Effects of Tai Chi Chuan on the elderly balance: a semi-experimental study

Efeitos do Tai Chi Chuan no equilibrio de idosos: um estudo semiexperimental

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Abstract

Aging impairs the functional capacity, possibly compromising the balance over the years. However, Tai Chi Chuan is a martial art that can provide balance improvements in elderly people. This study aimed to evaluate balance in elderly after three and six months of Tai Chi Chuan practicing. Participants were 27 individuals (62±4.4 years) who underwent Tai Chi Chuan training (one hour each) twice a week, for six months. Balance was assessed by the Timed Up and Go (TUG) test, Berg Balance Scale (BBS) and Romberg test, all evaluated before and after three and six months of practicing. MANOVA for repeated measures was used to compare times in TUG and BBS tests. The Cochrane Q test was used to compare moments and frequencies in the Romberg test (α=0.05). Results showed significant improvement in TUG performance ($p \leq 0.01$), BBS score ($p \leq 0.01$) and in the Romberg test ($p \leq 0.01$) after three and six months, compared with pre-training. These results suggest that Tai Chi Chuan practice can improve the balance in elderly people.

Key words: Tai Chi Chuan. Balance. Elderly.

Resumo

O envelhecimento compromete a capacidade funcional ao longo dos anos, possivelmente afetando o equilíbrio dos idosos. No entanto, o Tai Chi Chuan é uma arte marcial que pode proporcionar melhoras no equilíbrio desses indivíduos. O objetivo deste estudo foi avaliar o equilíbrio de idosos após três e seis meses de prática do Tai Chi Chuan. O estudo incluiu 27 idosos (62±4,4 anos) que foram submetidos a um treinamento de Tai Chi Chuan duas vezes por semana, com duração de uma hora cada sessão, durante seis meses. O equilíbrio foi avaliado pelo teste *Timed Up and Go* (TUG), Escala de Equilíbrio de Berg (BBS) e teste de Romberg, todos avaliados em diferentes momentos: pré-treinamento, três e seis meses após o mesmo. Uma MANOVA para medidas repetidas foi utilizada para comparar os momentos nos testes TUG e BBS. Para o teste de Romberg, bem como nas frequências, utilizou-se o teste Q de Cochrane (α=0,05). Os resultados demonstraram melhora significativa do desempenho no TUG, quando

Palavras-chave: Tai Chi Chuan. Equilíbrio. Idosos.

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comparado o momento pré com três e seis meses de treinamento (p≤0,01). De forma semelhante, na BBS foi observado aumento na pontuação em três e seis meses em relação ao pré-treinamento (p≤0,01). O teste de Romberg apresentou também melhora significativa em três e seis meses após o treinamento (p≤0,01). Estes resultados sugerem que a prática de Tai Chi Chuan pode melhorar o equilíbrio de idosos.

INTRODUCTION

Balance is directly related to the quality of life, and its magnitude is directly related to the prevalence of falls,[1] that can generate more complex injuries involving joints such as ankle, knee, hip, spine and upper limbs.[2] It is well known that aging impairs balance over the years, by affecting a number of factors, such as neural, cognitive and/or reduction in physical activity.[3] Thus, the more advanced the age, the less physically active are elderly people, therefore impairing the maintenance of balance.[4]

According to Oinuma et al.,[5] falling is the leading cause of mortality and morbidity among elderly people. According to Nickens[6] and Perry,[7] about 50% of people who suffered a fall, fracturing the hip joint, will possibly find difficult in performing the walking movement functionally again. According to the literature, women fall more frequently than men, mainly due to hormonal changes after menopause.[8]

According to Ragnarsdóttir,[9] the body balance and postural control are used as synonymous terms and could be defined as the ability to maintain the center of gravity on the body designed limits of the base of support during dynamic and static conditions. During the static equilibrium, Brocklehurst et al.[10] say it is impossible to stand without exercising motion, because the body just hovers over its support base and the more advanced the age, the greater the degree of postural sway. The authors[10] also point out that postural sway is related to the risk of falling, and that it can identify people predisposed and thus develop behavioral strategies that help prevent them.

