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Effects of a Modified Tai Chi Program on Older People with Mild Dementia: A Randomized Controlled Trial

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Abstract.
Background: Tai Chi exercise is a non-pharmacological therapy that has received increased attention in recent years. A Tai Chi program has been specifically modified for older people with cognitive impairments by the research team.
Objective: We aim to assess the effects of this Tai Chi program on mild dementia.
Methods: Eighty older people with mild dementia were recruited and randomly assigned to a Tai Chi group or a control group. The Tai Chi group practiced the Tai Chi program three times a week for 10 months, while the control group continued receiving routine treatments. All participants were assessed for cognitive function, behavior/mood, and activities of daily living at baseline, 5 months, and 10 months.
Results: The Tai Chi group performed better than the control group. Repeated measures ANOVA revealed a significant group × time interaction in the Montreal Cognitive Assessment (MoCA). Further analysis of sub-items of the MoCA showed a significant time effect in naming and abstraction. It was statistically significant in both main effect of time and group × time interaction in the Neuropsychiatric Inventory (NPI) and Geriatric Depression Scale (GDS). Paired sample *t* test showed the Tai Chi group scored lower at 5 and 10 months in the NPI and at 10 months in the GDS compared with baseline. The Tai Chi group scored lower than the control group at 10 months in the NPI and GDS.
Conclusion: The results suggest this Tai Chi program may help improve cognitive function and mental well-being for older adults with mild dementia.

Keywords: Behavioral and psychological symptoms, cognitive function, dementia, depressive mood, Tai Chi

INTRODUCTION

Dementia is a broad category of brain diseases that describes a group of symptoms associated with cognitive impairments severe enough to affect a person's activities of daily living (ADL). Other clinical symptoms such as emotional problems, and behavioral and

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psychological symptoms are common [1]. Dementia is one of the most common causes of disability among older adults and places a significant amount of stress on their caregivers [2, 3]. With an increase in the older population, it is apparent that dementia has become an urgent public health problem [4] in the world and created a heavy economic burden on societies and families [5]. Effective strategies for maintaining quality of life in older people with dementia are needed. However, there is no cure for dementia. Current medical treatments for symptomatic control such as cholinesterase inhibitors and antipsychotics show limited efficacy. Meanwhile, they usually have adverse effects, including gastrointestinal reaction, dizziness, and decreased heart rate [6–8]. New medication development for Alzheimer's disease (AD), the leading cause of dementia, still faces tremendous difficulties and challenges, including complex biological mechanisms and a lack of reliable biomarkers [9]. Thus, there is a growing interest in ongoing development of non-pharmacological interventions for dementia.

Studies show that physical exercise interventions are effective in maintaining or improving cognitive function in older adults with exercise being one of the most well-established interventions for improving physical and mental health [10–12]. Moreover, a meta-analysis concluded that exercise may enhance the ADL in people with dementia based on 6 randomized controlled trials (RCTs) with 289 participants [13]. However, further research is required in regards to the suitability of physical exercises for people with dementia as many of them are at risk of falls [14, 15].

Tai Chi is a traditional Chinese martial art; it consists of gentle and slow movements. Tai Chi is a mind-body exercise and has positive effects on balance, fall prevention, alleviating depression, and improving cognitive function [16–22]. A meta-analysis indicates that Tai Chi can improve cognitive function in older adults, particularly in the domain of executive ability [23]. Neuroimaging studies show that Tai Chi can increase brain volume [24] and modulate the resting state functional connectivity of the cognitive control network [25–27]. Moreover, a new Tai Chi exercise named "Dual-task Tai Chi", which combined Tai Chi exercise with cognitive tasks, was reported to be effective in improving executive function of community-dwelling older adults [28]. A virtual reality based Tai Chi exercise program was proved beneficial for the ability of abstract thinking and judgment in older adults with cognitive impairment [29]. These results support the potential benefits of Tai Chi exercise on cognition. However, the evidence of practicing Tai Chi in older people to improve cognitive functions is still insufficient.

The Tai Chi program in this study has been specifically designed for older people with cognitive impairment by our research team [30]. The feasibility and safety of this Tai Chi program has been preliminarily proven in a small sample of 5 older persons with mild dementia [30]. We therefore conducted an RCT on a larger scale to assess the effects of this Tai Chi exercise on people with mild dementia.

