Aerobic dance for cognitive and physical functions and mood in older adults with cerebral small vessel disease: abridged secondary publication

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KEY MESSAGES

Aerobic dance is safe and effective for improving cognitive functions in older adults with cerebral small vessel disease.

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Introduction

Cerebral small vessel disease manifests as age-related white matter lesions and lacunar infarcts. It is associated with a plethora of age-related disabilities such as dementia, falls, depression, and impaired daily functioning.[1] Primary prevention by lifestyle intervention is therefore of utmost importance. Aerobic and strength training improves executive functions, memory, and general cognitive functions in community-dwelling adults with mild cognitive impairment. Dancing can be performed in older persons with physical and cognitive impairments. It is aerobic training and involves memory, attention, sensory stimulation, and social interaction. It is a good exercise for enhancing cognitive, mood, physical, and daily functions in individuals with cerebral small vessel disease.

In the present study, the primary objective is to investigate the effects of a 24-week aerobic dance training on cognition, mood, physical, and daily functions in stroke- and dementia-free community-dwelling persons with neuroimaging evidence of cerebral small vessel disease. The secondary objective is to examine whether the effects of aerobic dance training are mediated by changes in cerebral vasomotor reactivity (CVR).

Methods

This was a rater-blind randomised controlled study comparing the effects of aerobic dance with simple stretching and health education on cognition, mood, physical, and daily functioning for 36 weeks. A total of 110 community older adults were randomised in a close to 1:1 ratio into either the aerobic dance group or the control group.

Inclusion criteria were age ≥65 years, community dwelling, presence of significant cerebral small vessel disease (defined by the presence of ≥2 lacunar infarcts and/or a rating of ≥2 of white matter lesions using the age-related white matter changes scale on magnetic resonance imaging), presence of good temporal window on at least one side for transcranial Doppler ultrasonography, and written informed consent given.

Exclusion criteria were a history of stroke, dementia (determined by a score of lower than the education-adjusted cutoff on Mini-Mental State Examination for dementia or a history of dementia diagnosis), comorbidity with medical conditions affecting the central nervous system or cerebral white matter (such as multiple sclerosis, brain tumour, uncontrolled epilepsy, history of severe head injury, substance abuse), inadequately controlled psychiatric disorders affecting cognition and mood, and physical or sensory impediments hindering participation in cognitive assessment or exercise training.

Participants were assessed at baseline and weeks 12, 24, and 36 by a trained research assistant blinded to treatment allocation. Cognitive functions were assessed using the Montreal Cognitive Assessment, Colour Trails Test, Symbol Digit Modalities Test, Category Fluency Test, Modified Boston Naming Test, Rey Complex Figure Test, Digit Span Test, Hong Kong List Learning Test for global cognition, executive functions, psychomotor speed, and memory. Physical functions were assessed using the Mini-Balance Evaluation Systems Test (for dynamic balance), timed-up-and-go test (for functional mobility), and 6-minute walk test (for walking capacity). Depressive symptoms were assessed using the 15-item Geriatric Depression Scale (GDS). Daily functions were assessed using the Lawton instrumental activities of daily living scale. Physical activities performed outside of training session were recorded using the International Physical Activity Questionnaire (IPAQ) to account for the potential confounding effects.

Transcranial Doppler ultrasonography was performed using a 2-MHz pulsed Doppler hand-held probe to insonate the middle cerebral artery through the temporal window above the zygomatic arch at a depth of 52-56 mm, and the vertebral artery through the occipital window at a depth of 64 mm. The pulsatility index (for vascular resistance of cerebral vessels) of the middle cerebral artery and vertebral artery and the breath-holding index (as a marker of CVR) were calculated.

