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Effects of multiple training modalities in the elderly with subjective memory complaints

A pilot study

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Abstract

Background: This study investigated the effects of multiple training modalities (MTM) on senior fitness and neuropsychiatric function in the elderly with subjective memory complaints (SMC).

Methods: This study was conducted in 24 elderly subjects with Clinical Dementia Rating (CDR) score of 0 and instrument of ascertainment of dementia 8 (AD8) score of <2. The participants were classified into SMC (n=7) and non-SMC (n=17).

All were assigned to receive multiple training modalities (1 hour for each training: physical fitness activities, calligraphy or drawing, and meditation) twice a week over a 16-week period.

A series of senior fitness test, and neuropsychiatric tests, namely the Traditional Chinese version Mini-Mental Status Examination (MMSE), Cognitive Assessment Screening Instrument (CASI), and the Center for Epidemiologic Studies Depression Scale (CESD), were conducted before and after the intervention. We compared the differences of pre/posttest-MTM and SMC/non-SMC in senior fitness and the neuropsychological tests.

Results: There was no significant difference between SMC and non-SMC groups in demographic characteristics. MTM showed significant improvement in senior fitness and CESD, but not in CASI and MMSE. Significant change in recent memory subscale of CASI was only observed in SMC group, whereas improvement of partial senior fitness and CESD were observed in both groups.

Conclusion: MTM had effects in enhancing senior fitness and improving depressive syndromes in the elderly. MTM contributed to greater improvement in recent memory function in the SMC group than in the non-SMC group.

Abbreviations: AD = Alzheimer disease, AD8 = instrument of ascertainment of dementia 8, CASI = Cognitive Assessment Screening Instrument, CDR = Clinical Dementia Rating, CERAD = Consortium to Establish a Registry for Alzheimer Disease, CESD = Center for Epidemiologic Studies Depression Scale, MCI = mild cognitive impairment, MMSE = Mini-Mental Status Examination, MTM = multiple training modalities, SMC = subjective memory complaints.

Keywords: calligraphy, dementia, meditation, multiple training modalities, subjective memory complaints

1. Introduction

The rapid growth of the elderly population has become a challenging medical problem in developed countries.[1] Dementia is a major public health problem associated with this population, and Alzheimer disease (AD), considered as a chronic neurodegenerative disease that usually starts slowly and worsens over time, accounts for 60% to 70% of dementia cases.[2]

Subjective memory complaints (SMC), also known as significant memory concern, subjective memory impairment, subjective cognitive decline, or subjective cognitive complaints are defined as conditions in healthy individuals with self-reported cognitive complaints in the absence of objective cognitive deficits. SMC is common in older adults.[3] Recent evidence has indicated that SMC is a risk factor for future accelerated cognitive decline and progression to preclinical or clinical state of mild cognitive impairment (MCI) and AD.[4]

As dementia has gradually developed to be an important issue, effective nonpharmacological interventions that entail fewer side effects compared with pharmacological interventions must be developed to lessen the functional impact of AD.[5,6] In Asian countries, Chinese calligraphy handwriting, drawing and meditation are commonly practiced traditional Chinese leisure activities. Citizens used to practice the activity in the public place as a group. It has been observed that some common practiced

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traditional Chinese leisure activities in Asian countries, such as calligraphy, Tai Chi, music therapy and meditation, have had useful effects on cognitive performance.[7–10]

Chinese calligraphy handwriting is often regarded as a unique form of art in Chinese culture. It is the writing of Chinese characters by hand using a soft-tipped brush. Drawing is a form of visual art in which a person uses various drawing instruments to mark paper or another two-dimensional medium. Chinese calligraphic handwriting and drawing are 2 traditional Chinese arts requiring integration of the mind and body with characters (Chinese alphabet) through an interwoven dynamic process. They involve visual perception of the characters, spatial structuring of the characters, cognitive planning, and maneuvering of the brush to follow specific character configurations. They are often practiced to stabilize and improve both the mind and body. Clinical researches revealed calligraphic writing improves attention span, concentration, relaxation, and emotional stabilization.[11,12] Besides, Calligraphy as intellectual leisure activities in later life may delay cognitive deterioration.[7] Physical fitness activities are often practiced in citizens including endurance, or aerobic activities (brisk walking or jogging), strength, or resistance training (lifting weights and using a resistance band), balance exercises (standing on one leg) and flexibility exercises (doing various limbs stretches). Aerobic exercise alone or combined with mind-motor training appeared to benefit cognition in those with or without dementia.[13] Meditation is defined as a practice where an individual uses a technique, such as focusing their mind on a particular object, thought or activity, to achieve a mentally clear and emotionally calm state. Meditation may be used with the aim of reducing stress, anxiety, depression, and pain, and increasing peace, perception, and wellbeing.[10] Besides, meditation had been proved to improve memory and cognitive function in adults with subjective cognitive decline.[14]

As a single training modality of Chinese traditional leisure activity had been proved to improve cognitive function, we think the combined training modalities might have more benefits than single training modality. A pilot study regarding using multiple training modalities (MTM) of Chinese traditional leisure activities concluded these to be useful nonpharmacological interventions to lessen the functional impact of AD,[15] but it is unknown whether these effects will work on SMC. Thus, we designed the MTM for group practice for SMC. Effects of MTM have been focused on the elderly with SMC, those who are supposed to progress into dementia in the future.[15] Whether early nonpharmacological interventions have clinical prevention from dementia progression is an important issue since the social cost of dementia is high, especially for family caregivers. Therefore, the purpose of the current study was to determine the effect of MTM in physical function and neuropsychiatric function in the elderly with SMC.

