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Detraining effects of regular Tai Chi exercise on postural control ability in older women: A randomized controlled trial

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ABSTRACT

Objective: This study aimed to investigate the training and detraining effects of Tai Chi (TC) on postural control ability in single leg stance (SLS) by conducting a single-blind randomized controlled trial.
Method: Forty-eight older women were randomly divided into the TC, brisk walking (BW), and control(C) groups by using computer-generated program. The participants completed a 16-week intervention training and 8-week detraining program. Postural control ability in SLS was tested at the baseline, 16 t h, 20 t h, and 24 t h weeks. The primary outcomes included single-leg stance time (Time) and secondary outcomes included maximal displacement of the center of pressure (COP) in the anterior–posterior (AP) direction (D-ap), maximal displacement of the COP in the medial–lateral (ML) direction (D-ml), total length of the COP trajectories (Lng), and 95% confidence ellipse area of the COP movements (area), mean AP total excursion velocities (V-ap), and mean ML total excursion velocities (V-ml).
Results: Significant within-group difference compared with the baseline and between-groups difference compared with control group were found at 16 t h, 20 t h, and 24 t h weeks in the TC group and at the 16 t h and 20 t h weeks in the BW group in all the primary and secondary outcomes. Most of secondary outcomes including Lng, D-ml, V-ml, Area increased significantly at the 24 t h week compared with that at the 16 t h week in BW group.
Conclusions: TC was effective in improving postural control ability and maintaining intervention gains, and was recommended as an appropriate exercise to prevent falls in the older adults.

Introduction

The risk of falling in the older adults increases with aging. Approximately one-third of older adults over 65 years of age fall at least once a year.[1] Falls could result in severe injuries, such as fractures, head injuries, and even death.[2] Moreover, the high costs of health care resulting from falls have placed an enormous burden on families. The total costs reached about 23.3 billion in the USA and 1.6 billion dollars in the UK.[3] Declining postural control ability in single-leg stance (SLS), which is profoundly challenging for older adults, is a significant predictor of falls[4] in the elderly. Nearly 50% of falls occur during the single-leg support phase, such as stepping over obstacles and climbing stairs.[5,6]

Regular Tai Chi (TC) could improve postural control ability.[7,8] A cross-sectional study reported that long-term TC practitioners performed well in SLS tests with their eyes closed,[9] possessed less body sway in perturbed single-leg stance,[10] leaned further without losing stability, and showed a good control of their leaning trajectory.[11] Longitudinal studies also provided evidence of the benefits of TC for postural control ability. After a 24-week intervention, the TC group showed significantly shorter total, medial–lateral, and anterior–posterior center of pressure (COP) sway paths compared with the control group.[7] Similarly, another study also corroborated that a 10-week TC training could decrease the COP path and area during postural control tests in the older adults.[12] Furthermore, TC exercise could improve joint kinesthesia,[13] muscle strength in

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lower extremities,[14] and neuromuscular reaction in older women.[15]

Although TC has been recognized as an effective exercise to improve postural control in older adults, few detraining effects on postural control ability were known. Some older people have stopped training for various reasons, including diseases, injuries, and travels, and they may go on retraining. After post-exercise, some intervention effects on the physical function could start to diminish.[13] Nevertheless, few data offered the magnitude and retention of the maintenance of postural control ability during detraining periods.

Alternatively, brisk walking (BW) was one of the prevalent moderate-intensity aerobic exercise forms across all ages. Although some longitudinal studies have proven that BW could improve static and dynamic balance abilities and lead to the reduction of fall risk in the older adults,[16,17] others affirmed the inconsistent results on postural stability.[18] To our knowledge, TC and BW are safe methods of exercise for older women and require an equivalent energy expenditure.[19] Nonetheless, the detraining effects of both exercises on postural control ability in older women remained unclear.

The present study aims to compare the detraining effects of TC and BW on postural control in the older adults. The following hypotheses are formulated: (1) after the 16-week intervention, the postural control with SLS will improve in both groups, and (2) TC will be effective for maintaining SLS during a detraining period.

