Figure 1.

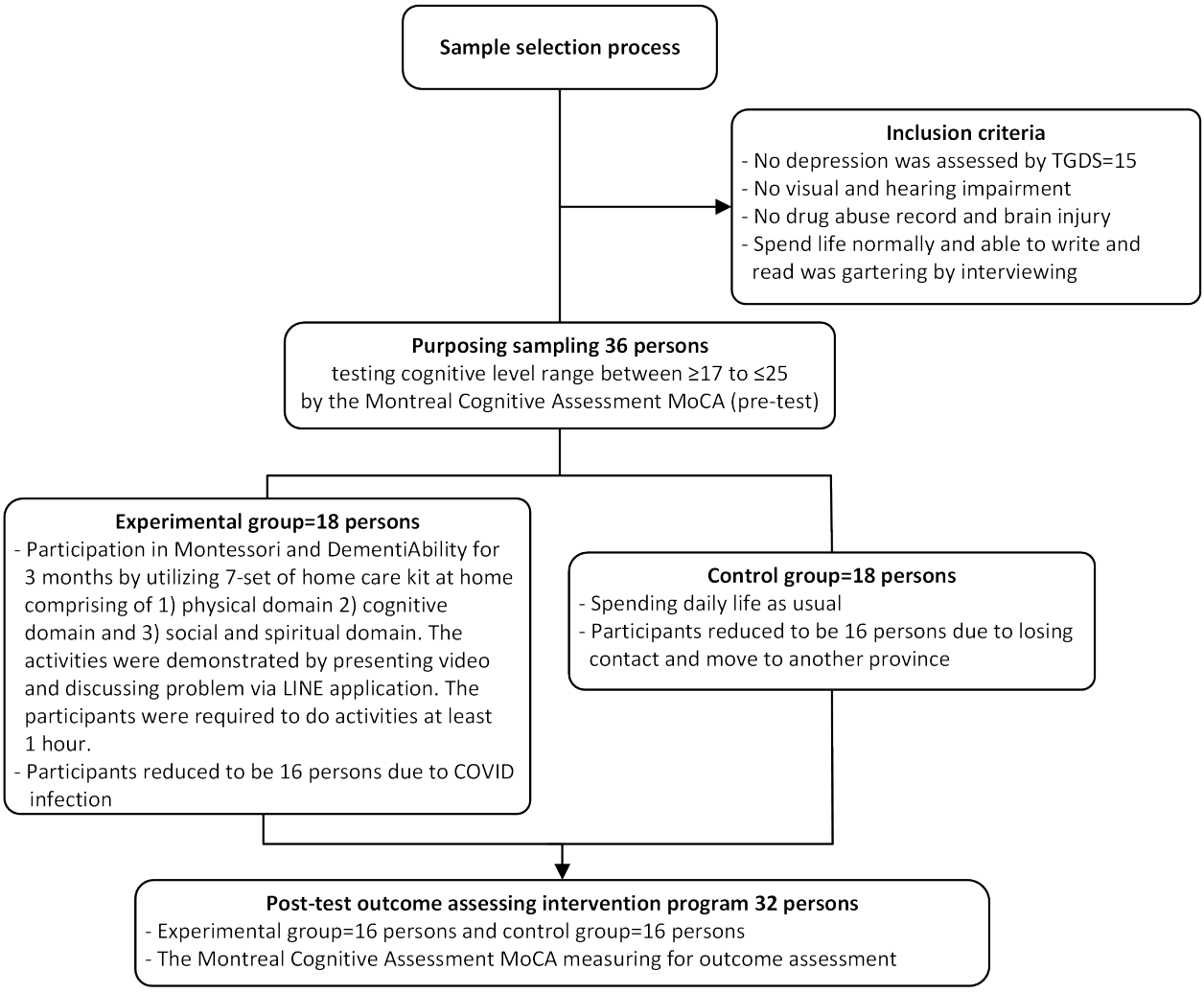


Figure 1 *Diagram of samples' inclusion and exclusion and outcome assessment.*

Procedure

The participant screening was from November to December 2021 at Songkhla Rajanagarindra Psychiatric Hospital. Participants were the older adults who gained a MoCA assessment ranking of more than or equal to 17 and less than or equal to 24 and had no diagnosis of depression, brain injury, or drug addiction. Almost all participants could read, write, work, and financially help their families. Thirty-two people were randomly assigned into two groups: 16 for the experiment and 16 for the control groups. The treatment program for the experimental group was conducted from January to March 2022. As this research was conducted during the COVID pandemic, the intervention program or a seven-set home care kits was a treatment program sent to the participants' homes for three months. The seven-set home care kits were comprised of 3 domains: 1) physical domain emphasizing physical exercise activities such as left-right brain exercise using hand and fingers and 9-square-table aerobic exercise 2) cognitive domain enhancing attention, stimulating cognition such as brain teaser exercise, e.g., mathematics and languages, and eye-hand coordination activities, and 3) social and spiritual domain nurturing social connection such as writing cards and enhancing spiritual belief such as coloring mandala arts and praying relevant to individual respectfulness.

