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The effects of Baduanjin exercise on the subjective memory complaint of older adults

A randomized controlled trial

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Abstract

This study aimed to explore the efficacy of Baduanjin exercise on promoting memory function, executive function and general self-efficacy, decreasing the level of subjective memory complaints of older adults.

In this randomized controlled trial, 80 patients were randomly allocated in a 1:1 ratio to 12-week Baduanjin exercise group or 12-week control group. Subjective memory complaint questionnaire, Auditory verbal learning test, Trail Making Test and General Self-Efficacy Scale was used to assess the subjective memory complaint level, memory function, executive function and general self-efficacy level at three times (baseline, after intervention and follow up at 3 months). One-way repeated measures analysis of variance was used to compare the outcome variables of the two groups.

There were no significant differences between the Baduanjin exercise and the control group at baseline in demographic, SMCQ, MoCA, and GDS-15. Compared to participants in the control group, participants in the Baduanjin group had a significantly improvement in memory function ($F = 46.93$, $P < .00$), executive function ($F = 317.83$, $P < .00$) and general self-efficacy ($F = 38.72$, $P < .00$) at the end of 12-week intervention period and after 3months follow-up period ($P < .01$). At the same time, participants in the Baduanjin group had a significantly greater decrease in subjective memory complaint scores at the end of 12-week intervention period and after 3months follow-up period ($F = 24.53$, $P < 0.00$).

Baduanjin exercise appears to be a feasible and acceptable intervention to improve subjective memory complaint among older adults.

Abbreviations: $\eta 2$ = Partial Eta Squared, AD = Alzheimer disease, MCI = mild cognitive impairment, SMC = subjective memory complaints.

Keywords: a randomized controlled trial, Baduanjin exercise, cognitive decline, subjective memory complaints

1. Introduction

According to the World Health Organization, 47.5 million people worldwide have dementia with an annual incidence of 7.7 million new cases every year. This number is projected to increase to 75.6 million people by 2030 and to 135.5 million people by 2050.[1] There were 178 million Chinese aged 60 years or older constituting 13.26% of the total population, dementia from China are projected to continue to rise to over 16 million in 2030.[2] In 2011, the National Institute on Aging and the Alzheimer disease (AD) Institute recommended new diagnostic criteria for AD, which clearly stated that AD is a continuous pathophysiological process, including subjective memory complaint, mild cognitive impairment (MCI) and Alzheimer's disease.[3] Population-based studies suggest that between 50%

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Each subject filled out an informed consent form after being informed of the intervention objectives and intervention methods. This study was approved by the ethics committee of Harbin medical university, which was completed in accordance with the Declaration of Helsinki.

The authors have no conflicts of interest to disclose.

The datasets generated during and/or analyzed during the current study are not publicly available, but are available from the corresponding author on reasonable request.

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and 80% of older individuals (aged 70 years andolder) who perform within normal ranges on cognitive tests, report some form of perceived decline in cognitive functioning when asked.[4] The problem of subjective memory complaint is common in the elderly[5] and has a risk of transformation to MCI and AD.[6] Therefore, there is a need to develop an efficient and cost-effective therapeutic method for subjective memory complaints (SMC) in older adults.

Older adults with subjective memory complaints experience a decline in memory functioning, without evidence for objective cognitive impairments or an underlying neurodegenerative disease or psychological disorder.[7] The absence of objective cognitive impairment distinguishes SMC from MCI. In principle, MCI was developed as a diagnostic entity, whereby the absence or presence of cognitive impairment is decided on the basis of clinical judgment. Cognitive test performance of the patient can support this diagnostic judgement.[8] There is accumulating evidence that older individuals with SMC have an increased likelihood of biomarker abnormalities consistent with Alzheimer disease pathology and an increased risk for future pathologic cognitive decline and dementia.[9] Although the experienced decline lies within the normal limits of cognitive ageing, it will have a negative impact on daily life and quality of life.[10] Therefore, in the stage of subjective memory decline, when the performance of the elderly in the objective cognitive test has not decreased significantly, targeted intervention is an effective starting point to prevent and delay the occurrence of dementia.

Previous studies have shown that physical exercise is beneficial to improve the cognitive function of the elderly. Some studies have shown that the physical activity (especially aerobic exercise) was negatively correlated with risk of cognitive decline in older adults with or without cognitive impairment.[11,12] The mechanism is still uncertain, but aerobic exercise may increase neurogenesis in the dentate gyrus of the hippocampus. Further, animal research suggests that exercise promotes the growth of new brain cells in the hippocampus and it is beneficial to the regeneration of neurons.[13] Although diversified sports or the common aerobic exercise such as running, gymnastics has also been shown to improve mental health and cognitive function in older adults, because of their hard exercise and need to consume more energy, so it is likely to lead to poor adherence in the elderly.

