

EFFECTS OF SIMPLIFIED EIGHT-FORM TAI CHI EXERCISE ON THE BALANCE ABILITY AMONG THE ELDERLY

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This study mainly investigated the effects of a 16-week, simplified eight-form Tai Chi exercise on balance ability among the elderly under four conditions, namely, double stance with eyes open (DO), double stance with eyes close (DC), single stance with eyes open (SO), and single stance with eyes closed (SC). Methods: A 3D force plate (Kistler, 9287BA) was used to assess balance stability by measuring the center of pressure (COP) data when the participants were standing still. The main outcome showed Tai Chi practitioners had a lower value in root mean square of COP in the anterior–posterior direction (DO RMS-AP), mean square of COP in the medial–lateral direction (DO RMS-ML) under DO condition, average rate of COP in the medial–lateral direction (SC COP-ML) under SC condition, and a higher single stance with eyes open time (SOT) than these of no exercise practitioners. It is concluded that 16-week, simplified eight -form Tai Chi exercise could improve balance ability.

KEYWORDS: Tai chi, body stability, center of pressure,

INTRODUCTION: Each year, approximately one out of three older adults will experience a fall, and approximately 50% of elders who had previously suffered falls will experience repeated falls (Novak, Komisar, Maki, & Fernie, 2016). Approximately 25% of falls result in an injury ranging from minor bruising to hip fractures. Hip fractures are a particularly severe consequence of falling: the one-year mortality rate following hip fracture is approximately 25% (Elliott, Foster, Whitaker, Scally, & Buckley, 2015). Recent reports have identified that stair gait falls account for 26% of all self-reported falls (Antonio & Perry, 2014), and has become the leading cause of accidental death for the elderly (Buckley, Heasley, Scally, & Elliott, 2005).

Tai Chi is a traditional Chinese conditioning exercise. The basic Tai Chi exercise is a series of graceful movement linked together in a continuous sequence so that the body is constantly shifting from foot to foot. During the performance of Tai Chi, deep breathing and mental concentration are required to achieve harmony between body and mind (Wong, Lin, Chou, Tang, & Wong, 2001). It has been proved that Tai Chi could improve body stability in the elderly by altering their body condition, gait, and proprioception (Chang et al., 2016; Sun et al., 2016; Zhou et al., 2015; Zhou et al., 2014). Motions characteristic of Tai Chi, like bending the knees and shifting weight in a smooth and controlled motion, improve lower-limb strength (Gyllensten, Hui-Chan, & Tsang, 2010); Tai Chi exercise expanded the limits of body stability boundary (Li, 2014), which is considered as a risk factor for falls among the elderly (Mao, Li, & Hong, 2006).

The most popular Tai Chi styles in the whole world are 108-form Yang style and 24-form standard style, it means that practitioners need to remember and perform 108 or 24 movements during the exercise. As humans age, the learning ability of humans starts to decrease. It would be a hard task for the elderly to memorize the complicated movements, and many practitioners quit the exercise since the difficulty of the movements. From this point of view, an simplified simplified eight -form Tai Chi exercise was designed, but few studies investigates the effects of the exercise on improving one's balance. Accordingly, this study aimed to investigate the effects of the 16-week, simplified simplified eight-form Tai Chi exercise on balance ability among the elderly by a test-retest research design under 4 different conditions, namely, double stance with eyes open (DO), double stance with eyes close (DC), single stance with eyes open (SO), and single stance with eyes closed (SC).

METHODS: Subjects: A total of 30 elderly aged from 65 to 75 years were recruited and randomly divided into the Tai Chi group and the control group. After considering several criteria, one person was excluded from the Tai Chi group, and five people were excluded from the control group. The 14remaining people in the Tai Chi group practiced simplified Tai Chi for 1 hour a day and 4 times a week for 16 weeks, whereas the 9-remaining people in the control group performed their daily activities without engaging in regular physical exercise. Equipment: A 3D force plate (Kistler, 9287BA) was used to assess balance stability by measuring the center of pressure (COP) data when the participants were standing still. Test steps: The participants were asked to stand still under SO, SC, DO, and DC conditions for three times. Under SO and SC conditions, the participants were asked to stand as long as possible. Under DO and DC conditions, the participants were asked to stand still of two minutes. Outcomes: the root mean square of COP in the anterior–posterior direction (RMS-AP), root mean square of COP in the medial–lateral direction (RMS-ML), average velocity of COP in the anterior–posterior direction (COP- AP), average velocity of COP in the medial–lateral direction (COP-ML), SO time (SOT), and SC time (SCT). Data analysis: A two-factor repeated variance analysis of the group and intervention effects and the interactions. If a significant interaction effect was observed between these independent variables ($p < 0.05$), then Bonferroni's adjusted post hocs were adopted to perform a pairwise comparison.

