Effectiveness of Tai Chi in maintenance of cognitive and functional abilities in mild cognitive impairment: a randomised controlled trial

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KEY MESSAGES

1. Regular physical exercise may o er benefits for cognitive function in older Chinese.
2. Tai Chi may be associated with a better preservation of global functioning after 1 year.
3. Physical exercise should be considered as part of a public health strategy to promote cognitive health in older adults.

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Introduction

With increasing longevity, dementia care has become a major public health concern. At present, there is no drug therapy proven to delay preclinical cognitive deterioration. As progression of dementia is also related to lifestyle and physical factors, non-pharmacological interventions may have a role in modifying disease progression.[1] In a review for the neuroprotective e ects of physical exercises, attenuation of age-related gray matter loss, increased hippocampal volume, and functional connectivity of neural networks have been identified.[2]

Practicing Tai Chi has been demonstrated to result in better cognitive function and less decline with age.[3] We therefore compared the e ectiveness of Tai Chi with stretching-and-toning exercise in the preservation of cognitive and functional decline in Chinese older persons at risk of cognitive decline.

Methods

is study was conducted from December 2007 to March 2010. It was approved by the Survey and Behavioural Research Ethics Committee of the Chinese University of Hong Kong, the Joint CUHK-NTEC Clinical Research Ethics Committee, and the Ethics Committee of the Department of Health. Written informed consent was obtained from all subjects before commencement of training.

Subjects over 65 years old were recruited from social and residential homes for the elderly. ey were considered at risk of cognitive decline if they had mild cognitive impairment (measured by a clinical dementia rating [CDR] of 0.5) or amnestic mild cognitive impairment. Each participating centre was considered as one unit. All subjects in a given centre were randomised to the intervention or control group, so as to avoid biases due to communication between subjects within the centre. e intervention group received training on '24-style Tai Chi' by a certified Tai Chi master. e complex patterns of movements entail higher cognitive demands in addition to physical exercise. e control group was trained with stretching and relaxation exercises developed by physiotherapists and conducted by an occupational therapist. e assessors were blinded to the randomisation status.

Intervention was conducted in two phases. In the induction phase, the instruction course spanned from 4 to 6 weeks. Instructors conducted regular weekly sessions at the training centres until participants were familiar with the exercise. In the maintenance phase, subjects were given a video CD of the exercise programme. e frequency of the intervention was ≥30 minutes per day and ≥3 days per week. e centre in-charge logged the extent of exercise adherence. Practice could be either in a group at the centres or at home. e Tai Chi masters provided refresher lessons every month until the 12th month to boost adherence and ensure correct performance of posture sequence.

Comprehensive cognitive, functional, and neuropsychiatric assessments were conducted at baseline, 2, 6, and 12 months, using the following assessment tools: (1) CDR to evaluate global severity of cognitive impairment. A CDR of ≥1 is defined as clinical dementia. (2) e Alzheimer's Disease Assessment Scale – Cognitive subscale is a standard cognitive test for evaluating e cacy in intervention trials for Alzheimer's disease. To screen for additional cognitive domains that are also impaired in very mild dementia and mild cognitive impairment, digit span, delay recall, category verbal fluency tests, and mini-mental state examination were also used.

(3) e Disability Assessment for Dementia (DAD) was used to assess everyday functioning sensitive to early deterioration in persons with dementia. e Cornell Scale for Depression in Dementia (CSDD) was used to assess depressive symptoms in persons with dementia. (4) e Chinese Neuropsychiatric Inventory (NPI) was used to assess neuropsychiatric symptoms. (5) e Berg Balance Scale (BBS) was used to assess balance abilities in the elderly. e test consists of 14 tasks common in everyday life. Any interaction e ect between balance and cognitive function was assessed.

e primary outcome measure was the rate of 'conversion' to clinical dementia (CDR of ≥1) after one year of intervention. e changes in cognitive scores from baseline were considered as the cognitive outcome indicator. Functioning changes (as measured by the DAD) between groups were compared. Secondary outcome measures were: (1) the change in CSDD score at 1 year, (2) the change in NPI score at 1 year (prevalence of motivational mood symptoms such as depression, apathy, anxiety), and (3) the change in BBS.