Shumway-Cook & Woollacott[11] state that in keeping balance within the limits of stability and postural control, the system tries to adjust the position of the center of gravity through body movements or by adopting strategies for reducing body instability. However, aging impairs body balance, affecting the quality of life of these individuals. Thus, there are several activities, such as Tai Chi Chuan,[11] that can help improve and maintain the balance.

Tai Chi Chuan is an ancient Chinese martial art that improves coordination between consciousness and breathing, while minimizing tensions, by executing slow and flexible movements.[12] Its practice promotes mental concentration and the control of movements of the whole body. Cheng[13] says that besides being practical in its implementation, large spaces or equipment are not needed. Huang et al.[1] and Yan & Downing[14] mentioned that Tai Chi offers to its practitioners a variety of physical and psychological benefits, such as improvements in motor control, increase in strength, reduction of stress, anxiety and depression. It also has high acceptance and adherence for being individualized, not exhausting and non-competitive. Furthermore, the American College of Sports Medicine (ACSM) recommends the practice of physical activity such as Tai Chi Chuan as the best way to improve health.[15]

Zhang et al.[16] evaluated the effects of eight weeks of Tai Chi Chuan physical practice in community-dwelling elderly people with relatively-low balance performance. They found that Tai Chi Chuan improved balance function and flexibility in the community-dwelling elderly with lower ability to keep balance.

Pereira et al.[17] investigated the effects of Tai Chi Chuan on balance and strength of the knee extensor muscles among elderly women. The experimental group practiced Tai Chi Chuan for 12 weeks, three times a week. Strength was

measured using a maximal repetition test on the extensor chair and balance was evaluated using the unipodal support test with the eyes closed. The experimental group presented increases of 17.83% in the knee extensors muscle strength and 26.10% in balance; on the other hand, the control group did not show any significant changes in these variables. In a meta-analisys study.

Logghe et al.[18] concluded that there are insufficient evidences of the effectiveness of Tai Chi Chuan on falling prevention, decreasing fear of falling and improving balance in elderly people. However, the presence of a positive dose-effect relation in Tai Chi Chuan is highly likely. Thus, the aim of this study was to evaluate the effects of practicing Tai Chi Chuan by comparing the balance of elderly people after three and six months of training.

METHODS

Study design

This research is a semi-experimental study.[19] The study subjects were selected by probabilistic non-intentional sampling.[20]

Study subjects

Twenty seven elderly women with mean age of 62.3±4.4 years, height 1.62±0.06 and body mass of 68.1±6.5 volunteered to participate in this study. The following inclusion criteria were adopted: (1) should be at least 60 years old; (2) should not be practicing physical exercises regularly for at least one year; (3) have the physical and cognitive skills required for the practice of Tai Chi Chuan; and (4) do not take any medications that could affect balance.

Experimental protocol

The participants were recruited in November 2011 in the city of Caxias do Sul (Brazil) and then submitted to an interview, in order to identify whether the subjects fulfilled the inclusion criteria. For the characterization of subjects, the body mass (kg) and height (cm) were assessed. Subsequently, three evaluations were carried out: (1) in December 2011, just before starting the training program; (2) in February 2012, three months after starting the training program; and (3) in May 2012, six months after starting the training program.

Training protocol

The Tai Chi Chuan training program corresponded to a session lasting one hour and performed twice a week. The training protocol consisted of (1) 30% (approximately 20 minutes) of general flexibility exercises, stretching, Chinese gymnastics (Lian Gong), Chinese massage (Tui-Na) and Chinese exercise equipment and improvement in muscle strength and ventilation system (Qi-Gong); (2) 70% (approximately 40 minutes) of 13 basic steps of the modern style Yang Tai Chi Chuan (Peng, Lu, Chi, An, Tsai, Lieh, Chou, Kao, Chin, Tui, Ku, Pan and Ting) that performed gates, stances, kinetic movements, techniques, tactics and force.