2. Methods

We conducted a pretest and posttest comparison pilot study to evaluate the effects of multiple training modalities (MTM) on the level of senior fitness and neuropsychiatric function in the elderly with and without subjective memory complaints (SMC).

2.1. Ethical considerations

Patients were voluntary participants in the study, and were informed about the study purpose. A written informed consent, including research title, purpose, explanation of research, and study procedures, was obtained from each eligible participant. Risks and benefits were also explained clearly to the participants. Side effects of MTM are rare. Each participant had the opportunity to ask questions and was free to refuse to answer any question or assessment and withdraw from the study at any time. Participants were protected from discomfort and harm during the study. The study was approved by the Institutional Review Board of Kaohsiung Medical University Chung-Ho Memorial Hospital (KMUHIRB-SV(I)-20170034). This study was conducted in accordance with the *Declaration of Helsinki*.

2.2. Subjects

Participants were recruited from the neurological outpatient department of Kaohsiung Municipal Ta-Tung Hospital located in the southern part of Taiwan. The older adults recruited in our study are volunteers randomly selected from outpatients at the neurology clinic. They are the relatives/partners of the patients visiting the outpatients at the neurology clinic. The inclusion criteria were as follows:

(1) >65 years of age;
(2) health individual without dementia based on the Clinical Dementia Rating (CDR)[16] score of 0 and instrument of ascertainment of dementia 8 (AD8)[17] score of <2;
(3) sufficient four limbs mobility to perform requisite finger-pointing tasks, such as flexing and extending the shoulder, elbow, wrist, and fingers; and
(4) no neurological or musculoskeletal diseases, such as stroke and visual and auditory impairments.

AD8 is a brief tool used to screen dementia that was developed at Washington University in St. Louis and is capable of screening extremely mild dementia in the general population. If the score of AD8 is greater than or equal to 2, the person is considered to be suspected of dementia, including extremely mild dementia.

The exclusion criteria were as follows:

(1) could not finish the 16-week training course, and
(2) could not accept and cooperate with neuropsychiatric tests.

Any participant who missed any sessions of the 16-week training course or pre/posttest was withdrawn from the study. The participants who met the inclusion and exclusion criteria were invited with completion of written informed consent. The participants were divided into 2 groups, SMC and non-SMC, based on the Consortium to Establish a Registry for Alzheimer Disease (CERAD).[18] We adopted questions from CERAD for evaluating SMC. There were four questions regarding the SMC as follows,

(1) Is it not easy for the subject to remember what happened recently?
(2) Does the subject forget the conversation a few days ago or a few hours ago?
(3) Does the subject repeat the same question?
(4) Does the subject forget to turn off the gas stove fire?

The participant was sorted to SMC with presence of one or more of the above problems.

2.3. Multiple training modalities

Multiple training modalities (MTM) comprised three training modalities as follows, physical fitness training, hand-eye

coordination training (Chinese calligraphy handwriting and drawing), and mind fitness training (meditation). All participants attended 3 hours of multiple training modalities (1 hour for each training modality) twice a week over a 16-week period with the order of physical fitness training, hand-eye coordination training, and then mind fitness training. Physical fitness activities include 10 minutes of pre-exercise, 40 minutes of main exercise, and 10 minutes of finishing exercise. The main exercise of physical fitness activities include endurance, or aerobic activities (brisk walking or jogging), strength, or resistance training (lifting weights and using a resistance band), balance exercises (standing on one leg) and flexibility exercises (doing various limbs stretches). The pre-exercise consisted of 5 minutes of walking and 5 minutes of stretching. The finishing exercise included 10 minutes of stretching. During the exercise, the subject wore a heart rate monitor to check whether the exercise intensity has been reached. Besides, during the physical fitness practice session, an experienced physical fitness instructor led the participants, who replicated the motions, postures, and speed of movement. Assistants took precautions against the falling down and exercise injuries of participants. The participants practiced Chinese calligraphy and drawing in a quiet room led by a trained assistant. The Chinese calligraphy character content was chosen randomly from a handbook of calligraphy writing. Calligraphic writing involves "brush handwriting by tracing the strokes and structures of the characters displayed in a mixture of traditional calligraphic styles." The drawing involves "brush painting" by imitating the demonstrative Chinese painting. The instructions for the meditation were to concentrate on a physical point inside the center of chest and keep the body and mind relaxed. This is 1 common type of meditation. If participants could not focus on the heart, they were advised to focus on their heartbeat without counting. Instruction will also try to sense the temperature of the chest and, while trying to focus on the heart, maintain continuous concentration without stress. If participants were wandering thoughts, they were suggested to let go of these and shift their attention back to the heart. They were required to keep their eyes closed and sit on a mat with a crossed leg posture during meditation, but they could change to another comfortable posture if they needed to. After meditation, rest session was practiced. The instructions for the rest session were to keep body and mind relaxed and just to take a rest without falling asleep. They were allowed to pursue any wandering thoughts or flow of consciousness. All participants kept their eyes closed during the rest session and sat with a crossed leg posture the same as for the meditation session.