Before launching the intervention, a pilot test was applied to three elderly people with MCI who had similar backgrounds to the research participants but lived in different places. The pilot group participated in the program for two weeks. After that, they were interviewed about program satisfaction and practicality. The researcher adjusted the program based on the pilot group's suggestions. Finally, the program has been approved by three experts: a psychiatrist and two nurses with more than five years of experience with people having dementia and MCI.

At the first day of the intervention, the instruction was demonstrated by video presentations. In addition, the Line application was used to communicate and follow up regarding the activities' difficulty level and designed activities to match participants' interests and abilities. The participants were asked to engage in activities for at least one hour per day, e.g.,1) physical activities spending time for 20 minutes or more per day, 2) cognitive activities using time for 20 minutes or more per day, e.g., brain tease exercise, and 3) social and spiritual activities utilizing time for 20 minutes per day or more, e.g., coloring or praying. Each week, participants reported levels of activities engagement to evaluate the effectiveness of each activity. After completing the treatment program, the experimental and control groups did a post-test of the MoCA and were interviewed to gather more information.

Statistical analysis

Demographic data and activity satisfaction were analyzed and illustrated using mean and percentages. The Median Wilcoxon Value was employed to identify the cognition differences in the post-test of the two groups. Mann-Whitney U was employed to examine the differences between pre-test and post-tests scores of each group. Interview data was analyzed for satisfaction with the activities.

Results

Most of the participants were between the age of 60-65 (56.25%), predominantly female (78.12%), and mostly completed primary school six years of schooling (59.38%). Most participants were gardeners (34.38%), chronic illness (87.50%). No difference existed between the group before the intervention, indicated by the median experimental group, 21.00, and the control group, 20.50. After the intervention, Mild cognitive impairment was evident by a median of MoCA's score for the experimental group of pre-test 21.00 and post-test 25.00 and for a control group of pre-test 20.50 and post-test 23.00. All values are present. Demographic information is shown in Table 1

Table 1 Baseline of demographic characteristics of participants.

Details	Experimental group	Control group	Percentage (range)
Age (60-65 years)	9 (56.25%)	9 (56.25%)	18 (56.25%)
Gender (female)	13 (81.25%)	12 (75.00%)	25 (78.12%)
Education (primary level)	9 (56.25%)	10 (62.50%)	19 (59.38%)
Occupation (gardener)	5 (31.25%)	6 (37.50%)	11 (34.38%)
A chronic illness	15 (93.75%)	13 (81.25%)	28 (87.50 %)
Mild cognitive impairment (Montreal cognitive assessment Thai version (MoCA))			
Pre-test	21.00 (median)	20.50 (median)	Min=17 Max=24
Post-test	25.00 (median)	23.00 (median)	Min=18 Max=28

Intervention program and cognitive level

The Mann-Whitney U Test was applied to compare the effect of intervention between the experiment group and the control group before and after the experiment. Before the experiment period, there was no significant difference between the experiment group and the control group, as shown in Table 2. After the investigation, the results found a statistically significant difference between the experimental and control groups regarding the attention span domain (p=0.03). There were four domains that the experimental group showed a higher medium score than the control group: visuospatial perception (experimental group M=3.50 and control group M=3.00), attention span (experimental group M=5.00, control group M=4.50), language use (experimental group M=2.00, and control group M=1.00), and abstract thinking (experimental group M=1.00, control group M=0.50). The two domains, naming three kinds of animals and delayed recall, showed the same medium score between groups. The orientation domain of the control group presented a higher medium score than the experimental group (experimental group M=5.00 and control group M=6.00), which is illustrated in Table 3.

Table 2 Comparison cognitive score of mean, median, and Mann-Whitney U test before intervention of experimental group and control group separated in each domain.