Aerobic dance training was conducted in groups of five by a certified physiotherapist experienced in exercise training for older persons. The intervention lasted for 24 weeks, with 60 minutes of exercise per session, which included 10 minutes of warm-up, up to 40 minutes of dancing, and 10 minutes of cool-down. Participants were instructed to achieve 40% of their age-specific target heart rate (ie, heart rate reserve). Participants started doing the dance exercises for 30 minutes in month 1 and gradually progressed to 40 minutes to reach the target of 70% of heart rate reserve. Participants practised once per week in months 1 and 2, and twice per week in months 3 to 6. Participants were also asked to practise at home. In months 1 and 2, the dance consisted of rhythmical whole-body movement of weight shifting and repeated stepping in different directions (forward, backward, and sideways) and arm movements of multi-directional reaching and stepping. Progression was made to increase the speed and amplitude and complexity of the movements. Participants were asked to practise at home twice per week for 20 to 30 minutes. In months 3 to 6, the dance steps became more complex by adding lunge steps, tandem walking, and turning. Progression was made to increase the speed, amplitude, and complexity of the movement. Participants learned a new dance every 2 weeks. They were asked to practise at home for 30 to 40 minutes twice per week in weeks 1 and 3 each month, and 3 times per week in weeks 2 and 4 each month.

Participants in the control group (5 participants per group) received a weekly 3-hour programme containing stretching exercise, stress reduction, and health education on dementia and stroke prevention for 6 months. The total number of hours with staff contact in the control group was comparable to that in the intervention group (72 vs. 80 hours).

Between weeks 24 and 36, participants in both groups were not asked to comply with any exercise regimen, but they were free to exercise at their own will. This 12-week observation period was for assessing the sustainability effects of training.

Adverse events were recorded. Participants were asked about the occurrence of any adverse events at each clinical visit and were provided with a contact number to notify the study team about any occurrence of adverse events.

Group comparisons of baseline variables were conducted using independent sample *t* test, Chi-squared test, or Fisher's exact test where appropriate. An intention-to-treat analysis was used. Treatment effect was analysed using mixed effect model using analysis of covariance, with age, sex, years of education, and IPAQ score as covariates at baseline and at weeks 12, 24, and 36. Group effect size on outcomes was measured by the Cohen's *d* or Cohen's f^2 statistic, with 0.2, 0.5, and ≥0.8; 0.02, 0.25, and ≥0.4 indicating small, medium, and large effects, respectively. Performance on each cognitive test was analysed without being combined into a single composite score to determine the effects of intervention on specific cognitive domains. To examine whether the effects of treatment are mediated through changes in CVR, a standard mediation model was performed, with age, sex, years of education, change in IPAQ as covariates. Unstandardised indirect effects were computed for each of 5000 bootstrapped samples, and the 95% confidence interval was computed by determining the indirect effects at the 2nd and 97th percentiles. The mean pulsatility index and breath-holding index were calculated separately on the right and left hand for measuring CVR. Post-treatment effect between months 24 and 36 was examined using repeated measure analysis of covariance with treatment condition and time (outcome measures at months 24 and 36) being factors of interest. Pairwise deletion was used to handle missing data. Only the particular cases needed to test a particular assumption were eliminated in order to preserve more information. Alpha was set at 0.05 for all analyses. Statistical analyses were performed using SPSS (Windows version 21; IBM Corp, Armonk [NY], US).

Results

A total of 110 participants were randomised to either the aerobic dance group (n=54) or the control (stretching + education) group (n=56). 53 participants in the treatment group and 54 participants in the control group had at least one follow-up assessment. Fourteen (12.7%) participants withdrew from the study. There was no significant group difference at baseline in terms of demographics, vascular risk factors, cognitive functions, mood, physical functions, daily functions, physical activity, or CVR.