During the meditation practice sessions, an experienced meditation instructor led the participants, who learnt the skills of postures, mind focusing, and breathing pattern. The MTM was designed for a group practice.

We employed the different specialists in physical fitness activities, Chinese calligraphy handwriting/drawing and meditation from our community. The specialists had enough experiences in tutoring the training modalities by training the participants with oral presentation accompanied with demonstrative in action or video. The specialists trained the participants for 1 hour in each of these three modalities before MTM intervention. The participants had enough practice under specialists' instruction. All participants tested and practiced in a single group. The order of MTM was physical fitness activities, calligraphy or drawing, and then meditation. There was no a rotation between the order of different activities. All participants were advised to maintain their routine activities.

2.4. Measurement outcomes

To evaluate the effects of MTM, each participant underwent a series of senior fitness and neuropsychiatric assessment at the baseline and after 16 weeks of the intervention. The senior fitness test contained 6 items, namely arm curl test, chair stand test, chair sit-and-reach test, back scratch test, 2-minute step test and 8-foot up-and-go test by using criteria of Senior Fitness Test Manual, 2nd Edition by Rikli and Jones.[19] The arm curl test is designed for testing numbers of bicep curls that can be completed in 30 seconds holding a hand weight of 5 lbs (2.27 kg) for women; 8 lbs (3.63 kg) for men. Chair stand test is designed for testing numbers of full stands that can be completed in 30 seconds with arms folded across chest. Chair sit-and-reach test is designed for testing the distance (centimeters) between extended fingers and tip of toe from a sitting position at front of chair with leg extended and hands reaching toward toes. Back scratch test is designed for testing the distance (centimeters) between extended middle fingers with 1 hand reaching over the shoulder and 1 up the middle of the back. Two-minute step test is designed for testing numbers of full steps completed in 2 minutes, raising each knee to a point midway between the patella and iliac crest. Score is number of times right knee reaches the required height. Eight-foot up-and-go test is designed for testing time (seconds) required to get up from a seated position, walk 8 feet (2.44 m), turn, and return to seated position. The higher scores of arm curl test, chair stand test, chair sit-and-reach test and 2-minute step test indicate better senior fitness function. The lower scores of back scratch test, and 8-foot up-and-go test indicate better senior fitness function.

The neuropsychiatric tests contained the Traditional Chinese version Mini-Mental Status Examination (MMSE),[20] the Cognitive Assessment Screening Instrument (CASI),[21] and the Center for Epidemiologic Studies Depression Scale (CESD).[22] The MMSE is a 30-point questionnaire that is used extensively in clinical and research settings to measure cognitive impairment. MMSE contains 8 categories, namely orientation to time (5 points), orientation to place (5 points), registration (3 points), attention and calculation (5 points), recall (3 points), language (2 points), repetition (1 point), and complex commands (6 points). MMSE is the summation of the scores of 8 categories. CASI that comprises 25 items with sum scores range from 0 to 100. CASI has nine subscales that assess remote memory (10 points), recent memory (12 points), attention (8 points), mentality (10 points), orientation (18 points), drawing (10 points), abstract (12 points), category fluency (10 points), and language (10 points).[23] CASI total is the summation of scores of 9 subscales.

The higher scores of MMSE and CASI indicate better cognitive function. The CESD consists of 20 questions asking about various symptoms of depression as they have occurred in the past week, and the majority of the items focus on the affective component of depression. It is scored by the frequency of depressive symptoms during the past week as follows, rarely or none of the time (less than 1 day) (0 point), some or a little of the time (1–2 days) (1 point), occasionally or a moderate amount of time (3–4 days) (2 points) and most or all of the time (5–7 days) (3 points). Possible range of CESD scores is from 0 to 60, with the higher scores indicating the presence of more symptomatology.

All assessments were performed by psychologists. The psychologist was blind to the condition/groups of subjects.

Table 1

The demographic characters of recruited subjects by memory complaints.

	Total (N = 24)	Non-SMC (N = 17)	SMC (N = 7)	*P* value
Age, years (mean ± SD)	68.3 ± 6.4	67.5 ± 7.3	70.3 ± 3.5	.342
Female (N,%)	19.0,79.2%	14.0,82.4%	5.0,71.4%	.608
Education, years (mean ± SD)	11.2 ± 3.3	11.6 ± 3.6	10.6 ± 2.7	.521
Height, cm (mean ± SD)	158.2 ± 6.7	158.4 ± 6.3	157.8 ± 9.3	.876
Weight, kg (mean ± SD)	57.6 ± 11.0	56.6 ± 11.9	61.1 ± 7.1	.487
Waist, cm (mean ± SD)	78.8 ± 8.3	77.0 ± 8.2	85.9 ± 4.0	.054
Hip, cm (mean ± SD)	95.1 ± 7.5	94.6 ± 7.9	97.0 ± 6.0	.577
Neuropsychiatric test				
CASI total, 0–100 (mean ± SD)	90.9 ± 4.6	92.2 ± 3.0	89.5 ± 6.1	.299
MMSE (mean ± SD)	26.6 ± 1.9	27.3 ± 1.6	25.7 ± 2.0	.028*
CESD (mean ± SD)	10.6 ± 8.9	7.3 ± 6.8	14.0 ± 7.7	.022*

CASI = Cognitive Assessment Screening Instrument, CESD = the Center for Epidemiologic Studies Depression Scale, MMSE = Mini-Mental Status Examination, SMC = subjective memory complaints.
* Statistically significant.