Cognitive domain	N	Median	Mean	Mean rank	Sum of rank	Mann-Whitney U	
						Value	Prob
Visuospatial							
Experimental group	16	3.00	3.13	15.41	246.50	110.5	0.51
Control group	16	3.50	3.38	17.59	281.50		
Total	32	3.00	3.25				
Naming							
Experimental group	16	3.00	2.87	16.56	265.00	127.0	0.99
Control group	16	3.00	2.81	16.44	263.00		
Total	32	3.00	2.84				
Attention span							
Experimental group	16	4.00	4.13	16.88	270.00	122.0	0.84
Control group	16	4.00	3.94	16.13	258.00		
Total	32	4.00	4.03				
Language							
Experimental group	16	1.00	1.38	16.63	266.00	126.0	0.96
Control group	16	1.00	1.38	16.38	262.00		
Total	32	1.00	1.38				
Abstraction							
Experimental group	16	1.00	0.94	17.72	283.50	108.5	0.47
Control group	16	1.00	0.75	15.28	244.50		
Total	32	1.00	0.84				
Delayed recall							
Experimental group	16	2.00	1.94	16.00	256.00	120.0	0.78
Control group	16	2.50	2.06	17.00	272.00		
Total	32	2.00	2.00				
Orientation							
Experimental group	16	6.00	6.00	17.00	272.00	120.0	0.78
Control group	16	6.00	5.94	16.00	256.00		
Total	32	6.00	5.97				
Total cognitive ability							
Experimental group	16	21.00	20.75	16.88	270.00	122.0	0.84
Control group	16	20.50	20.56	16.13	258.00		
Total	32	21.00	20.66				

Table 3 Comparison cognitive score of mean, median, and Mann-Whitney U test after intervention of experimental group and control group separated in each domain.

Cognitive domain	N	Median	Mean	Mean rank	Sum of rank	Mann-Whitney U	
						Value	Prob
Visuospatial							
Experimental group	16	3.50	3.75	18.16	290.50	101.5	0.32
Control group	16	3.00	3.31	14.84	237.50		
Total	32	3.00	3.53				
Naming							
Experimental group	16	3.00	2.94	17.03	272.50	119.0	0.75
Control group	16	3.00	2.81	15.97	255.50		
Total	32	3.00	2.87				
Attention span							
Experimental group	16	5.00	5.25	20.09	321.50	70.50	0.03**
Control group	16	4.50	4.31	12.91	206.50		
Total	32	5.00	4.79				
Language							
Experimental group	16	2.00	1.44	16.69	267.00	125.0	0.93
Control group	16	1.00	1.44	16.31	261.00		
Total	32	1.50	1.44				
Abstraction							
Experimental group	16	1.00	1.19	18.41	294.50	97.5	0.25
Control group	16	0.50	0.88	14.59	233.50		
Total	32	1.00	1.03				
Delayed recall							
Experimental group	16	4.00	3.81	15.50	248.00	112.0	0.56
Control group	16	4.00	4.19	17.50	280.00		
Total	32	4.00	4.00				
Orientation							
Experimental group	16	5.00	5.88	15.50	248.00	112.0	0.56
Control group	16	6.00	6.00	17.50	280.00		
Total	32	6.00	5.97				
Total cognitive ability							
Experimental group	16	25.00	24.75	19.00	304.00	88.0	0.14
Control group	16	23.50	23.19	14.00	224.00		
Total	32	24.00	23.19				

The experiment group (before and after the experiment period)

The Wilcoxon Value was employed to compare cognition scores before and after joining the intervention program of the experimental group. The result showed that four domains showed a statistically significant difference, e.g., total cognition ability (p=0.001), attention span (p=0.002), delayed recall (p=0.003), and visual-spatial perception (p=0.004). Moreover, the median score of all cognitive domains in the experimental group after the intervention period reported a higher score than before the intervention period, except naming, abstraction, and orientation, which reported the same score, which is shown in Table 4.

Table 4 Comparison cognitive score of mean, median, and The Wilcoxon Value test after intervention of experimental group separated in each domain.

Cognitive domain	N	Median	Mean	SD	Wilcoxon value	Wilcoxon prob
Visuospatial						
Post-intervention	16	3.50	3.73	1.29	2.673	0.004**
Pre-intervention	16	3.00	3.13	1.09		
Naming						
Post-intervention	16	3.00	2.94	0.25	1.000	0.158
Pre-intervention	16	3.00	2.87	0.34		
Attention span						
Post-intervention	16	5.00	5.25	0.78	2.951	0.002**
Pre-intervention	16	4.00	4.13	1.15		
Language						
Post-intervention	16	2.00	1.44	0.89	0.159	0.437
Pre-intervention	16	1.00	0.89	0.81		
Abstraction						
Post-intervention	16	1.00	1.19	0.66	1.265	0.103
Pre-intervention	16	1.00	0.94	0.68		
Delayed recall						
Post-intervention	16	4.00	3.81	1.33	2.783	0.003**
Pre-intervention	16	2.00	1.94	1.61		
Orientation						
Post-intervention	16	6.00	5.88	0.34	1.414	0.079
Pre-intervention	16	6.00	6.00	0.00		
Total cognitive ability						
Post-intervention	16	25.00	24.75	2.15	3.360	0.001**
Pre-intervention	16	21.00	20.75	2.05		