METHODS

Details of this Tai Chi program and method in this study have been published previously [30]. This RCT (ChiCTR-INR-16009872) was conducted from March 2015 to September 2018. Participants were enrolled by dementia specialists. Eighty participants were recruited and randomized to either a Tai Chi group or a control group. The randomization was carried out by an independent research assistant who was not involved in the enrollment, assessment, or intervention of the participants. Random number sequences were generated using SAS software. Sealed envelopes with the serial number outside and group number inside were produced and kept in a locked drawer, which was inaccessible to all the researchers. The envelopes were opened sequentially by the independent research assistant after baseline assessments and participants were assigned to the intervention group or control group at a ratio of 1:1 according to the group number printed inside the envelopes. The ethical review committee of the Beijing Geriatric Hospital approved the study protocol.

Participants

Participants were recruited from the Center for Cognitive Disorders of Beijing Geriatric Hospital and three long-term care facilities nearby. Written informed consent was obtained from all participants or their guardians.

Inclusion criteria were: 1) age $\geq$ 60 years; 2) diagnosed with dementia based on the diagnostic criteria of the Diagnostic and Statistical Manual of Mental Disorders, 4th edition; and 3) a Clinical Dementia Rating score $<$2.

Exclusion criteria were: 1) severe visual or auditory impairment; 2) serious medical conditions in major organs (such as heart, lung, kidney, and liver); 3) illnesses affecting mobility; 4) unable to accept

assessments or interventions that were required in this study for any reasons.

Intervention

In addition to their routine treatment and personalized daily care, participants in the intervention group carried out this Tai Chi program three times a week for 20 minutes each time under the guidance of the professional therapists where the participants resided. The intervention was practiced in groups with one therapist to five to eight participants. The control group received only routine treatments and personalized daily care. The duration of this study was 10 months. Demographic information of all participants included age, gender, and educational level. The baseline variables contained medical co-morbidity (severity of illness quantified with the Charlson Comorbidity Index (CCI)) and the medicines such as cholinesterase inhibitors and atypical antipsychotics. The reasons for withdrawals from the study after randomization of all participants were collected.

Outcome assessment

Outcomes were measured at the baseline, 5 months, and 10 months after commencement of the Tai Chi program. The Mini-Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) were used to measure global cognitive function. The WHO-University of California Los Angeles-Auditory Verbal Learning test (WHO-UCLA-AVLT) was used to assess immediate recall ability and delayed recall ability. The Trail Making Test (TMT) was used to test visual attention and task switching. The Geriatric Depression Scale (GDS) was used to assess the depressive mood. The Neuropsychiatric Inventory (NPI) was used to assess behavioral and psychological symptoms. Performance in ADL was measured by the Barthel Index (BI). The incidence of falls was collected to assess the safety of the Tai Chi program. Complaints related to the intervention were documented and treated when necessary, including fatigue, pain, and dizziness.

Data analysis

Demographic characteristics and baseline variables were analyzed using independent t tests for continuous variables and Chi-square tests for categorical variables. The variations of scores of psychometric assessments over time between two groups were examined using repeated measures analysis of variance (ANOVA). If repeated measures ANOVA revealed a significant main effect of time or group, *post hoc* paired sample t test would be used to compare the scores of each group at different time points, and independent t tests would be used to compare the scores of the two groups at each time point. Repeated measures ANOVA revealed a significant main effect of time or group or group $\times$ time interaction on the MoCA and NPI, a further analysis on their sub-items was undertaken. As sub-score of the MoCA and the NPI is ordinal data, the generalized estimating equation (GEE) analyses [31] was performed to determine whether the intervention effects differed over time and between the groups in the sub-items of these assessments.

The association between intervention and incidence of falls were analyzed using Chi-square test. All analyses were performed using SPSS, version 16.0 (SPSS Inc, Chicago, IL). Two-sided probability values of $p < 0.05$ were considered statistically significant.