Information from a knowledgeable collateral source, usually a spouse or an adult child, was also collected.

2.5. Statistical analysis

Descriptive statistics were used to summarize the sample characteristics and target variables. The frequency distributions were determined for nominal variable (i.e., gender), and mean and standard deviation were calculated for continuous variables (i.e., age, educational level, senior fitness tests and neuropsychiatric assessment scores, namely, CASI, MMSE, CESD). Paired *t* test analysis was used to compare the differences between pre and post MTM in the same group. Independent *t* test analysis was used to compare the difference between SMC and non-SMC groups in terms of senior fitness tests and the neuropsychological assessment scores. $P < .05$ was considered statistically significant. Data were analyzed using SPSS for Windows 17.0 (SPSS Inc., Chicago, IL).

3. Results

There were 30 participants initially, and 24 participants completed the training modalities. There were 12 instructors in total during the intervention.

Six participants had withdrawn from the study due to the poor compliance and health condition.

The demographic characteristics of the participants in the study groups are listed in Table 1. Twenty-four participants were recruited for this study. Seven participants were assigned to the SMC group and 17 participants to the non-SMC group based on the CERAD concerning the SMC. All participants completed the baseline and post-intervention assessments. No significant differences were observed between SMC and non-SMC groups for all the baseline demographic characteristics, except MMSE and CESD. It revealed SMC group had lower MMSE, and higher CESD scores than non-SMC group. The existing difference between 2 groups showed SMC group had lower cognitive function and worse depressive symptoms than non-SMC group in baseline.

The differences between the pre- and post-intervention of MTM were significant in all 6 items of senior fitness tests, as shown in Table 2. There were no significant differences between the pre and post-intervention of MTM in most parts of neuropsychological tests, except CESD (10.6 ± 8.9 vs 4.2 ± 6.3, $P < .001$), as shown in Table 2. The higher the CESD score is, the more severe the depressive symptoms are. In conclusion, the results indicated the improvement of senior fitness and depressive syndromes after MTM intervention.

By memory complaints shown in Table 3, 4 items of senior fitness tests had significant changes in SMC group with MTM intervention, except for chair sit-and-reach test and back scratch test. Meanwhile, 5 items of senior fitness tests had significant changes in the non-SMC group with MTM intervention, except for the back-scratch test. The SMC group had the worse function in total scores of CASI, recent memory, mentality, language subscales in CASI, MMSE, and CESD than did the non-SMC group in the baseline. The SMC group had better function in attention, orientation, drawing, abstract, and fluency subscales in CASI than did the non-SMC group in the baseline. The significant neuropsychological changes in the SMC group are shown in recent memory subscales of CASI (6.3 ± 2.5 vs 9.2 ± 3.8, $P = .021$)

Table 2

Senior fitness tests and neuropsychiatric tests before and after MTM.

N = 24	Pre-MTM	Post-MTM	*P* value
Senior fitness tests			
Arm curl test, no. (mean ± SD)	14.6 ± 5.3	19.6 ± 6.2	<.001*
Chair stand test, no. (mean ± SD)	11.5 ± 3.6	16.0 ± 4.6	<.001*
Chair sit-and-reach test, cm (mean ± SD)	−3.0 ± 12.0	1.4 ± 9.6	.003*
Back scratch test, cm (mean ± SD)	−4.6 ± 12.3	−2.7 ± 12.1	.011*
8-foot up-and-go test, sec. (mean ± SD)	7.4 ± 1.5	6.3 ± 1.1	<.001*
2-miuute step test, no. (mean ± SD)	72.7 ± 15.0	92.6 ± 18.8	<.001*
Neuropsychiatric test			
CASI total, 0–100 (mean ± SD)	90.9 ± 4.6	91.4 ± 4.0	.608
Remote memory, 0–10 (mean ± SD)	10.0 ± 0.0	10.0 ± 0.0	NA
Recent memory, 0–12 (mean ± SD)	8.9 ± 2.7	9.5 ± 2.4	.357
Attention, 0–8 (mean ± SD)	7.6 ± 0.6	7.7 ± 0.6	.495
Mentality, 0–10 (mean ± SD)	8.9 ± 1.4	8.8 ± 1.2	.782
Orientation, 0–18 (mean ± SD)	17.6 ± 1.1	17.8 ± 0.5	.368
Drawing, 0–10 (mean ± SD)	9.7 ± 0.8	9.9 ± 0.5	1.000
Abstract, 0–12 (mean ± SD)	9.6 ± 1.0	9.75 ± 1.0	.607
Fluency, 0–10 (mean ± SD)	8.7 ± 1.2	8.3 ± 1.6	.523
Language, 0–10 (mean ± SD)	9.8 ± 0.3	9.7 ± 0.6	.098
MMSE (mean ± SD)	26.6 ± 1.9	26.7 ± 1.7	.664
CESD (mean ± SD)	10.6 ± 8.9	4.2 ± 6.3	<.001*