Compared with TaiChi, Baduanjin exercise is easier to learn because it consists of only eight movements. Baduanjin exercise is one of the most common forms of Qigong that has been practiced in China more than 1000 years.[14] Baduanjin belongs to a mind–body aerobic exercise. In the process of exercise, it pays attention to the unity of spirit, seeks both static and static in movement, attaches importance to the realization of entering stillness, and strengthens the connection between physiology and psychology through the regulation of mind to the brain. The effect is better than simple limb movement.[15] According to Sun's study Baduanjin exercise has shown promising results on movement reaction among elderly after three months of practice.[16] Another study showed that Baduanjin exercise can significantly improve the overall cognitive function in patients with MCI.[17] However, there is a lack of high-quality evidence for the effectiveness of Baduanjin exercise for patients with subjective memory complaint. Consequently, the purpose of this study was to verify the effect of Baduanjin exercise on cognitive function and mental health in the elderly with subjective memory complaint.

2. Methods

2.1. Design and setting

This study is a randomized controlled trial. The participants were recruited from the community and randomly allocated to either a Baduanjin training group or usual physical activity group at a 1:1 ratio using the Random Number Seed procedure of the statistical software SPSS22.0. The aim, procedures, and possible side effects of the exercise will be explained in detail to the patients; all patients will be asked to sign a written informed consent form before randomization. This study was approved by the ethics committee of Harbin medical university, which was completed in accordance with the Declaration of Helsinki.

2.2. Participants

All participants were aged between 60 and 75 years. The inclusive criteria: ① SMCs were confirmed by an affirmative answer to both of the following questions: "Are you complaining about your memory?;" and "Is it a regular complaint which lasts more than 6 months?." ② ≥60 years of age; ③ Willingness to participate in the study; ④ No movement disorder; ⑤ Have not practiced Baduanjin exercise before, and have not engaged in regular exercise in the past half a year (at least 2 times a week, at least 20 minutes each time). Criteria for exclusion are the following: ① Patient's condition was too severe to exercise, or activity was restrained by other diseases; ② psychiatric disorders clinically diagnosed in accordance with the DSM-5 (e.g., depression, general anxiety disorder); ③ vascular risk factors; ④ participating in another clinical study.

A priori sample size calculation was based on a preliminary experiment in MoCA scores among participants undergoing the 12-week Baduanjin training compared to those in the control group. Through preliminary experiment of Baduanjin exercise intervention, the biggest test efficiency of Baduanjin intervention on cognitive function was 0.301 (Cohen'$f = 0.301$), sample size of 58 participants was calculated to ensure the same effect size with 80% power by G*POWER version 3.1 program. Considering a 15% attrition rate, it is calculated that a total of 66 participants are needed in this study, 33 people are needed in the intervention group and the control group respectively. In the final sample of this study, there were 35 subjects in the Baduanjin group and 35 subjects in the control group, which met the basic needs of the subjects.

2.3. Intervention

2.3.1. Baduanjin exercise group. The participants in the intervention group practiced one hour Baduanjin exercise every day, and five days a week, including 15 min warm up, 40 min Baduanjin training and 5 min cool down. Baduanjin exercise was guided by two qualified coaches who have been in the Baduanjin sport for at least five years. To ensure intervention fidelity, two coaches who provided the intervention underwent training provided by the investigators. The training scheme of Baduanjin exercise was in accordance with the Health Qigong—Baduanjin published by the General Administration of Sport of China, which is mainly divided into eight steps: two hands support Tianli Sanjiao, left and right bow like shooting sculpture, recuperating spleen and stomach should lift alone, five labor and seven injuries look back, shake head and tail to remove heart fire, two hands climb feet to take care of the kidney and waist, save fist to increase

Table 1

Baduanjin exercise steps.