Intention-to-treat analysis was carried out for all subjects who completed the baseline assessment. e mean e cacy parameters (CDR, CDR sum of boxes, cognitive test battery, DAD, NPI, CSDD, and BBS scores) for both groups were computed for each visit. Multilevel generalised linear modelling was used to account for the correlations from within subjects and within centres. Baseline di erences between groups were evaluated using a two-level model with subjects at level 1 and centres at level 2. Changes of e cacy indicators from baseline to each follow-up and intervention di erences were tested with a three-level model with occasions (time points) at level 1, subjects at level 2, and centres at level 3. e CDR outcome was dichotomised into mild cognitive impairment or dementia and analysed using the multilevel logistic model (binomial distribution and logit link function).

Results

Of 548 participants in the 38 centres screened, 171 were randomised into the intervention and 218 in the control groups (Table 1). At 1 year, 92 (53.8%) and 169 (77.5%) of the subjects completed assessment, respectively. Participants in the intervention group had a mean of 1.5 years more education (p=0.007). ere were no di erences in CDR, cognitive function, subjective complaints, neuropsychiatric symptoms and BBS between groups.

At 1 year, 4 (4.3%) and 28 (16.6%) of the respective participants were rated as dementia (after controlling for education) [Table 2]. Multilevel logistic regression (controlled for baseline di erences in education) revealed that the intervention group had a lower risk of developing dementia at 1 year (odds ratio [OR]=0.28, 95% confidence interval [CI]=0.05-0.92, P=0.064). e change of CDR sum of boxes scores showed that the intervention group on average had a 21% better preservation (lower scores)

TABLE 1. Baseline characteristics of participating centres and individuals

Characteristic	Intervention group (n=171)	Control group (n=218)	P value (comparison of centre means)
No. of centres	19	19	
Mean (median) group size	7.8 (8)	9.5 (9)	1.12
No. of hostel:social centres	4:15	6:13	χ^2=0.46
Mean±SD participant age (years)	77.2±6.3	78.3±6.6	0.23
No. of males:females	46:125	46:172	0.37
Mean±SD educational level (years)	4.1±4.3	2.6±3.2	0.007
Mean±SD mini-mental state examination score	24.7±3.0	24.3±2.9	0.73
Mean±SD Alzheimer's Disease Assessment Scale – Cognitive subscale	12.7±4.9	14.2±5.7	0.18
Mean±SD category verbal fluency	31.6±7.2	29.5±6.9	0.12
Mean±SD 10-minute delayed recall	3.9±2.3	3.4±2.4	0.17
Mean±SD digit span (backward)	2.4±1.1	2.2±1.1	0.24
Mean±SD visual span (backward)	2.3±1.1	2.3±0.9	0.98
Mean±SD Berg Balance Scale	52.3±3.1	52.1±3.1	0.55
Mean±SD neuropsychiatric inventory score	1.2±2.4	1.3±2.2	0.31
Mean±SD Cornell depression score	0.8±1.6	0.8±1.8	0.42
Mean±SD clinical dementia rating sum of boxes	1.02±0.8	1.08±0.8	0.52

TABLE 2. Baseline and 1-year follow-up comparison of cognitive and functional profiles in the intervention and control groups