RESULTS

A total of 80 participants met the inclusion and exclusion criteria and were recruited. The recruitment procedure is shown in Fig. 1. All participants were allocated randomly to the Tai Chi group ($n = 40$) or the control group ($n = 40$). Six participants withdrew from the study during the study period (including three with new onset of medical problems unrelated to dementia, two with changing residence, and one unwilling to continue), of which four were from the Tai Chi group and two were from the control group. The six participants who withdrew from the study before the first follow-up visit were not included in the final analysis. We compared the characteristics of the baseline information of the 6 dropout participants with the 74 participants who completed the study. There are no significant differences in age (82.1 ± 6.4, versus 81.9 ± 6.0, $p > 0.05$), gender (male, 2, 33.3% versus 24, 32.4%, $p > 0.05$), educational level (months, 71.0 ± 15.8 versus 72.4 ± 16.7, $p > 0.05$), CCI scores (1.55 ± 0.87 versus 1.63 ± 0.94, $p > 0.05$), MMSE scores (21.08 ± 6.11 versus 20.75 ± 5.86, $p > 0.05$), MoCA scores (13.25 ± 5.17 versus 13.20 ± 4.95, $p > 0.05$), WHO-UCLA-AVLT scores of immediate recall (8.82 ± 3.98 versus 8.74 ± 4.17, $p > 0.05$), WHO-UCLA-AVLT

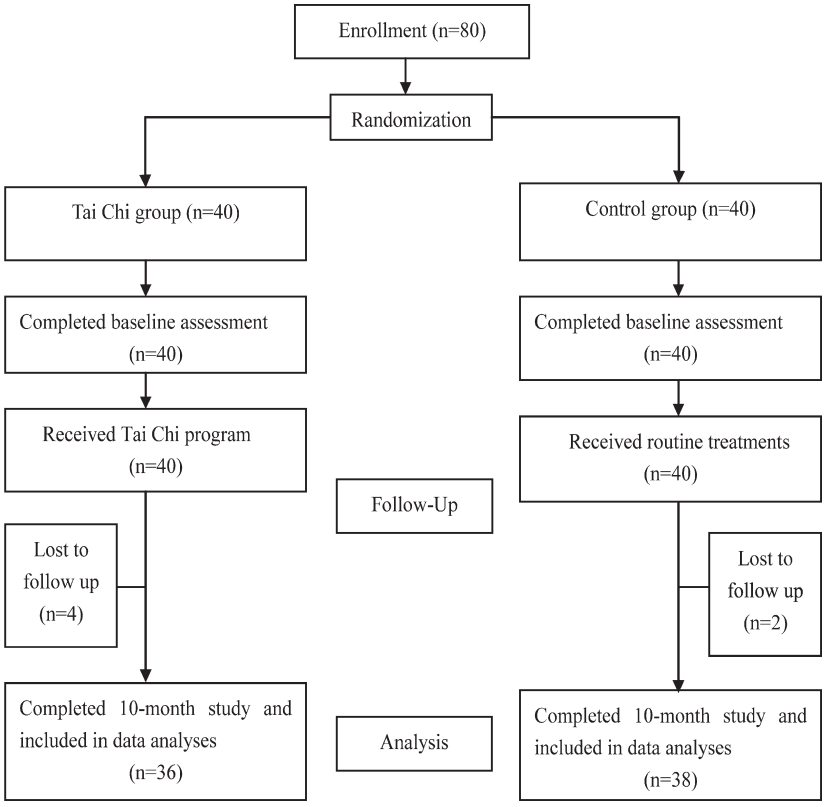

Fig. 1. Flow of participants through the study.

scores of delayed recall (7.61 ± 3.79 versus 7.50 ± 3.58, $p > 0.05$), TMT scores (43.23 ± 15.44 versus 43.86 ± 15.24, $p > 0.05$), GDS scores (5.00 ± 2.41 versus 4.89 ± 2.25, $p > 0.05$), NPI scores (12.26 ± 4.99 versus 12.19 ± 4.74, $p > 0.05$), and BI scores (92.18 ± 10.54 versus 93.04 ± 11.70, $p > 0.05$). Baseline characteristics and measures of all 80 individuals who participated in the study are presented in Table 1. The mean age of the participants was 81.9 years, and 67.5% of them were female. The average MMSE score of them was 20.76. There were no significant differences between the two groups in any demographic variables (Table 1).

Cognitive and ADL measures

The Mauchly's Test of Sphericity was used to test the variances of the differences between repeated measurements at different time points. The results of Mauchly's Test of Sphericity were not statistically significant ($p > 0.05$) when analyzing the MMSE, MoCA, WHO-UCLA-AVLT, TMT, or BI scores. Therefore, we could not reject the Sphericity assumption that the variances of the differences were equal. The data were then processed by one-way repeated measures ANOVA analysis.