Practice step
a. Respiratory guidance (5 min) The breath guidance of traditional Chinese medicine is a kind of health-preserving method handed down in ancient times to spit out the old and accept the new and adjust the breath, which can mobilize the qi of the five internal organs and six internal organs through the breath guidance. Spit out the turbid qi of the viscera and absorb the fresh qi, which plays an important role in improving the whole body qi of SMC in the elderly.
b. Warm-up exercise (10 min) Under the guidance of the doctor, carry on the whole body joint activity, stretch the body, fully warm up.
c. Baduanjin exercise (40 min) The essentials of Baduanjin exercise: when practicing, it requires natural coordination of body, breath and mind. The body is natural, the action is in accordance with the Dharma; the breathing is uniform, the breath is not strong, and the shape is accompanied by each other; the mind is in the center, the spirit is focused, and the spirit is continuous. Strive to achieve accurate, skilled and coherent movements, gradually achieve the organic combination of movement, breathing and ideas, and integrate form, qi and spirit. Mentally relaxed, calm and physically accessible. In the process of exercise, she is relaxed, soft and rigid, and on the basis of relaxing the muscles of the whole body, it is gentle and powerful, and the movement is consistent.
d. Relax exercise (5 min) The elderly stand still or lie flat, relax the whole body, meaning to keep the field, the whole body is calm, breathing evenly, in a natural state, continue until the body is harmonious and comfortable.

strength angrily, and eliminate all diseases in the back.[18] For more specific details, please refer to Table 1.

2.3.2. Control group. In order to make the intervention conditions of the control group consistent with those of the Baduanjin group, the control group invited a professional gymnastics teacher to carry out gymnastics practice between physical education classes, in order not to affect the accuracy of the data of the control group and to ensure that the teacher also took the teaching seriously. We didn't tell her the purpose of this study. The control group was provided with similar measurement questionnaires to the questions that were simultaneously given to the Baduanjin group. To avoid a potential overlap (contamination) with the Baduanjin program components, the investigator specifically asked the participants in the control group not to use Baduanjin or other related techniques, such as Tai Chi or yoga, during the study.

2.4. Measures

2.4.1. Montreal cognitive assesement (MoCA). In this study, Montreal Cognitive questionnaire was used to evaluate the cognitive function,[19] which is a cognitive screening instrument created and validated to detect MCI. MoCA is a test that evaluates visuospatial/executive functions, naming, verbal memory registration and learning, attention, abstraction, delayed verbal memory, and orientation with a total score of 0 to 30. A higher score reflects better cognitive performance and a score less than 26 was found to be the optimal cutoff point for a diagnosis of cognitive impairment. The questionnaire has been used in Chinese older men and demonstrated good reliability and validity.[20]

2.4.2. Subjective memory complaint questionnaire (SMCQ). Subjective Memory Complaints Questionnaire was used to assess subjective memory complaints.[21] This questionnaire consisted of 14 items, and each of the items is scored as "yes" or "no," higher scores indicate stronger memory complaints. Previous studies have shown that the scale has demonstrated good internal consistency, the Cronbach's alpha was 0.872.[22]

2.4.3. Auditory verbal learning test (AVLT). We used the Chinese vision of the[23] AVLT to test the subjects' memory ability. AVLT includes three subtests of immediate recall, short term-delayed recall and long-term delayed recognition. In the immediate recall test, the assessor read out 15 words and asked the subjects to recall them immediately; after an interval of about 5 minute, recall the 15 words just now (short-term-delayed recall). In the long-term delayed recognition test, a subject given another list of 15 unrelated words and must recognize the original list of 15 word.[24] The questionnaire was used among the elderly in China, which demonstrated good reliability and validity, the Cronbach's alpha was 0.886.[25]

2.4.4. Trail making test (TMT). In this study, TMT was used to evaluate the executive function of the subjects.[26] The TMT consists of two parts, TMT-A and TMT-B, in the TMT-A part, the subjects were asked to connect the numbers from 1 to 25 in the project in order from small to large, while TMT-B requires participants to draw a line alternating between numbers and letters in ascending order between the number and the letter, the scoring index is the number of time taken, and the longer the time is, the worse the executive function is, the TMT-B/TMT-A is considered as a valid index of executive ability.

2.4.5. Geriatric depression scale (GDS-15). The GDS-15[27] was used as a self-report measure of mood. The questionnaire consists of 15 items and higher scores indicated more depression, the presence of depressive symptoms was defined as a score of at least 5. The GDS-15 was used to assess depression among elderly adults in China, and it has demonstrated good internal consistency. The Cronbach's alpha was 0.79.[28]

2.4.6. The general self- efficacy scale (GSES). Self-Efficacy was measured by the GSES. The GSES was developed by Schwarzer,[29] The GSES was translated by Zhang[30] has demonstrated good psychometric properties in Chinese, the questionnaire had good re-retest reliability of 0.83.[31] The questionnaire consists of 10 items, each item has four response categories ranging from "do not agree" (1point) to "agree" (4 points), average score of 10 items and higher scores indicated better.