RESULTS: Table 1 shows that after 16 weeks of Tai Chi intervention, the values of DO RMS-AP, DO RMS-ML, SC COP-ML decreased, and SOT increased. $week_0$ represents before intervention, and $week_{16}$ represents after intervention, a denotes a significant difference from the Tai Chi group in $week_{16}$, while b denotes a significant difference from the control group at the same time. After 16 weeks of simplified Tai Chi exercise, the DO RMS-AP, DO RMS-ML, SC COP-ML decreased, and SOT increase among Tai Chi practitioners, whereas those of the no exercise practitioners did not show any significant difference.

Table 1 DO RMS-AP,DO RMS-ML,SC COP-ML, and SOT (mean±SD)

		Tai Chi group (n=14)	Control group (n=9)	Post Hoc	Interaction
DO RMS-AP	Week ₀	5.62±0.47 ^a mm	5.76±0.58 mm	a=0.012	P=0.012
	Week ₁₆	14.60±1.52 ^b mm	7.84±1.90 mm	b<0.001	
DO RMS-ML	Week ₀	6.71±1.66 ^a mm	9.89±2.07 mm	a<0.001	P<0.001
	Week ₁₆	19.74±1.23 ^b mm	6.53±1.57 mm	b=0.013	
SC COP-ML	Week ₀	33.53±20.02 ^a mm	202.18±24.98 mm	a<0.001	P<0.001
	Week ₁₆	147.91±6.96 ^b mm	171.10±8.68 mm	b=0.008	
SOT	Week ₀	16.03±2.24 ^a s	13.38±2.80s	a<0.001	P<0.001
	Week ₁₆	41.49±3.49 ^b s	14.85±4.36 s	b<0.001	

* a denotes a significant difference from the Tai Chi group in week 16

* b denotes a significant difference from the control group at the same time

DISCUSSION: The purpose of this study was to explore the effect of simplified eight-form Tai Chi on the balance ability compared control group. Our findings suggest that after a 16-week of simplified eight-form Tai Chi exercise, DO RMS-AP, DO RMS-ML and SC COP-ML decreased, and SOT increased. The static posture control of the elderly has been widely used to measure their ability to maintain balance while standing. COP displacement, COP root mean square, and average COP rate in the AP and ML directions have been used as indicators of static posture control in many studies (Hatton et al., 2011; Hazime et al., 2012; Nagy et al., 2007; Wingert et al., 2014). After a 16-week, simplified eight-form Tai Chi exercises, the values of the DO RMS-AP and DO RMS-ML decreased. Before intervention, the small change in the elderly's body position may also reflect a strategy that automatically disturbs the body to make it swing as little as possible because of fear of falling. During simplified eight-form Tai Chi practice, participants need to bend their knees and move their weight to control balance, and the basic premise of the program is emphasize practicing single forms with repetitions and bilateral stepping with body-weight transfer. Previous studies showed that Tai Chi exercises, knee strength muscle strength increased (eg, quadriceps femoris, biceps femoris, tibialis anterior, and gastrocnemius), which may be the reason result in increased DO RMS-AP and DO RMS-ML. In addition, during the practising of Tai Chi, it is necessary to continuously move the center of gravity to different positions in a stable and coordinated manner. The movement of the center of gravity constantly challenges the balance control system, and the range of motion is greater without losing the stability limit (Tsang et al., 2003). The value of SC COP-ML also increased after the intervention, Tai Chi exercise requires changing of the center of gravity, and the movement of the center of gravity is alternated more in medial-lateral direction compared with other exercise, like normal walking. The unique exercise manner allows the human body to exercise well in the medial-lateral muscles (groups) and nervous system, the increase of SC COP-ML may be resulted in the increased strength of the lower limb muscle groups in the medial-lateral directions. Simplified eight-form Tai Chi can also produce a good self-protection effect to prevent physical harm, improve one's balance ability, increase the SOT index, promote muscle strength, and extend one's time of standing on one

foot(Tse S K et al.,1992).

CONCLUSION: Our data suggest that simplified eight-form Tai Chi practitioners show better balance ability than no exercise practitioners. Simplified eight-form Tai Chi could improve their posture control ability, it be considered as a training method to improve the balance of the elderly.

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