Methods

Study design

A single-blinded randomized controlled trial was designed to compare the effects of TC and BW on body balance in SLS during a 16-week training and an 8-week detraining (Figure 1). Both TC and BW groups participated in one 60-min intervention exercises at 5 times a week for 16 weeks. The control group attended group session with the same schedule as the two intervention groups. After stopping the exercises, all participants were prohibited to perform regular exercises for 8 weeks. Postural control ability was tested at the baseline and at the 16 t h, 20 t h, and 24 t h weeks.

Participants

Sample size estimation

G*Power software was used to calculate the sample size with the formula by Hopkins.[20] The following data were determined: effect size = 0.35, two-tailed significance, statistical power = 0.8, α value = 0.05, and drop-out rate = 25%.[18] So three groups of 48 participants were the required sample size.

Participant recruitment and randomization

48 older women aged 60–70 years were recruited through newspapers, leaflets, and community advocacy from Jinan city, China. The exclusion criteria were as follows: having any regular exercise experience and any records of cardiovascular, neurological, falling history, and musculoskeletal diseases. All participants were randomly divided into the TC (n = 16), BW (n = 16), and control (C) groups (n = 16) by using computer-generated program. This study was approved by the ethics committee of Shandong Sport University (No.201613). All the participants were requested to sign a written informed consent statement. The total study period was 6 months.

Exercise intervention

During the 16-week training periods, each group participated in a 60-min session at 5 times a week for 16 weeks. In addition, at least 64 attendance sessions of 80 (80%) were required for each participant among the three groups.

The participants were individually taught to perform a24-form TC exercise by a qualified TC master in the first 3 weeks. Each session included a 10-min warm-up, 20-min learning new movement forms, 20-min reviewing learned movements before, and 10-min cool-down. Subsequently, they practiced with master supervision for the 13 weeks. Each session included a 10-min warm-up, 40-min TC, and 10-min cool-down.

Brisk walking was defined as walking at a 1.79 m/s speed value.[21] During this exercise, the participants perceived that their breathing significantly accelerated, that their body got extremely hot, and that their sweat streamed down.[18] A professional instructor asked the participants to regulate their pace and speed on a pedestrian road. The time of walking increased from 10 to 40 min progressively over the first 3 weeks and then remained constant at 40-min for the later 13 weeks. A session consisted of a 10- minutes warm-up, 40- minutes BW, and 10- minutes cool-down.

The control group was asked to watch TV programs, read newspapers, or attend healthy education lectures with the same schedule as the two other groups. However, they were prohibited to perform any regular exercise and were allowed to maintain their dietary habits.

During the 8-week detraining, the participants of the three groups were asked to stop the intervention exercise and any regular exercise. The researchers called all participants on a weekly basis to confirm whether they participated in any programmed exercises.

Outcomes

Primary outcomes

The SLS tests were performed to assess postural control ability in a quiet testing room, which reported good interclass correlation coefficient (ICC = 0.95 to 0.99) and within the rater interclass correlation coefficient (ICC = 0.73 to 0.93).[22] This measurement procedure asked the participants to stand on the ground in SLS with eyes open and closed, arms hanging on the sides of their relaxed bodies while the other leg was flexed 90° at hip and knee joint. When the balances with eyes open were tested, participants were required to gaze at a dot on the wall 2.5 m away. The length of time was recorded from the moment the participants' foot was off the floor until it touched the floor again. The SLS with the participants' eyes open and closed were performed thrice, and the longest one was selected for analysis. A 1-min break was given between trials.

Secondary outcomes

The tests were performed with a foot pressure plate (RSscan footscan 2D Balance 0.5 m system).[23] Each participant was asked to stand barefoot in a comfortable self-chosen stance facing the positive anterior–posterior (AP)direction on a plate with the dominant leg, which is described as the preferred leg for kicking a football,[24] as motionless as possible. The other leg was fixed 90° at hip and knee joint flexion. Both arms hung relaxed at the sides. Two conditions of standing were tested randomly: one when participants were asked to perform single-leg standing for 22 s with eyes open while looking straight ahead at a dot on the wall 2.5 m away[25]; another one was when they performed single-leg standing for 12 s with eyes closed.[26] The trial was unavailable and repeated if the participants moved the supported leg or if the non-weight leg touched the supporting surface during the testing duration. Three successful trials of each SLS with eyes open and closed were tested after two familiarized test procedures. The time interval for breaks was 1 min between two trials. All measurement procedures were performed under the supervision of a technician.