At week 12, no significant treatment effect

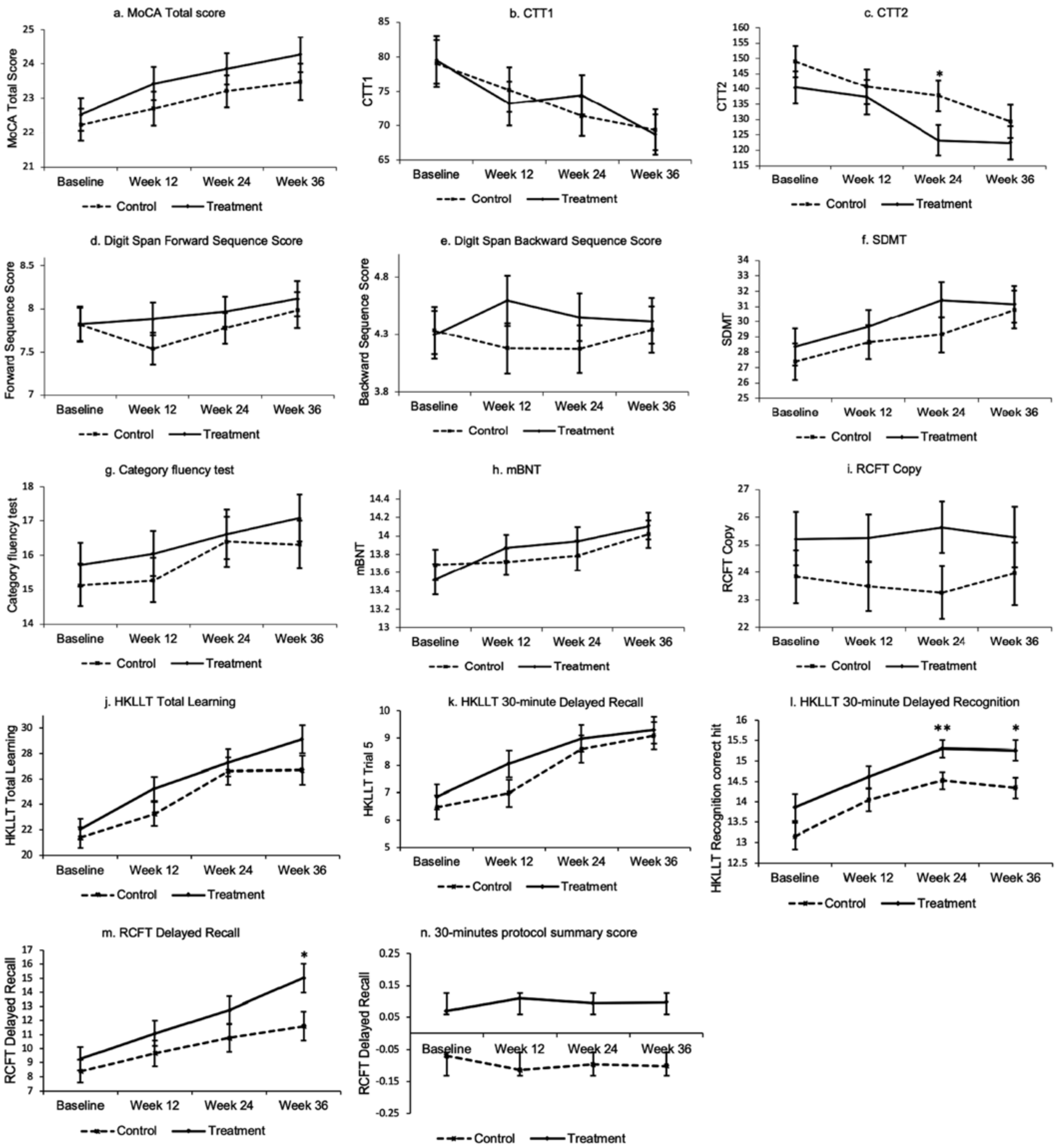

FIG 1. Group difference on cognitive functions at different time points. At week 24, the treatment group has better performance in executive functions measured by Colour Trails Test (CTT) and delayed recognition measured by Hong Kong List Learning Test (HKLLT). There is no group difference in other cognitive functions such as global cognition measured by Montreal Cognitive Assessment (MoCA), memory measured by Rey Complex Figure Test (RCFT), and processing speed measured by Symbol Digit Modalities Test (SDMT).

on cognitive functions was found. At week 24, the treatment group had better performance in executive functions and delayed recognition (Fig. 1). Effect size (Cohen's f^2) was 0.18 for delayed recognition and 0.39 for executive functions. There was no group difference in other cognitive functions.

At week 12, the treatment group had better performance in timed-up-and-go test. At weeks 24 and 36, there was no significant treatment effect on physical functions (Fig. 2).