CASI = Cognitive Assessment Screening Instrument, CESD = the Center for Epidemiologic Studies Depression Scale, MMSE = Mini-Mental Status Examination, NA = non-analytic, MTM = multiple training modalities, SMC = subjective memory complaints.
* Statistically significant.

Table 3

Senior fitness tests and neuropsychiatric tests before and after MTM between SMC and non-SMC groups.

	SMC (n = 7)			Non-SMC (n = 17)		
	Pre-MTM	Post-MTM	*P* value	Pre-MTM	Post-MTM	*P* value
Senior fitness tests						
Arm curl test, no. (mean ± SD)	11.3 ± 5.3	19.1 ± 6.1	.005*	14.2 ± 4.6	19.7 ± 6.5	<.001*
Chair stand test, no. (mean ± SD)	11.5 ± 2.7	17.5 ± 2.5	.003*	10.6 ± 3.0	15.5 ± 5.0	<.001*
Chair sit-and-reach test, cm (mean ± SD)	−1.9 ± 10.6	3.9 ± 5.6	.162	−4.1 ± 12.0	0.7 ± 10.5	.013*
Back scratch test, cm (mean ± SD)	−9.0 ± 15.6	−5.1 ± 15.3	.117	−3.3 ± 11.4	−2.0 ± 11.6	.063
8-foot up-and-go test, sec.(mean ± SD)	7.3 ± 0.5	5.9 ± 0.6	<.001*	7.3 ± 1.4	6.5 ± 1.2	.013*
2-miuute step test, no. (mean ± SD)	69.8 ± 7.4	93.3 ± 9.8	.007*	68.7 ± 12.2	92.4 ± 21.2	<.001*
Neuropsychiatric tests						
CASI total, 0–100 (mean ± SD)	89.5 ± 6.1	92.7 ± 5.0	.088	92.2 ± 3.0	91.3 ± 3.5	.414
Remote memory, 0–10 (mean ± SD)	10.0 ± 0.0	10.0 ± 0.0	NA	10.0 ± 0.0	10.0 ± 0.0	NA
Recent memory, 0–12 (mean ± SD)	6.3 ± 2.5	9.2 ± 3.8	.021*	10.4 ± 1.1	9.9 ± 1.8	.379
Attention, 0–8 (mean ± SD)	7.7 ± 0.5	7.8 ± 0.4	.363	7.6 ± 0.7	7.7 ± 0.7	.723
Mentality, 0–10 (mean ± SD)	8.7 ± 1.6	8.7 ± 1.5	>.999	9.1 ± 1.3	8.9 ± 1.2	.713
Orientation, 0–18 (mean ± SD)	17.8 ± 0.4	17.8 ± 0.4	NA	17.4 ± 1.4	17.8 ± 0.6	.376
Drawing, 0–10 (mean ± SD)	10.0 ± 0.0	10.0 ± 0.0	NA	9.8 ± 0.6	9.8 ± 0.6	>.999
Abstract, 0–12 (mean ± SD)	10.3 ± 1.2	10.2 ± 0.8	.611	9.3 ± 0.6	9.5 ± 1.0	.389
Fluency, 0–10 (mean ± SD)	8.8 ± 1.0	9.2 ± 0.4	.530	8.7 ± 1.3	8.1 ± 1.7	.339
Language, 0–10 (mean ± SD)	9.8 ± 0.3	9.8 ± 0.3	NA	9.9 ± 0.2	9.6 ± 0.7	.098
MMSE (mean ± SD)	25.7 ± 2.0	26.2 ± 1.9	.456	27.3 ± 1.6	26.8 ± 1.7	.409
CESD (mean ± SD)	14.0 ± 7.7	5.7 ± 5.3	.010*	7.3 ± 6.8	3.6 ± 7.3	.004*

CASI = Cognitive Assessment Screening Instrument, CESD = the Center for Epidemiologic Studies Depression Scale, MMSE = Mini-Mental Status Examination, MTM = multiple training modalities, NA = non-analytic, SMC = subjective memory complaints.

* Statistically significant.

and CESD (14.0 ± 7.7 vs 5.7 ± 5.3, $P = .010$), whereas in the non-SMC group, significant change between pre- and post-interventions was only shown in CESD (7.3 ± 6.8 vs 3.6 ± 7.3, $P = .004$). These results indicated the improvement of recent memory in the SMC group and depressive syndromes in both groups after the MTM intervention. We have found that MTM intervention contributed to greater improvement in recent memory in the SMC group than in the non-SMC group.