2.5. Statistical analyses

In this study, SPSS22.0 was used for statistical analysis, a two-sided p value of less than 0.05 was considered significantly

different. In this study, t-test and chi-square test were used to compare the baseline demographic and clinical measures data between the two groups. One-way repeated measures analysis of variance (ANOVA) was used to analysis the outcomes between two groups at different time. The within-subject factor between time points was denoted by "Time," and the between-subject factor, that is, Baduanjin exercise vs. control group was denoted by "Group." A significant "Time × Group interaction" thus indicated a difference in response between the two groups. Partial Eta Squared ($\eta 2$) was used to assess effect size in ANOVA model.

3. Results

3.1. Adherence to the intervention

The remaining 80 eligible subjects were enrolled and randomly assigned to either the Baduanjin group (n = 40) or the control group (n = 40). Of the 40 participants, 38 (95%) completed the entire Baduanjin exercise intervention.1 participant dropped out at 4 weeks, and 1 at 8 weeks. Attrition was due to personal reasons unrelated to the study. Another 3 participants did not complete the follow-up assessment (Lost to follow-up). In the control group,1 discontinued prior to postintervention assessment and 4 were lost to follow-up. Eventually, data from 35 participants in the Baduanjin group and 35 participants in the control group were included in the final analyses (Fig. 1).

3.2. Clinical and demographic characteristics

Demographic characteristics and baseline results for both groups are showed in Table 2. The mean age of the Baduanjin exercise group was 64.4 ± 6.57years; the mean age of the control group was 65.37 ± 6.31 years (mean ± standard). The majority of the two group participants were married, and had an secondary school level education and monthly income was mostly 1000~3000 rmb. There were no significant differences between the Baduanjin exercise and the control group at baseline in demographic, SMCQ, MoCA, and GDS-15.

3.3. Training effects on outcome measures

In order to investigate the intervention effect of Baduanjin, firstly, we took the measurement time (baseline, pos-intervention, follow up 3months) as the internal variables and the groups (Baduanjin group, control group) as the inter-test variables. Gender, age, marital status, education level and family annual income were used as covariables to do the repeated measures analysis of variance.

3.3.1. Memory complaints. The Baduanjin group had a significant reduction in SMCQ score at the end of 12-week intervention period (5.09 ± 1.82) (t = 2.695, $P = .009$)and after 3 months follow-up period (4.97 ± 1.62). However, the reduction of SMCQ score in control group is modest at the end of 12-week