The control group (before and after the experiment period)

The results showed a statistical difference in the total cognition ability (p=0.005) and delayed recall (p=0.001). After the experimental period, three parts-total cognition ability, delayed recall, and attention span-showed a higher medium score. Three domains-language, naming three kinds of animals, and time and place orientation-showed the same medium score. Visual-spatial perception and abstract thinking showed a lower medium score when compared before and during the intervention periods, presented in Table 5.

Table 5 Comparison cognitive score of mean, median, and The Wilcoxon Value test after intervention of control group separated in each domain.

Cognitive domain	N	Median	Mean	SD	Wilcoxon value	Wilcoxon prob
Visuospatial						
Post-intervention	16	3.00	3.31	1.14	0.183	0.427
Pre-intervention	16	3.50	3.38	1.59		
Naming						
Post-intervention	16	3.00	2.81	0.54	0.000	0.500
Pre-intervention	16	3.00	2.81	0.54		
Attention span						
Post-intervention	16	4.50	4.31	1.20	1.103	0.135
Pre-intervention	16	4.00	3.94	1.19		
Language						
Post-intervention	16	1.00	1.44	1.03	0.183	0.428
Pre-intervention	16	1.00	1.38	1.09		
Abstraction						
Post-intervention	16	0.50	0.88	1.025	0.302	0.381
Pre-intervention	16	1.00	0.75	0.78		
Delayed recall						
Post-intervention	16	4.00	4.19	0.83	3.443	0.001**
Pre-intervention	16	2.50	2.06	1.44		
Orientation						
Post-intervention	16	6.00	6.00	0.00	1.000	0.159
Pre-intervention	16	6.00	5.94	0.25		
Total cognitive ability						
Post-intervention	16	23.00	23.19	2.99	2.584	0.005**
Pre-intervention	16	20.50	20.56	2.16		

Discussion and implication

Over ten weeks, a seven-set home care kit was delivered to the experimental group's homes every 12 weeks. A stimulating daily program schedule has been set to develop three domains: the physical, cognitive, and social domains, including spiritual domains. Furthermore, MoCA was used as an outcome measurement to identify the treatment program's effectiveness. The results showed that the post-test comparison between the experimental and control groups was significantly different in the attention span domain at p=0.03 (experimental group, M=5.00 and control group, M=4.50). Using the Wilcoxon Value, the results showed that pre- and post-test scores of the experimental group were significantly different in 4 domains: total cognition ability p=0.001, (pre-test, M=21.00 and post-test M=25.00), attention span p=0.002, (pre-test, M=4.00 and post-test M=5.00), delayed recall p=0.003, (pre-test, M=2.00 and post-test M=4.00) and visuospatial perception ability p=0.004, (pre-test, M=3.00 and post-test M=3.50). For control group, there were two domains that showed significant different between pre- and post-test: delayed recall p=0.001 (pre-test, M=2.50 and post-test, M=4.00) and total cognition ability p=0.005 (pre-test, M=20.50 and post-test, M=23.00).

According to these research findings, the attention span domain significantly differed between the experimental and control groups. This finding may be due to using Montessori's pedagogy and the multidisciplinary research integrated throughout the DementiAbility Methods. Montessori was primarily focused on the attention domain. She mentioned that attention helps a person concentrate and derives from an internal passion, resulting in repetitive and consistently engaging activities. The DementiAbility Methods expand on Montessori's work and with current research that includes both forms (procedural and declarative/explicit and implicit) and types (working, short-term, and long-term) of memory to help explain enhanced functioning in each of the three personhood domains (cognitive, physical, and social/spiritual). Neuropsychologists have discovered that success related to achieving tasks and activities is based on what is known about supporting memory loss and understanding spared abilities and learned associations.[16,17] When memory is supported, individuals can circumvent the deficits associated with cognitive decline (according to the type of damage, location of injury, and extent of damage at the brain level).