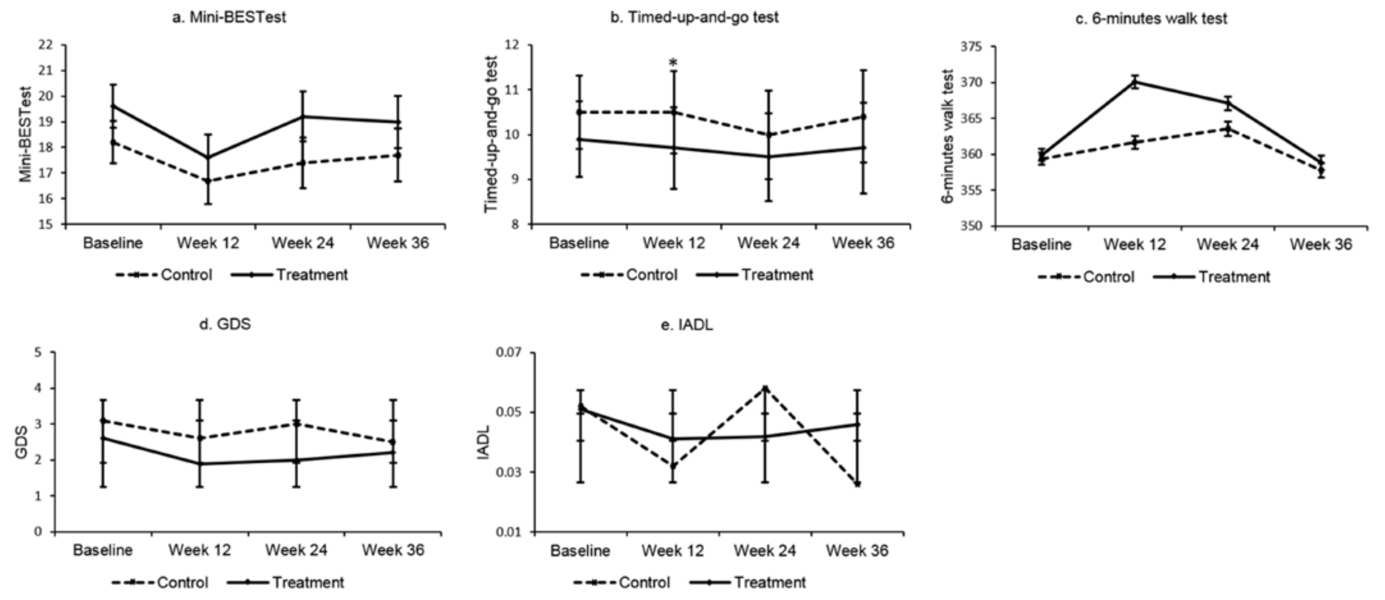

FIG 2. Group difference on physical functions, Geriatric Depression Scale (GDS), and Lawton instrumental activities of daily living scale (IADL) at different time points. At week 12, the treatment group has better performance in timed-up-and-go test. There is no significant group difference on GDS or Lawton instrumental activities of daily living scale at any time point.

There was also no significant group difference on GDS or Lawton instrumental activities of daily living scale at any time point.

There was no significant group difference on the pulsatility index or breath-holding index or IPAQ score at any time point. No mediation was found between aerobic dance training and cognitive functions, mood, or physical functions, after adjusting for age, sex, years of education, and change in IPAQ.

Post-treatment effects were found in memory (total learning and delayed recall) and GDS score.
A total of 26 adverse events were reported; 15 of them were serious adverse events. Only one event (plantar fasciitis) occurred in the treatment group was considered to be related to the intervention.

Discussion

The 24-week aerobic dance training improved performance across multiple cognitive domains. Moreover, the memory benefits lasted for at least 3 months after active treatment. Nonetheless, we did not find any clinically significant effects of treatment on physical functions, mood, or daily functions, nor a significant mediating role of CVR on the treatment effects on cognition.

In community older persons with cerebral small vessel disease, the 24-week aerobic dance training significantly improved memory and executive functions, with enduring memory benefits lasting at least 3 months. No benefits were found for physical functions, mood, or daily functions. Cognitive benefits of aerobic dance did not appear to be mediated by improvement in CVR. The aerobic dance is safe for older persons with cerebral small vessel disease.

Funding

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Reference

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