For the MoCA, repeated measures ANOVA revealed no effects for time or group, but a significant group × time interaction ($F = 5.71$, $p = 0.01$), indicating that there was an increasing trend in the intervention group in the MoCA test. No effect on group, time, or group × time interaction was found in the other measures, including the MMSE, WHO-UCLA-AVLT, TMT, and BI scores (Table 2, Fig. 2).

Results of the GEE analysis on the MoCA's subscores showed that the Tai Chi group improved in the scores of naming and abstraction over the 10-month study period. The time effects in these two sub-items of MoCA (naming and abstraction) were statistically significant ($Wald\ \chi^2 = 13.83, p < 0.01$; Wald $\chi^2 = 9.21$, $p = 0.01$). However, outcomes of other sub-items (visuospatial/executive, attention, language, delayed recall, orientation) were not statistically significant in the group or time effects ($p > 0.05$).

Table 1
Comparison of demographic characteristics, main medicines received, and baseline assessments between the two groups with all participants

Characteristic	Tai Chi group ($n=40$)	Control group ($n=40$)
Age (y)	81.9 ± 6.0	81.9 ± 6.1
Sex (n, %)		
Male	12 (30.0)	14 (35.0)
Female	28 (70.0)	26 (65.0)
Educational level (mo)	71.3 ± 15.3	73.2 ± 17.6
Main medicines (n, %)		
Donepezil	18 (45.0)	18 (45.0)
Rivastigmine	13 (32.5)	14 (35.0)
Atypical antipsychotics	2 (5.0)	2 (5.0)
CCI scores	1.62 ± 0.94	1.61 ± 0.93
MMSE scores	20.73 ± 6.57	20.80 ± 5.16
MoCA scores	13.08 ± 5.35	13.32 ± 4.56
WHO-UCLA-AVLT scores		
Immediate recall	8.64 ± 4.36	8.84 ± 3.98
Delayed recall	7.49 ± 3.96	7.53 ± 3.24
TMT scores	43.55 ± 14.48	44.17 ± 16.00
GDS scores	4.86 ± 2.55	4.94 ± 1.92
NPI scores	12.53 ± 4.83	11.83 ± 4.65
BI scores	93.24 ± 10.37	92.85 ± 12.01

Means ± standard deviations are presented unless specified otherwise. Independent *t*-tests for all variables except gender and main medicines (Chi-square test). CCI, Charlson Comorbidity Index; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; WHO-UCLA-AVLT, WHO-University of California Los Angeles-Auditory Verbal Learning test; TMT, Trail Making Test; NPI, Neuropsychiatric Inventory; GDS, Geriatric Depression Scale; BI, Barthel Index.

Mood, behavioral, and psychological symptoms measures

When analyzing the NPI and GDS scores, the results of Mauchly's Test of Sphericity were not statistically significant ($p>0.05$) as well. Then the data analysis was performed with one-way repeated measures ANOVA.

For the NPI, repeated measures ANOVA revealed both a significant main effect of time ($F=5.46$, $p=0.01$) and a significant group × time interaction ($F=4.99$, $p=0.02$). *Post hoc* paired sample *t* test showed that the Tai Chi group scored lower at 5 and 10 months compared with baseline (8.01 ± 3.77, 6.35 ± 4.80, versus 12.53 ± 4.93, *Cohen's d* = 1.03, 1.36, $p<0.05$). Moreover, the Tai Chi group scored lower than the control group at 10 months (6.35 ± 4.80 versus 10.19 ± 5.73, Cohen's $d=0.72$, $p<0.05$). The 10 items of NPI were classified into three syndromes: 1) affective impairments (apathy or indifference, depression or dysphoria, and anxiety); 2) psychotic symptoms (delusion and hallucination); and 3) lack of control disorders (agitation, elation or euphoria, disinhibition, irritability or lability, motor disturbance) [32]. The GEE analyses of these syndromes showed that the scores of affective impairments in the Tai Chi group decreased over the 10-month study period. Both the group effects and the time effects in the syndrome of affective impairments were statistically significant (Wald $\chi^2=10.54$, $p<0.01$; Wald $\chi^2=11.26$, $p<0.01$).