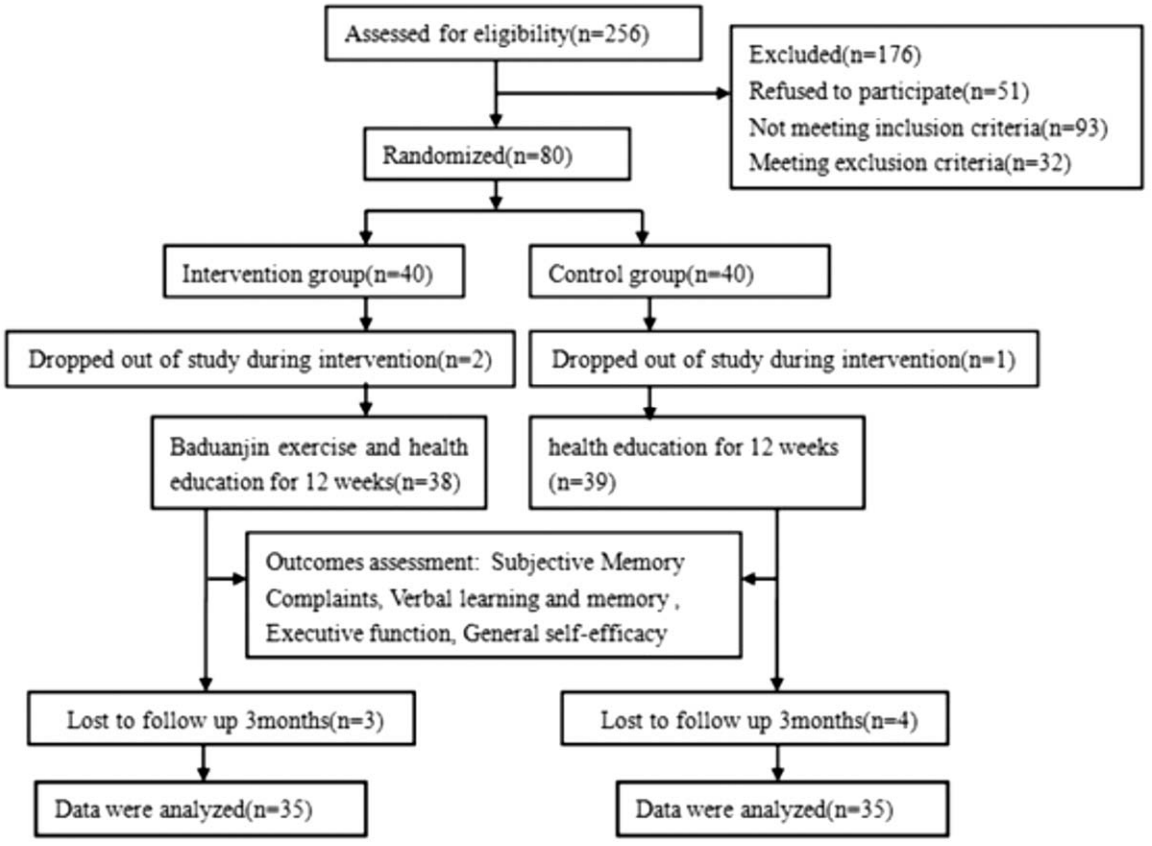

Figure 1. Study design.

Table 2

Baseline characteristics of subjects.

Characteristics	Intervention (n = 32)	Control (n = 33)	t or χ^2	P
Age (Mean ± SD)	64.40 ± 6.57	65.37 ± 6.31	-0.631	.530
Gender n (%)			0.514	.473
Men	16 (45.71)	18 (51.43)		
Women	19 (54.29)	17 (48.57)		
Education n (%)			0.683	.877
Primary education or lower	6 (17.14)	8 (22.86)		
Secondary school	16 (45.71)	15 (42.86)		
High school	10 (28.57)	8 (22.86)		
University	3 (8.6)	4 (11.4)		
Marital status n (%)			1.120	.290
Married (remarried)	27 (77.14)	23 (65.71)		
Single (never married, widowed or divorced	8 (22.86)	12 (34.29)		
Household monthly income n (%)			0.521	.771
low (≤1000rmb)	7 (2)	8 (22.86)		
middle (1000~300rmb)	18 (51.43)	15 (42.86)		
high (≥3000rmb)	10 (28.57)	12 (34.28)		
SMCQ	6.37 ± 2.16	6.54 ± 2.42	-0.313	.755
MOCA (Mean ± SD)	26.97 ± 1.15	27.23 ± 1.14	-0.940	.351
GDS-15 (Mean ± SD)	2.69 ± 1.02	2.83 ± 0.98	-0.595	.554

GDS-15 = geriatric depression scale-15, MOCA = montreal cognitive assesement, SMCQ = subjective memory complaint questionnaire.

intervention period (6.29 ± 1.86) (t = 0.384, $P = .702$) and after 12-week follow-up period (6.34 ± 2.10). Table 3 shows the results of the within-group effects and between-group over time from baseline to the 3 months for each group using repeated measures ANOVA. A significant effect of "Group" (F = 4.032, $P = .049$)and "Time" (F = 24.528, $P = .000$) was detected in the SMCQ scores, the results also revealed a significant time-by-group interaction on the SMCQ scores ((F = 37.09, $P < .01$, $\eta 2 = 0.17$). And the total decreased SMCQ score of the two groups at the three time intervals are shown in Figure 2.

3.3.2. Verbal learning and memory. Both groups had comparable AVLT score at baseline (33.46 ± 5.80 vs 33.89 ± 4.56, $P = .732$). After 12 weeks intervention, the AVLT score in the intervention group increased from 33.46 ± 5.80 to 40.83 ± 5.39 (t = 12.25, $P = .000$) while the AVLT score control group less increased from 33.89 ± 4.56 to 36.26 ± 5.53(t = -1.858, $P = .064$). A significant "Time × Group interaction" effect was found in the AVLT total score (F = 7.36, $P = .008$, $\eta 2 = .098$), as shown in Table 3. There was only a time effect on the subscale of immediate recall (F = 10.36, $P = .000$, $\eta 2 = .132$) and no group effect (F = 2.32, $P = .132$, $\eta 2 = 0.003$) and time-by-group interaction (F = 2.639, $P = .083$, $\eta 2 = .037$); there was a significant time and a time-by-group interaction of the subscale of short-term-delayed recall and long-term delayed recognition. Learning and memory ability can be improved by Baduanjin exercise, and total AVLT score between 2 groups at three time points are shown in Figure 2.