Attention, visual-spatial perception, working memory, and cognition ability

Attention plays a significant role in storing visuospatial information, particularly related to new items entering perception, attention-helping encoding, maintenance, and retrieval.[18] Two areas of attention and working memory (WM) function harmoniously. First, attention helps to keep the information in mind and protects irrelevant stimuli or wandering thoughts from interfering.[19] Attention also helps with removing irrelevant information from working memory in an attempt to remain focused.[20] Second, working memory is necessary when carrying out a new task that was just learned or being learned.[21] Working memory operates on the further action inconsistent with a previously learned one and when it switches from one study to another. WM plays a crucial role in controlling attention and action automatically in response to changing to a new one.[22] Regarding visual-spatial ability, older adults' cognition deterioration and gaze behavior require working memory to apply different encoding strategies to interpret spatial relationships. For example, Meiran found that older adults prefer to use landmark strategies (such as windows or doors) as the categorical representations of location concerning the environment.[22] They found this was due to difficulties in formulating precise space relations, which differs from young adults who focus on the local arrangement of objects.[23] Therefore, the impact of external irrelevant stimuli must be more clearly understood when creating interventions and environments (e.g., eliminating unnecessary external markings on activities, flooring, and table tops) and applied to interventions and environments for those with MCI. It may imply that when older adults face uninformative landmarks, they are more likely to have difficulty extracting helpful information from the tasks. Then, they must control their attention to encode data into categorical relationships to facilitate decision-making precision. As a result, people with MCI who are challenged by WM deficits need more understanding when new tasks involve complicated processes. When the limitations of WM and the need to control and focus on attention are considered, interventions can be developed to enhance performance and quality outcomes, such as understanding new tasks, including protection against the risk of falling.[23]

The DementiAbility Methods embed these concepts of working memory into its pedagogy. Research related to all forms of memory is integrated into all parts of the DementiAbility Methods, including assessment tools, activities, environments, and resources for individuals. All forms of memory need to be clearly understood and integrated into understanding and addressing the needs and abilities of individuals to achieve successful outcomes. It is a critical component of successful programming, as older adults adopt mastery avoidance goals, and, overall, they do not want to fail or showcase that their ability or comprehension has diminished.[25] When older adults understand a task and complete it, they are more likely to engage with a sense of achievement, mastery, and joy, thereby prolonging engagement and successful outcomes.

Research on the neuroplastic brain, also known as neural plasticity of the brain, has grown in recent years.[26-28] This research suggests that even if the brain's physical structures deteriorate, learning ability is flexible, and the brain can reorganize its structures and functions, thus creating the ability to learn new activities. This research can be used to re-teach people what they previously knew and teach older adults to learn and do new things.[29] When applying their past experiences to learn and understand new tasks, a systematic approach of visual-spatial perception helps them spend less time trying to understand how to perform activities.[22] Nilakantan *et al*. found that learning occurs in sequence, discovering that moving from simple to complex activities and tasks is best.[22] Montessori and DementiAbility integrate this concept into their programming. When these concepts are implemented, older adults enjoy a sense of achievement, thus creating successful outcomes when engaged in activities that match their abilities. Also, attention plays a crucial role in restoring visual-spatial perception related to sensation perception and the environment, leading to formulating plans and conceptual thinking.[30] Enhanced self-esteem and well-being goals can be more readily achieved When activities enhance their confidence to set and initiate their daily schedules and engage them successfully while adding purpose in life. Wells and Dawson have found that a lot of the decline witnessed in dementia is due to disuse rather than due to neurological abnormalities.[31] Owen, Berry, and Brown found that when activities are meaningful, stimulating, and purposeful, behavioral concerns are addressed, and quality of life is enhanced for the person with dementia and their care providers.[32] Sutin *et al.* also found that older adults engaging in intervention with a strong sense of purpose could reduce the risk of dementia by 30%.[33] Therefore, enabling abilities based on a clear understanding of the function of memory (working memory, declarative, and procedural memory) can impact outcomes when considered with multi-modal interventions (including activity programming). However, due to the short intervention duration, the participants may remember content in the MoCA as utilizing only the outcome assessment.

In conclusion, research on memory, learning, and perceptual deficits play a crucial role in creating successful, engaging activities and environments for older adults, and most importantly, an understanding of memory impacts outcomes when activities are matched to interests, skills, and abilities. Programs such as Montessori for dementia and DementiAbility not only take these critical components of memory into account as they relate to MCI, but they also focus on the whole person's needs, taking the physical domain, cognitive domain, and the social and spiritual domain into account. It, in turn, enhances the attention domains and promotes working on visual-spatial perception and delayed recall in working memory in older adults with MCI. The results of this paper provide evidence that current research on memory when integrated into activity programming, enhances abilities and may help protect against dementia in older adults with MCI.

Conflict of interest

The authors declare no conflict of interest.

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