We demonstrated the changes of scores (the differences between pre-MTM and post-MTM) after MTM intervention between 2 groups in Table 4. The result revealed significant greater improving of 8-foot up-and-go test in senior fitness tests,

Table 4

Changes of scores (the differences between pre-MTM and post-MTM) with MTM intervention between non-SMC and SMC groups.

	Non-SMC (N = 17)	SMC (N = 7)	*P* value
Senior fitness tests			
Arm curl test, no. (mean ± SD)	5.5 ± 5.5	7.8 ± 5.7	.366
Chair stand test, no. (mean ± SD)	4.9 ± 4.1	6.0 ± 2.6	.521
Chair sit-and-reach test, cm (mean ± SD)	4.8 ± 11.2	5.8 ± 7.1	.830
Back scratch test, cm (mean ± SD)	1.3 ± 11.5	3.9 ± 15.4	.653
8-foot up-and-go test, sec. (mean ± SD)	−0.8 ± 1.0	−1.5 ± 0.1	.038*
2-miuute step test, no. (mean ± SD)	23.7 ± 11.5	23.5 ± 7.1	.976
Neuropsychiatric test			
CASI total, 0–100 (mean ± SD)	−0.9 ± 3.5	3.2 ± 3.7	.037*
Remote memory, 0–10 (mean ± SD)	NA	NA	NA
Recent memory, 0–12 (mean ± SD)	−0.6 ± 2.1	2.9 ± 2.1	.005*
Attention, 0–8 (mean ± SD)	0.1 ± 0.8	0.2 ± 0.4	.814
Mentality, 0–10 (mean ± SD)	−0.2 ± 1.5	0.0 ± 2.1	.849
Orientation, 0–18 (mean ± SD)	0.4 ± 1.6	0.0 ± 0.0	.376
Drawing, 0–10 (mean ± SD)	0.0 ± 0.9	0.0 ± 0.0	1.000
Abstract, 0–12 (mean ± SD)	0.3 ± 1.0	−0.2 ± 0.8	.370
Fluency, 0–10 (mean ± SD)	−0.6 ± 2.0	0.3 ± 1.2	.325
Language, 0–10 (mean ± SD)	−0.3 ± 0.6	0.0 ± 0.0	.098
MMSE (mean ± SD)	−0.6 ± 2.4	0.5 ± 1.5	.324
CESD (mean ± SD)	−3.7 ± 3.5	−8.3 ± 5.1	.035*

CASI = Cognitive Assessment Screening Instrument, CESD = the Center for Epidemiologic Studies Depression Scale, MMSE = Mini-Mental Status Examination, MTM = multiple training modalities, NA = non-analytic, SMC = subjective memory complaints.

* Statistically significant.

CASI total, recent memory subscale of CASI, and CESD in SMC group than non-SMC group.

4. Discussion

We have found multiple training modalities (MTM) had more benefit in subjective memory complaints (SMC) in improving recent memory. Besides, MTM improved depressive syndromes and most parts of senior physical fitness tests in the elderly.

The baseline demographic characters including age, gender, education, and physical characteristics between SMC and non-SMC groups showed no significant difference. It ruled out the possible causes having impact in senior fitness performance and neuropsychiatric assessment. However, the comparison of cognitive function between 2 groups revealed SMC group had lower MMSE and higher CESD scores than non-SMC group. The existing differences indicated SMC group had lower cognitive function and worse depressive symptoms than non-SMC group. The finding is consistent with the previous study.[24,25] Evidences showed that a higher number of SMC in well cognitively functioning individuals was most closely related to depressive symptomatology, while some specific complaints reflected lower memory performance and should be considered when screening for people at risk of cognitive decline.[26]

As clinical trials for the treatment of dementia have consistently produced disappointing results, we decided to focus more attention on developing strategies to prevent and treat cognitive decline early in life in preclinical or asymptomatic stages of dementia. Studies on nonpharmacological interventions for SMC are ongoing, but the benefits of treatment are inconclusive, which are related to randomized, controlled trials, long-term effects, limited case numbers, and differences of protocols. Multiple-modality exercise and mind-motor training had greater improvements in global cognitive functioning and memory in older adults with SMC.[27] However, some studies showed equivocal impact.[28] Our study revealed MTM contributed to benefits in recent memory in SMC, depressive syndromes, and physical fitness in the elderly. We propose explanations and clinical implications for the effect.

First, the practice in our MTM contained physical fitness training, hand-eye coordination training (Chinese calligraphy handwriting and drawing), and mind fitness training (meditation). MTM was designed for group practice, which is a socialization skill. It has been proven that socialization skills with physical and intellectual activities enhance the effects of nonpharmacological interventions in dementia.[29] Second, aerobic exercise training enhanced cardiovascular fitness. Calligraphy and meditation program had therapeutic effect on hypertension.[30,31] These programs controlled cardiovascular risk factors and prevented vascular dementia.[32] Third, psycho-affective states are potentially modifiable risk factors for dementia, including depressive symptoms, stress, neuroticism, anxiety and sleep disturbance.[33] Meditation is useful in reducing stress, anxiety, depression, and pain[34,35] and control the psycho-affective risks for dementia. The MTM interventions in our study overall had benefits in improving depressive symptoms in the elderly with or without SMC, and also enhanced the effect of MTM in dementia prevention. Fourth, training programs increased memory-related cerebral volume. Aerobic exercise showed growth in volume in anterior hippocampal regions and meditation increased brain structure and function, especially in frontal, limbic structures, and insula.[35,36] Fifth, meditation is associated with increased brain network integration, reflected in higher alpha frequency bandwidth in electroencephalography.[37] Sixth, SMC might be considered as a very early stage of dementia. In this stage, the signs and symptoms of the dementia may be subtle and only recent memory impairment was apparent. The scores of MMSE were within normal range in MCI and SMC. We suggest the recent memory subscale of CASI is a favorable indicator to evaluate cognitive functional changes in MCI and SMC. We highlight early intervention as a strategy to prevent SMC from progressing to mild cognitive impairment (MCI) and dementia is crucial.