3.3.3. Executive function. The results indicated that the outcomes on executive function abilities were not different between groups at baseline (t = .263, $P = .794$). The intervention group had a significant reduction in TMT total score at the end of 12-week intervention period, the TMT score in the intervention group decreased from 154.97 ± 26.7 to 134.54 ± 25.7(t = 3.261, $P = .002$), while the TMT score control group less decreased from 153.37 ± 24.2 to 152.54 ± 24.7(t = .142, $P = .888$). For repeated measures ANOVA, there was a time effect on the subscale of TMT A (F = 249.39, $P = .000$, $\eta 2 = 0.78$) and TMTB ($F = 317.83$, $P = .00$, $\eta 2 = .824$); no group effect on TMTA (F = 2.84, $p = 0.097$, $\eta 2 = 0.04$) and TMTB ($F = 2.163$, p = 0.146, $\eta 2 = 0.003$); the subscale of TMTA ($F = 112.68$, $P = .000$, $\eta 2 = 0.62$), and TMTB ((F = 327.486, $P = .000$, $\eta 2 = 0.828$) showed significant time-by-group interaction. The participants in both groups showed an decrease in the TMT total score, and there was a significant time-by-group interaction of the TMT total score (F = 408.37, $P = .000$, $\eta 2 = 0.86$), as shown in Table 3. Baduanjin exercise can significantly improve the executive ability of SMC, and the total TMT score between two groups at three time points are shown in Figure 2.

3.3.4. General self-efficacy. There were no significant differences in the GSES score between the 2 groups at baseline (t = -0.826, $P = .412$). After intervention, the total score of GSES in the Baduanjin group (3.03 ± 0.75) was significantly higher than that in the control group (2.60 ± 0.78) ($P < .05$), the effect was maintained after 12-week follow-up period (F = 10.50, $P = .002$), it shows that Baduanjin exercise has an influence on the general self-efficacy of the subjects. For repeated measures ANOVA, a significant effect of "Time" was detected in the GSES score (F = 38.72, $P < .001$, F = 0.148), and a significant effect of "Time × Group interaction" effect was found in the GSES score (F = 12.72, $P = .000$, $\eta 2 = 0.16$), as shown in Table 3 and Figure 2.

4. Discussion

Baduanjin is a traditional Chinese health preservation movement. Through the soothing and stretching of the limbs and dredging the meridians and collaterals, Qi and blood can enter the Zang-fu organs through the meridians, so as to achieve the effect of regulating and improving Zang-fu organs, Qi and blood, Yin and Yang.[32] It has been considered as a popular community exercise to promote health in China.[33] Our study is the first randomized controlled trial to examine the the effect of Baduanjin exercise on subjective memory complaints in China. Compared with the control group, the intervention group showed a significant improvement in memory, executive function abilities and general

Table 3

Comparisons between the groups on outcome measures (Mean ± SD).

	Baduanjin (n = 30) (Mean ± SD)			Control (n = 29) (Mean ± SD)					
	baseline	pos-intervention	follow up 3 m	baseline	pos-intervention	follow up 3 mo	F	*P*	$\eta 2$
Primary outcome									
SMCQ	6.37 ± 2.16	5.09 ± 1.82	4.97 ± 1.62	6.54 ± 2.41	6.29 ± 1.86	6.34 ± 2.10			
Time effect							24.528	.00	0.27
Time × group effect							13.397	.00	0.17
Group effect							4.032	.049	0.056
AVLT									
Total score	33.46 ± 5.80	40.83 ± 5.39	40.91 ± 5.16	33.89 ± 4.56	36.26 ± 5.53	35.49 ± 5.24			
Time effect							46.926	.000	0.408
Time × group effect							14.846	.000	0.179
Group effect							4.588	.036	0.063
immediate recall	7.31 ± 2.10	8.79 ± 2.06	8.63 ± 1.90	7.46 ± 1.99	7.77 ± 2.79	7.69 ± 2.54			
Time effect							10.364	.000	0.132
Time × group effect							2.639	.083	0.037
Group effect							2.320	.132	0.033
Short-term-delayed recall	7.49 ± 2.00	9.43 ± 2.10	9.74 ± 1.93	7.80 ± 1.84	8.46 ± 1.80	8.66 ± 1.83			
Time effect							147.86	.000	0.685
Time × group effect							32.04	.000	0.320
Group effect							1.644	.204	0.024
long-term delayed recognition	10.37 ± 1.83	11.74 ± 1.85	11.60 ± 1.65	10.43 ± 2.00	10.71 ± 1.96	10.49 ± 1.99			
Time effect							14.07	.00	0.274
Time × group effect							8.31	.00	0.125
Group effect							2.858	.096	0.040
TMT									
Total score	154.97 ± 26.70	134.54 ± 25.71	130.31 ± 25.61	153.37 ± 24.22	152.54 ± 24.71	151.37 ± 24.01			
Time effect							536.61	.000	0.888
Time × group effect							408.37	.000	0.857
Group effect							4.333	.041	0.060
TMT A (s)	50.86 ± 13.63	43.49 ± 12.56	41.57 ± 11.84	51.46 ± 13.21	50.20 ± 12.64	49.54 ± 12.32			
Time effect							249.39	.000	0.78
Time × group effect							112.68	.00	0.62
Group effect							2.84	.097	0.04
TMT B (s)	104.11 ± 22.29	91.06 ± 21.51	88.74 ± 21.68	101.91 ± 20.37	102.34 ± 20.42	101.83 ± 20.13			
Time effect							317.83	.00	0.824
Time × group effect							327.486	.000	0.828
Group effect							2.163	.146	0.031
GSES	2.29 ± 0.86	3.03 ± 0.75	3.20 ± 0.58	2.43 ± 0.88	2.60 ± 0.78	2.71 ± 0.67			
Time effect							38.72	.00	0.363
Time × group effect							12.72	.00	0.158
Group effect							2.609	.111	0.037