For the GDS, repeated measures ANOVA suggest both a significant main effect of time ($F=4.51$, $p=0.01$) and a significant group × time interaction

Table 2
Outcome measurements between the two groups (baseline, 5-month and 10-month) and within individual groups (mean ± standard deviations)

Outcome Variable	Tai Chi group ($n=36$)	Control group ($n=38$)
WHO-UCLA-AVLT scores		
baseline		
Immediate recall	8.63 ± 4.35	8.84 ± 3.98
Delayed recall	7.47 ± 3.90	7.53 ± 3.26
5-month		
Immediate recall	8.77 ± 4.63	8.80 ± 3.19
Delayed recall	7.88 ± 4.21	7.45 ± 3.86
10-month		
Immediate recall	8.80 ± 4.92	8.81 ± 3.54
Delayed recall	7.91 ± 3.05	7.52 ± 3.17
TMT scores		
baseline	43.57 ± 14.52	44.14 ± 15.96
5-month	42.90 ± 14.11	44.60 ± 13.62
10-month	42.50 ± 15.06	44.50 ± 10.78
MMSE scores		
baseline	20.72 ± 6.56	20.79 ± 5.16
5-month	21.30 ± 6.20	20.24 ± 5.41
10-month	21.17 ± 5.47	19.47 ± 5.73
MoCA scores		
baseline	13.06 ± 5.34	13.32 ± 4.56
5-month	13.94 ± 5.88	12.37 ± 5.52
10-month	14.83 ± 5.71	12.16 ± 4.72
GDS scores		
baseline	4.83 ± 2.57	4.95 ± 1.93
5-month	4.44 ± 2.83	5.84 ± 3.25
10-month	2.44 ± 1.04[a,b]	5.37 ± 1.89
NPI scores		
baseline	12.53 ± 4.93	11.83 ± 4.55
5-month	8.01 ± 3.77[a]	10.46 ± 4.62
10-month	6.35 ± 4.80[a,b]	10.19 ± 5.73
BI scores		
baseline	93.24 ± 10.36	92.85 ± 13.02
5-month	94.74 ± 12.91	93.28 ± 11.94
10-month	94.12 ± 11.58	92.55 ± 13.29

[a]Denotes a difference significant at $p<0.05$ when compared with pretest values; [b]denotes a difference significant at $p<0.05$ when compared with the control group. WHO-UCLA-AVLT, WHO-University of California Los Angeles-Auditory Verbal Learning test; TMT, Trail Making Test; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; GDS, Geriatric Depression Scale; NPI, Neuropsychiatric Inventory; BI, Barthel Index.