There is indeed an effective finding for participants with SMC to improve their recent memories after the intervention. In the early stage of dementia, or in mild cognitive impairment, the most prominent early symptom is recent memory difficulty. The person begins to show symptoms noticeable to the people around them and symptoms interfere with daily activities. The person may begin to have difficulty with more complicated chores and tasks around the house or at work. The person can usually still take care of him or herself but may forget things like taking pills or doing laundry and may need prompting or reminders. Thus, recent memory impairment could relate to everyday functionality. By improving the recent memory with MTM, the elder with SMC enhanced more everyday functionality.

The improving of CESD in our study suggested MTM had effects in improving depressive symptoms in the elderly. Studies revealed depressive symptoms can predict incident dementia.[38] In addition, depressive symptoms shape the association between anxiety trait and dementia.[39] Depression is related to reduction of overall function and daily living. As improvements of depressive symptoms finding in our study, we think the MTM will have contribution in dementia prevention in the elderly with and without SMC.

Although the finding of the study was encouraging, there were some limitations. First, the study had limited sample size. Second, demographic data (e.g., family history and socioeconomic status) and certain medical information (e.g., comorbidity and co-medication), which could influence the results, were unavailable. Third, for a lot of the assessments given, ceiling effects likely prevented any effect of the intervention from being observed. Fourth, some variables, such as time of the day (hour) when the measurements were taken, or the participants' tiredness (number of hours of sleep the night before) on the particular day of testing, could have an impact on the study result. Fifth, a control group would be required to check if the outcomes of memory, physical fitness and depressive syndromes were subject to variation with no action taken by the participants.

5. Conclusions

Our study showed MTM had effects in enhancing senior fitness and improving depressive syndromes in the elderly. MTM contributed to improvement in most of senior fitness and depressive syndromes in both SMC group and non-SMC group. Besides, MTM contributed to greater improvement in recent memory function in the SMC group than in the non-SMC group. As far as improving difference is concerned, SMC group had greater improving difference in 8-foot up-and-go test, CASI total scores, recent memory function, and depressive syndromes than non-SMC group after MTM intervention. A comprehensive large-scale randomized clinical trial is necessary to address these

limitations. Future studies focusing on the nonpharmacological and preventive interventions in SMC are encouraged.