AVLT = auditory verbal learning test, GDS-15 = geriatric depression scale-15, GSES = the general self- efficacy scale, SMCQ = subjective memory complaint questionnaire, TMT = trail making test.

self-efficacy after 12-week Baduanjin exercise. Furthermore, most of those significant effects were sustained in the additional 12-week follow-up.

More and more studies have shown that exercise helps to improve the cognitive function of the elderly with or without cognitive impairment.[34,35] Based on the results of this study, we found that 12 weeks of a Baduanjin training was sufficient to improve subjective memory/objective memory functioning, which is consistent with a previous study.[36,37] Baduanjin exercise is a traditional Chinese fitness sport, simple and easy to learn, widely circulated in the folk. It consists of 8 steps. Practicing Baduanjin requires body-mind coordination by combining body posture, movement and breathing with meditation.[38] We believe that long-term regular exercise may increase neurogenesis in the dentate gyrus of the Hippocampus[39] and supports proliferation and division of neuronal precursor cells in the dentate gyrus (expansion phase).[40]

Regarding the effects of the intervention on executive functioning we found that the Baduanjin group, showed significant improvements, previous studies have shown that regular physical exercise can significantly improve executive function and processing speed.[34,41] Baduanjin exercises the nervous system with internal motion, static movement and the combination of the two. Static movement refers to the self-regulation of the nervous system, especially the information and consciousness nerve function, mainly by brain training, which is characterized by adjusting breath into stillness and loosening the brain into a static state. In order to ensure the smart action of the information machine system, to ensure the brain cells in the self-self static state under the control of the self-thinking dimension active.

Consistent with the findings of most studies, Baduanjin exercise has effects on improving the self-efficacy of SMC.[42,43] Regarding the mechanisms of efficacy (i) previous research has indicated that physical exercise can make elderly bodies stronger and healthier, alleviate stress and enhance physical functions and mental health level.[44] (ii) Fox's study has also found that regular physical exercise behavior itself will also