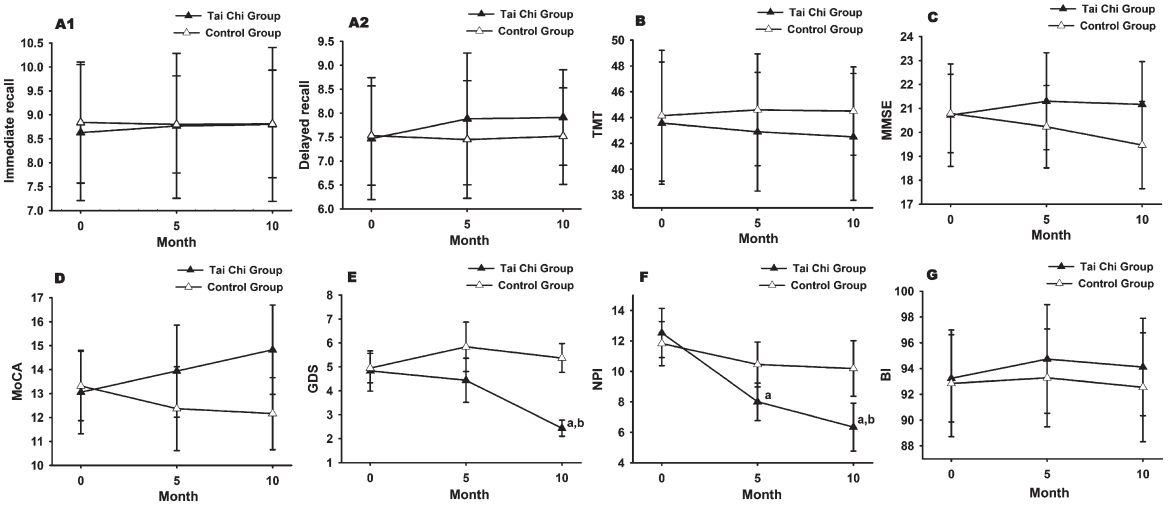

Fig. 2. Changes in mean scores of neuropsychological and functional tests over time. Error bars indicate 95% confidences intervals. No time or group effect was revealed in the WHO-UCLA-AVLT immediate recall (A1) or delayed recall (A2), TMT (B), MMSE (C), MoCA (D), or BI (G) scores by repeated measures ANOVA, but there was a significant group × time interaction effect in the MoCA scores. The GDS scores of the Tai Chi group significantly decreased at 10 months assessments and the NPI scores decreased at both 5- and 10-month assessments compared with baseline. Moreover, at 10 months, both of the GDS and NPI scores of the Tai Chi group were significantly lower than those of the control group (E, F). [a]denotes a difference significant at $p < 0.05$ when compared with pretest values; [b]denotes a difference significant at $p < 0.05$ when compared with the control group. WHO-UCLA-AVLT, WHO-University of California Los Angeles-Auditory Verbal Learning test; NPI, Neuropsychiatric Inventory; TMT, Trail Making Test; MMSE, Mini-Mental State Examination; MoCA, Montreal Cognitive Assessment; GDS, Geriatric Depression Scale; BI, Barthel Index; ANOVA, analysis of variance.

($F = 5.22$, $p = 0.01$). *Post hoc* paired sample t test showed that the Tai Chi group scored lower at the 10-month assessments compared with baseline (2.44 ± 1.04, versus 4.83 ± 2.57, Cohen's $d = 0.87$, $p < 0.05$). At 10 months, the Tai Chi group scored lower than the control group (2.44 ± 1.04 versus 5.37 ± 1.89, Cohen's $d = 0.35$, $p < 0.05$) (Table 2, Fig. 2).

Fall incidence and complaints

Five participants of the Tai Chi group reported mild fatigue or slight ache of their limbs in the first week of exercise. The Tai Chi program was not stopped due to these discomforts and the symptoms disappeared within one week without additional intervention. No fall incidents or other adverse events were reported in either group during the study period.

DISCUSSION

This RCT assessed the effects of a 10-month Tai Chi exercise program on the cognitive, emotional, behavioral, and psychological symptoms, and ability in maintaining ADL in older people with mild dementia. The results suggest that this Tai Chi program has positive effects on abstraction and naming ability. Moreover, the Tai Chi program is beneficial for people with depression, behavioral, and psychological symptoms. However, it does not appear to show obvious effects on improving ability to maintain ADL.

Effects on cognition

In this study, MMSE, MoCA, WHO-UCLA-AVLT, and TMT were used to assess cognitive outcomes. The Tai Chi practice improved MoCA scores over time indicating that global cognitive function of the participants benefited from this Tai Chi exercise program. There was no such improvement in the other cognitive measures including the MMSE. The reason may be that the MMSE is less sensitive than the MoCA in detecting subtle changes in cognitive functions. A further analysis of the MoCA suggests that its sub-scores of abstraction and naming were improved over time in the Tai Chi group. However, there was no statistically significant time or group difference in the WHO-UCLA-AVLT and TMT, which were used to assess the ability of memory and task switching, respectively.

Our results are consistent with a study from Taiwan [29], which showed that 6-month virtual reality-based Tai Chi exercise program had a protective effect

on only the ability of abstraction and judgment for cognitive function in older people with cognitive impairment. Previous studies also reported positive impacts of Tai Chi on other cognitive domains, including language, executive function, learning and memory, as well as global cognition [23]. Cheng et al. [19] found that participants practicing Tai Chi maintained their cognitive functions after 12 weeks training even at 6-month follow-up assessment, while participants in the control group who did simple handicrafts deteriorated over time. Their study indicates that Tai Chi can delay cognitive decline in older people, even in those with significant cognitive impairment. A Study of Dual-Task Tai Chi in Japan [28] reported that 12 weeks of Dual-Task Tai Chi training was effective for improving executive cognitive functions. Sungkarat et al. [18] found that performances of older adults with multiple-domain amnestic mild cognitive impairment on Logical Memory, Block Design, and TMT were significantly improved after 15 weeks of Tai Chi training. Results of another RCT [17] showed that 6-month Tai Chi training significantly enhanced the mental switching component of executive function and memory in older adults with amnestic mild cognitive impairment, possibly via an upregulation of brain-derived neurotrophic factor. The effects of Tai Chi on attention have also been reported. Cheung et al. [33] found that electroencephalography-derived attention level of the participants increased during Tai Chi training and decreased immediately after Tai Chi training suggesting that Tai Chi could improve attention ability of older adults. Kim et al. [34] reported that a 16-week Tai Chi training enhanced mental attentional executives of Chinese participants.