Evaluation protocol

For evaluating balance three tests were performed: *Berg Balance Scale* (BBS): evaluated the functional balance, based on 14 items common to everyday life. The maximum score that can be achieved in this scale is 56 and each item has an ordinal scale consisting of five options ranging from 0 to 4 points according to the level of difficulty (the higher the score, the better the balance). The test is simple, easy to administer, and safe for the evaluation of elderly subjects.[21,22.]

Timed Up and Go Test (TUG): this test assessed the sitting balance, changing from sitting to standing position, stability in ambulation and gait changes without using compensatory strategies. It is a simple test in which subjects were asked to stand up from a chair (resting position), walk a distance of three meters and then return to the chair and sit again (with their backs on

the backrest). All individuals were instructed to perform the task safely and as quickly as possible and their performances were analyzed by counting the time needed to complete it.[23,24] Before the tests, all the subjects were submitted to a familiarization protocol.

Romberg Test (RomT): this test is a method for assessing risks of falling and checking the body instability by measuring body oscillations, which are usually higher in the elderly. The subjects were asked to stand with their feet positioned in parallel to each other, remaining in that position and with eyes closed for one minute. If they could maintain the same, the evaluation is continued for one more minute. The test is considered positive when the subject is observed to oscillate, oscillate irregularly or even fall; or negative when no oscillation occurs.[25,26]

Statistical analysis

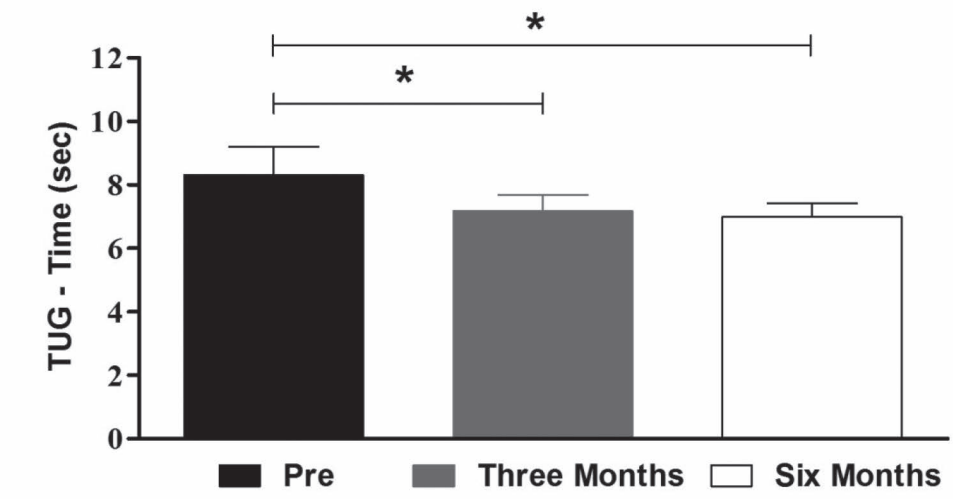
Descriptive statistics was carried out by calculating the mean and standard deviation values for each variable (mean±SD). Normality on data distribution was tested by the Shapiro-Wilk's test and the homogeneity by the Levene's test. Repeated measures MANOVA was used to test the effect of practicing Tai Chi Chuan on TUG and BBS performances over time. The comparison between each moment in which the TUG and BBS protocols were carried out (pre-training, after three and after six months) was done by means of a Bonferroni post-hoc analysis. Regarding the RomT, frequencies were used and the Cochran Q test with post-hoc McNemar. The level of significance adopted was 5%.

