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ORIGINAL ARTICLE

Comparative Impacts of Tai Chi, Balance Training, and a Specially-Designed Yoga Program on Balance in Older Fallers

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Abstract

Objective: To compare the effect of a custom-designed yoga program with 2 other balance training programs.

Design: Randomized controlled trial.

Setting: Research laboratory.

Participants: A group of older adults (N=39; mean age, 74.15±6.99y) with a history of falling.

Interventions: Three different exercise interventions (Tai Chi, standard balance training, yoga) were given for 12 weeks.

Main Outcome Measures: Balance performance was examined during pre- and posttest using field tests, including the 8-foot up-and-go test, 1-leg stance, functional reach, and usual and maximal walking speed. The static and dynamic balances were also assessed by postural sway and dynamic posturography, respectively.

Results: Training produced significant improvements in all field tests ($P<.005$), but group difference and time × group interaction were not detected. For postural sway, significant decreases in the area of the center of pressure with eyes open ($P=.001$) and eyes closed ($P=.002$) were detected after training. For eyes open, maximum medial-lateral velocity significantly decreased for the sample ($P=.013$). For eyes closed, medial-lateral displacement decreased for Tai Chi ($P<.01$). For dynamic posturography, significant improvements in overall score ($P=.001$), time on the test ($P=.006$), and 2 linear measures in lateral ($P=.001$) and anterior-posterior ($P<.001$) directions were seen for the sample.

Conclusions: Yoga was as effective as Tai Chi and standard balance training for improving postural stability and may offer an alternative to more traditional programs.

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Falls are the leading cause of death from injury in older individuals, whereas noninjurious falls often result in inactivity and functional dependence.[1] One third of persons >65 years old experience ≥1 falls annually.[2] Additionally, fall probability increases 4% per year.[3] Lack of physical activity, reduced muscle strength and power, and low postural stability are all strongly correlated with increased fall risk.[4]

Exercise interventions targeting postural stability attenuate fall incidence,[5] improve walking speed,[6] increase activities of daily living function,[7] and reduce fear of falling.[8] Tai Chi is widely used to improve older persons' balance and reduce fall risks[9] through improved strength, flexibility, kinesthetic awareness, and coordination.

Yoga integrates physical, mental, emotional, and spiritual dimensions to promote health. Several studies have reported that yoga increases muscle strength, power, endurance, flexibility,[10] and balance and coordination[11] in younger persons; however, there are a limited number of controlled studies demonstrating its capacity to improve balance in older persons. A study providing Kripalu yoga training to 8 women reported positive impacts on gait speed and postural control.[12] A second study used Iyengar Hatha yoga targeting older persons' lower body strength and flexibility, increased peak hip extension strength, and stride

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length.[13] Another study with independent living older adults indicated that a 12-week yoga program significantly increased static balance and lower body flexibility, but not fear of falling.[14] Finally, Tatum et al[15] showed that therapeutic yoga could improve standing balance, lower body strength, and floor transfer capacity of older persons.

The purpose of this study was to compare the effect of our specially designed balance yoga program on balance and postural control in older fallers with those produced by a Tai Chi program and a standard balance exercise program. We hypothesized that balance yoga would significantly improve static and dynamic balance and gait speed across 12 training weeks and these improvements would be greater than those resulting from Tai Chi or the standard balance exercise program.

Methods

Participants

Forty-eight healthy older persons participated in the study. To be included, the individual had to be ≥60 years old, be living independently, require no assistance in performing activities of daily living, and have fallen at least once in the past year. Individuals with neurologic impairment affecting balance; severe musculoskeletal impairment; unstable chronic disease state; significant visual or vestibular impairment; uncontrolled hypertension; simultaneous use of cardiovascular, psychotropic, and antidepressant drugs; and Mini-Mental State Examination score <18[16] were excluded. Participants were recruited using flyers and contacts at our university. They were required to forgo any formal balance-related exercise program for the study's duration.

Procedures

Figure 1 presents a Consolidated Standards of Reporting Trials flowchart for the study. During the initial visit, participants completed a written consent approved by our university's Subcommittee for the Use and Protection of Human Subjects, a health status questionnaire, a fall efficacy scale,[17] and the Falls Risk for Older People—Community Setting to confirm eligibility.[18] Participants who were eligible returned for another visit to complete baseline testing and were allowed to get familiarized with all field and laboratory tests. All tests were conducted by the same testers at each time point. Tests were performed by registered athletic trainers and kinesiology graduate students who were trained and supervised by a registered physical therapist.

Training began the week after the last testing day for all but 2 subjects, who started during the second training week. Because testing was completed within 2 weeks, <1 week lapsed between pretests and the beginning of training. Posttests began the week after training and were completed in 1 week.

Field tests

Five field tests were used to assess balance and gait, including the 8-foot up-and-go test,[19] 1-leg stance,[6] functional reach (FR),[6] and usual and maximal walking speed.[20,21] All tests are valid and reliable functional measures in older persons. The 1-leg stance and FR were performed on both the left and right sides. Because of the number of tests used, age and status of the participants, and potential for fatigue, tests were performed twice, with the higher value used for statistical analysis.

List of abbreviations:

CI **confidence interval**
EC **eyes closed**
EO **eyes open**
FR **functional reach**

Laboratory tests

Postural sway was assessed on an AccuSway force platform[a] with eyes open (EO) and eyes closed (EC). Data included the area of the 95% confidence ellipse, anterior-posterior and medial-lateral displacement averages, anterior-posterior and medial-lateral displacement maximums, anterior-posterior and medial-lateral displacement minimums, anterior-posterior and medial-lateral displacement SDs, average velocity, anterior-posterior and medial-lateral velocity maximums, and anterior-posterior and medial-lateral velocity minimums. Tests were performed with participants standing on the platform without shoes, with feet 16cm apart and arms at their sides. Each test included three 10-second repetitions. These results are effective predictors of recurrent falls in older persons.[6]

The participants also completed a dynamic posturography test on the Proprio 5000.[b] Briefly, the device's ultrasonic transmitter was positioned between L5 and S1. The platform then incrementally increased angles, speeds, and directions in a complex pattern. The maximum test duration was 120s; however, the platform stopped automatically before the 120s duration was reached if the sensor detected movement of 7.6cm or more across a .25s time interval or greater than 12.7cm from the starting point regardless of the direction. Data included the sum of the linear displacements; time on the test; linear displacements in the lateral, anterior-posterior, and up/down directions; and angular displacements for flexion/extension, lateral flexion, and rotation. The validity of the Proprio 5000 as a measure of movement of the participants' center of mass has been previously established.[6]

Intervention

Tai Chi, standard balance exercise program, and balance yoga classes occurred twice per week for 12 weeks. Visits lasted approximately 60 minutes, including 5-minute warm-up, 50-minute training, and 5-minute cool-down. We have demonstrated, as have others, that a twice per week training program using similar interventions was sufficient to engender a significant improvement in the participants.[6,8,22]

Tai Chi

Sixteen participants were randomly assigned to Tai Chi; 11 completed the training. Tai Chi was Chen style emphasizing whole-body motion using alternating fast and slow coordinated upper and lower body rotational movements.[23] A certified Tai Chi master taught the class. The form incorporated 18 movements, including knee bends, small and large forward and backward steps, trunk rotation, and weight shifts, focusing on postural alignment and eye-hand coordination (supplemental appendix S1, available online only at http://www.archives-pmr.org/).

Standard balance program

Sixteen subjects were assigned to the standard balance exercise program; 15 completed the program. The program included standard balance activities,[24] including maintaining balance on

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