Duration of the Tai Chi programs in the above studies is from 12 weeks to 1 year. However, the longer the Tai chi practice was carried out, the more effects there were on cognition in other studies, some of which were conducted on cognitively healthy older adults. Walsh et al. [35] found that experienced Tai Chi practitioners displayed a higher level of cognitive function compared with adults with similar age and gender in a cross sectional study. Other studies reported that long term Tai Chi practitioners performed better on multiple cognitive domains, especially verbal fluency, memory, and attention. Thus, Tai Chi exercise shows positive effects that may help preserve memory in older people [36–38].

Studies of the mechanisms of Tai Chi suggest that it is a type of aerobic mind-body exercise. This type of exercise has revealed evidence of improving cognitive functions, brain connectivity, and regional brain volume [25, 26]. A functional MRI study [26] proved the neural network changes associated with intensive mind-body training. Another functional MRI study [27] found that 12 weeks of Tai Chi training significantly improved memory and increased resting-state functional connectivity between the medial prefrontal cortex and hippocampus. Furthermore, the participants need to learn, memorize, and follow the forms and steps of Tai Chi practice, which promotes synaptic connectivity [39].

Effects on mood, behavioral, and psychological symptoms

The findings of this study on the GDS and the NPI suggest that Tai Chi alleviates depression, behavioral, and psychological symptoms. These results are consistent with previous studies. Yeung et al. [40] found that 12 weeks of Tai chi practice was effective in reducing depressive symptoms of older Chinese Americans. Dechamps et al. [41] reported that the total NPI score of the older adults in the 12-month Tai Chi training group was reduced, while the scores of older adults in the control group worsened significantly. Jimenez et al. [42] reviewed 35 Tai Chi intervention articles in various populations and reported that Tai Chi could benefit psychological function including improvements in moods and reduction in anxiety, anger, tension, and depression. Tai Chi is a mind-body exercise, which is an important contributor to improvements in psychological well-being. As Osypiuk et al. [43] demonstrated, there was compelling evidence of complex bidirectional interdependence of physical postures and mood.

Effects on ADL

Although it enhanced some domains of cognitive function and alleviated the mood and behavioral disorders of the participants, the Tai Chi program did not show obvious effects on maintaining ADL in this study. This phenomenon may be due to the relatively short duration of the Tai Chi training in this study. Other studies achieved better results. Dechamps et al. [41] found that after 12 months, the Tai Chi and cognition-action groups showed less decline in ADL than the control group, and their mobility and continence were better maintained. Some experts reported that Tai Chi exercise may potentially improve the ADL of post-stroke patients [44] and adults with

Parkinson's disease [45]. Further follow-up studies are needed to explore its effects on ADL which is essential for an individual's quality of life.

This 10-month study has confirmed the safety aspects of the modified Tai Chi program for older people with mild dementia and its effects on their cognitive function, mood, and behavior. The Tai Chi program with moderate exercise intensity is simple and easy to follow, and it does not require a large space or using any equipment. Participants showed good compliance in this study. This specifically designed Tai Chi program for older people with cognitive impairments can be used in conjunction with overall management of mild dementia.

There are several limitations in this study. First, a small sample size and short-term period may suggest insufficient capacity to detect statistical differences. Larger scale and longer follow-up RCTs are needed in the future. Second, follow-up data after cessation of the intervention was not collected. Therefore, the lasting effects after the completion of the Tai Chi exercise are unknown. Future research needs to be conducted to assess the long-term influence of the Tai Chi program, which will help to identify the optimal Tai Chi training duration for persons with dementia. Third, GDS scores of the participants were low in this study which may reduce the possibility of identifying changes in depressive symptoms. However, the study found a significant improvement over the 10-month period in the Tai Chi group. Fourth, only psychometric measurement tools were used to assess the outcomes in this study while biological and neuroimaging markers were not examined. Therefore, we intend to explore the underlying mechanisms of Tai Chi therapy further.

In conclusion, this study suggests that Tai Chi is an effective, safe, and appropriate non-pharmacological therapy for older people with mild dementia. A 10-month Tai Chi training led to a significant improvement in cognitive function, including naming and abstraction ability, as well as reducing depression, behavioral, and psychological symptoms. The modified Tai Chi program, which is specially designed for older people with cognitive impairment, is a promising non-pharmacological intervention for mild dementia.

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