Outcome	Intervention group (n=96)		Control group (n=169)		Group difference at 1 year
	Baseline	1 year	Baseline	1 year	
Mean±SD mini-mental state examination score	25.1±3.0	25.4±3.3	24.4±2.9	24.2±3.4	>0.05
Mean±SD Alzheimer's Disease Assessment Scale – Cognitive subscale	12.0±4.8	10.4±4.7	14.1±5.6	12.7±5.8	>0.05
Mean±SD category verbal fluency	31.5±6.8	34.6±7.5	29.7±6.8	32.6±7.9	>0.05
Mean±SD 10-minute delay recall	4.1±2.2	4.9±2.3	3.6±2.5	4.0±2.3	>0.05
Mean±SD digit span (backward)	2.3±1.1	2.4±1.2	2.2±1.1	2.4±1.1	>0.05
Mean±SD visual span (backward)	2.2±1.1	2.7±1.0	2.3±0.8	2.4±0.8	>0.05
Mean±SD Berg Balance Scale	52.4±3.3	53.4±2.3	52.2±3.1	52.3±3.4	0.053
Mean±SD Cornell depression score	0.81±1.8	0.12±0.5	0.87±1.9	0.16±0.6	>0.05
Mean±SD neuropsychiatric inventory score	1.0±2.2	1.7±3.2	1.3±2.3	1.6±3.1	>0.05
Mean±SD disability assessment for dementia	92.1±8.3	95.8±6.5	93.3±5.7	94.3±8.2	>0.05
Mean±SD clinical dementia rating sum of boxes	1.02±0.8	0.89±0.97	1.08±0.77	1.58±1.37	0.038
No. of patients with dementia	0	0	4	28	0.064

than controls (multilevel Poisson model, beta=0.79, 95% CI=0.63-0.99, P=0.038). Group di erences in DAD scores across time were not significant.

ere was no significant change in mini-mental state examination scores in both groups (multilevel linear model, beta=0.40, 95% CI= –0.62-1.42), P=0.44). At 1 year, there were improvements in digit backward and visual backward spans, delayed recall, category verbal fluency test, and Alzheimer's Disease Assessment Scale – Cognitive subscale scores, but di erences between groups were not significant. Postural balance was measured by BBS. e intervention group had borderline better performance with time (multilevel Poisson model, P=0.053).

ere were no significant changes in NPI scores across time, with a trend for lower CSDD scores from baseline to the third follow-up in both groups. e intervention group had 23% lower scores than the control group, but the di erence was not significant (multilevel Poisson model, beta=0.98, 95% CI= 0.53-1.12, P=0.176).

Discussion

In the intervention group, lower overall CDR and sum of boxes scores across the study period suggested that Tai Chi may help preserve cognitive abilities. e e ect sizes of exercise intervention are likely to be modest, so more sensitive outcome indicator than crude dementia conversion rates are required.

Both groups demonstrated improvements in cognitive test performance at 1 year. While practice e ects may help enhance cognitive test scores with time, exercise intervention may have cognitive-stimulating e ects resulting in better cognition. Physical activity was significantly protective against cognitive decline.[4] ere was a need to explore factors that may modulate global functioning. e intervention group demonstrated a trend towards better functional preservation and postural balance. It was possible that the balance training in Tai Chi provided additional stimulation of the central nervous system. e integrated approach on motor coordination may o er benefits in overall functioning in addition to cognitive enhancement.

e results need to be interpreted in the context of the limitations of the study. An active control group of stretching and toning exercise was selected. e intervention group was better-educated and exhibited higher drop out rates. Interpretation of group di erences in cognitive test scores should be considered after controlling for educational attainment. e high dropout rate in the intervention group reflected the need for adjuvant measures to boost adherence for high intensity programmes. e sample size was modest, which limited the power to detect subtle di erences in cognitive function between groups. Also, the observation period was only 1 year. A longer follow-up may o er additional insights on the longer-term benefits of exercise.

Conclusions

In older adults at risk of cognitive decline, combined cognitive motor stimulation and balance training may help preserve global functioning. Further research is needed to substantiate the cognitive reserve hypothesis and its role in modifying clinical impairment in dementia.

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References

1. Teri L, Gibbons LE, McCurry SM, et al. Exercise plus behavioral management in patients with Alzheimer disease: a randomized controlled trial. JAMA 2003;290:2015-22.
2. Ahlskog JE, Geda YE, Gra -Radford NR, Petersen RC. Physical exercise as a preventive or disease-modifying treatment of dementia and brain aging. Mayo Clin Proc 2011;86:876-84.
3. Lam LC, Tam CW, Lui VW, et al. Modality of physical exercise and cognitive function in Hong Kong older Chinese community. Int J Geriatr Psychiatry 2009;24:48-53.
4. Sofi F, Valecchi D, Bacci D, et al. Physical activity and risk of cognitive decline: a meta-analysis of prospective studies. J Intern Med 2011;269:107-17.