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References

[1] Nowrangi MA, Rao V, Lyketsos CG. Epidemiology, assessment, and treatment of dementia. Psychiatr Clin North Am 2011;34:275–94.
[2] Burns A, Iliffe S. Alzheimer's disease. BMJ 2009;338:b158.
[3] Jenkins A, Bayer A, Tree J, et al. Self-reported memory complaints: implications from a longitudinal cohort with autopsies. Neurology 2015;84:2384.
[4] Jessen F, Wolfsgruber S, Wiese B, et al. AD dementia risk in late MCI, in early MCI, and in subjective memory impairment. Alzheimers Dement 2014;10:76–83.
[5] Marmeleira J. An examination of the mechanisms underlying the effects of physical activity on brain and cognition. Eur Rev Aging Phys Activity 2013;10:83–94.
[6] Hogan M. Physical and cognitive activity and exercise for older adults: a review. Int J Aging Hum Dev 2005;60:95–126.
[7] Kwok TC, Bai X, Kao HS, et al. Cognitive effects of calligraphy therapy for older people: a randomized controlled trial in Hong Kong. ClinInterv Aging 2011;6:269–73.
[8] Wayne PM, Walsh JN, Taylor-Piliae RE, et al. Effect of tai chi on cognitive performance in older adults: systematic review and meta-analysis. J Am Geriatr Soc 2014;62:25–39.
[9] Tai SY, Wang LC, Yang YH. Effect of music intervention on the cognitive and depression status of senior apartment residents in Taiwan. Neuropsychiatr Dis Treat 2015;11:1449–54.
[10] Hodgins HS, Adair KC. Attentional processes and meditation. Conscious Cogn 2010;19:872–8.
[11] Yang XL, Li HH, Hong MH, et al. The effects of Chinese calligraphy handwriting and relaxation training in Chinese nasopharyngeal carcinoma patients: a randomized controlled trial. Int J Nurs Stud 2010;47:550–9.
[12] Kao HSR, Zhu L, Chao AA, et al. Calligraphy and meditation for stress reduction: an experimental comparison. Psychol Res Behav Manag 2014;7:47–52.
[13] Erickson KI, Kramer AF. Aerobic exercise effects on cognitive and neural plasticity in older adults. Br J Sports Med 2009;43:22–4.
[14] Innes KE, Selfe TK, Khalsa DS, et al. Meditation and music improve memory and cognitive function in adults with subjective cognitive decline: a pilot randomized controlled trial. J Alzheimers Dis 2017;56:899–916.
[15] Tai SY, Hsu CL, Huang SW, et al. Effects of multiple training modalities in patients with Alzheimer's disease: a pilot study. Neuropsychiatr Dis Treat 2016;12:2843–9.
[16] Morris JC. The clinical dementia rating (CDR): current version and scoring rules. Neurology 1993;43:2412–4.
[17] Yang YH, Galvin JE, Morris JC, et al. Application of AD8 questionnaire to screen very mild dementia in Taiwanese. Am J Alzheimers Dis Other Demen 2011;26:134–8.
[18] Morris JC, Heyman A, Mohs RC, et al. The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part 1. Clinical and neuropsychological assessment of Alzheimer's disease. Neurology 1989;39:1159–65.
[19] Rikli RE1, Jones CJ. Development and validation of criterion-referenced clinically relevant fitness standards for maintaining physical independence in later years. Gerontologist 2013;53:255–67.
[20] Folstein MF, Folstein SE, McHugh PR. Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189–98.
[21] Lin KN, Wang PN, Liu CY, et al. Cutoff scores of the cognitive abilities screening instrument, Chinese version in screening of dementia. Dement Geriatr Cogn Disord 2002;14:176–82.
[22] Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Meas 1977;1:385–401.
[23] Teng EL, Hasegawa K, Homma A, et al. The cognitive abilities screening instrument (CASI): a practical test for cross-cultural epidemiological studies of dementia. Int Psychogeriatr 1994;6:45–58.
[24] Loprinzi PD. Interrelationships between depression, exercise and subjective memory complaints. Rev Neurol (Paris) 2019;175:319–23.
[25] Choe YM, Byun MS, Lee JH, et al. Subjective memory complaint as a useful tool for the early detection of Alzheimer's disease. Neuropsychiatr Dis Treat 2018;14:2451–60.
[26] Markova H, Andel R, Stepankova H, et al. Subjective cognitive complaints in cognitively healthy older adults and their relationship to cognitive performance and depressive symptoms. J Alzheimers Dis 2017;59:871–81.
[27] Boa Sorte Silva NC, Gill DP, Owen AM, et al. Cognitive changes following multiple-modality exercise and mind-motor training in older adults with subjective cognitive complaints: The M4 study. PLoS One 2018;13:e0196356.
[28] Smith PJ, Blumenthal JA, Hoffman BM, et al. Aerobic exercise and neurocognitive performance: a meta-analytic review of randomized controlled trials. Psychosom Med 2010;72:239–52.
[29] Ruthirakuhan M, Luedke AC, Tam A, et al. Use of physical and intellectual activities and socialization in the management of cognitive decline of aging and in dementia: a review. J Aging Res 2012;2012: 384875.
[30] Guo NF, Kao HSR, Liu X. Calligraphy, hypertension and the type-A personality. Ann Behav Med 2001;23:S159.
[31] Nidich SI, Rainforth MV, Haaga DA, et al. A randomized controlled trial on effects of the Transcendental Meditation program on blood pressure, psychological distress, and coping in young adults. Am J Hypertens 2009;22:1326–31.
[32] Yang YH, Fuh JL, Mok VC. Vascular contribution to cognition in stroke and Alzheimer's disease. Brain Sci Adv 2018;4:39–48.
[33] Chételat G, Lutz A, Arenaza-Urquijo E, et al. Why could meditation practice help promote mental health and well-being in aging? Alzheimers Res Ther 2018;10:57.
[34] Goyal M, Singh S, Sibinga EM, et al. Meditation programs for psychological stress and well-being: a systematic review and meta-analysis. JAMA Intern Med 2014;174:357–68.
[35] Fox KCR, Nijeboer S, Dixon ML, et al. Is meditation associated with altered brain structure? A systematic review and meta-analysis of morphometric neuroimaging in meditation practitioners. Neurosci Biobehav Rev 2014;43:48–73.
[36] Fox KCR, Dixon ML, Nijeboer S, et al. Functional neuroanatomy of meditation: a review and meta-analysis of 78 functional neuroimaging investigations. Neurosci Biobehav Rev 2016;65:208–28.
[37] van Lutterveld R, van Dellen E, Pal P, et al. Meditation is associated with increased brain network integration. Neuroimage 2017;158:18–25.
[38] Ezzati A, Katz MJ, Derby CA, et al. Depressive symptoms predict incident dementia in a community sample of older adults: results from the Einstein Aging Study. J Geriatr Psychiatry Neurol 2019;Jan 10: doi: 10.1177/0891988718824036. [Epub ahead of print].
[39] Mortamais M, Abdennour M, Bergua V, et al. Anxiety and 10-year risk of incident dementia-an association shaped by depressive symptoms: results of the prospective three-city study. Front Neurosci 2018;12:248.