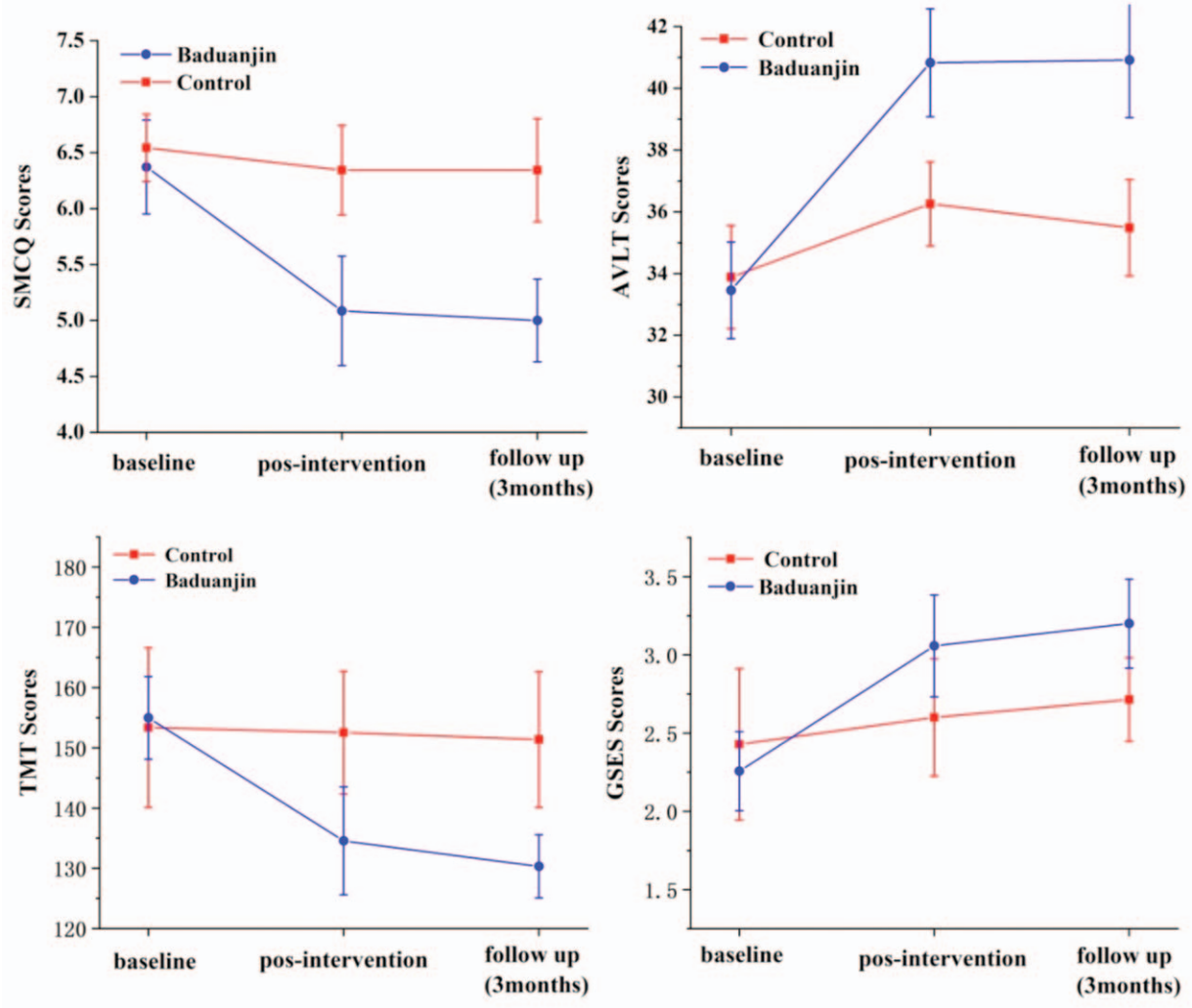

Figure 2. Scores of four test at baseline and pos-intervention and following 3 months. SMCQ, AVLT, TMT, GSES test. AVLT = auditory verbal learning test, GSES = the general self- efficacy scale, SMCQ = subjective memory complaint questionnaire, TMT = trail making test.

give elderly achievement of persistent feeling.[45] Moreover, Netz's meta-analysis[46] provided supporting evidence that the elderly like to practice physical activity and apply physical activity to daily life. This supporting evidence may yield positive mental health effects, which promotes the self-efficacy level of SMC elderly.

The results of this study show that regular Baduanjin exercise is beneficial to improve the cognitive function of the SMC elderly. Baduanjin exercise can be described as a combination of Confucianism, Buddhism, Taoism and traditional Chinese medicine. So Chinese elderly more easily accept this intervention methods, which enhance compliance. The participants reported that the time went faster during the Baduanjin sessions, and after the intervention, they will continue to practice the Baduanjin exercise.

5. Conclusion

In summary, this study found that 12-week Baduanjin exercise could improve the memory function and general self-efficacy of the older adults with SMC. We recommend the application of this free, simple, and safe technique to elderly with SMCQ as an intervention to help deal with their memory deficits.

5.1. Clinical implication and future direction

Subjective memory complaint is highly prevalent in the elderly, and the decline of cognitive function will have a negative effect on the daily life of the elderly. Our results have demonstrated that Baduanjin exercise is a feasible and effective intervention program for improving subjective memory complaint in community-dwelling older adults. Application of this simple, traditional Baduanjin exercise is recommended for SMC elderly to manage their subjective memory decline and improve their quality of life. A Baduanjin exercise program for community SMC elderly should consist of a well-developed Baduanjin exercise program with guidance and instructions from a Baduanjin exercise demonstration video, an educational brochure, and regular follow-up.

There are several limitations in the present study. First, 12 weeks of exercise is a relatively short duration. Therefore, the long-term effects of Baduanjin need to be studied further. In

addition, the effectiveness of Baduanjin intervention in non-Chinese population needs to be further studied. This intervention should be tested within a larger, more general population. Third, our study did not compare Baduanjin exercise to other forms of exercise. Therefore, it is still unclear whether Baduanjin exercise is more effective than other forms of exercise.

Author contributions

Hong Su and Lina Meng: formal analysis. Hong Su, and Haina Wang: data curation. All authors: conceptualization, methodology, writing—original draft preparation and writing—review and editing.

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