Ethical procedures

The study followed the ethical principles contained in the Declaration of Helsinki and was approved by the Ethics Committee from the institution in which this research was developed – Faculty of Serra Gaúcha (FSG), under the number 0184/2012. All participants signed an informed consent form prior to their participation in this research.

RESULTS

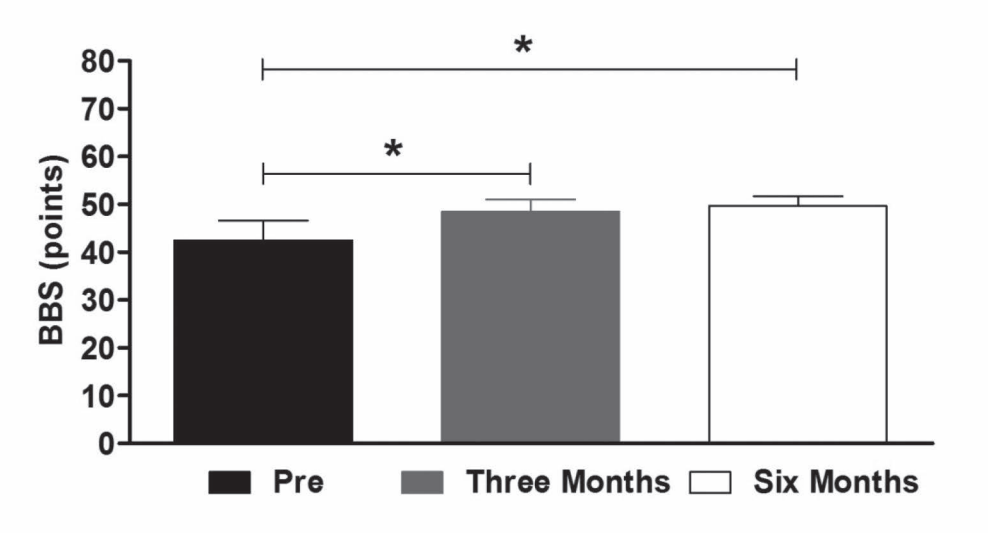
There was a significant effect of practicing Tai Chi Chuan on the TUG test performance ($p \leq 0.01$). However, no differences were observed when comparing the performances assessed after three and after six months of practices, as shown in figure 1.



*significant differences ($p \leq 0.001$).

Figure 1. Time in TUG test (mean±sd) at different moments. Caxias do Sul-RS, 2011.

Regarding the BBS test, practicing Tai Chi Chuan had also an effect on its performance ($p \leq 0.01$). The score reached previously to the start of training regimen was significantly lower than that achieved after three and after six months of practicing, however there were no differences between three and six months of practicing this martial art, as shown in figure 2.



*significant differences ($p \leq 0.001$).

Figure 2. Scores on the Berg Balance Scale (mean±sd) at different times. Caxias do Sul-RS, 2011.

Similarly to the other tests, the RomT has shown significant effect of practicing Tai Chi Chuan on balance ($p \leq 0.01$). Frequencies (relative and absolute) showed an increase in negative scores over time (table 1), totaling 100% at six months. However, when comparing three and six months of training no differences were observed ($p=0.15$).

Table 1. Absolute and relative frequencies of the Romberg test. Caxias do Sul-RS, 2011.

	Pre-training		Three months		Six months	
	n	%	n	%	n	%
Negative	12	44,4*£	23	85,2*	27	100£
Positive	15	55,6	4	14,8	-	-

*significant differences between pre-training and three months; £significant differences between pre-training and six months ($p \leq 0.001$).

DISCUSSION

The study of falls in the elderly is of particular interest due to its high frequency, but especially for the consequences caused by them (fractures, dislocations, lacerations, sprains, etc.) indicating a geriatric syndrome.[3] According to Fisher,[27] the improvement of balance is an important factor and a good indicator for the prevention of falls that can be trained. Hogan[28] indicated that balance is an important aspect for functional capacity, especially for motor independence and ability to perform activities of daily living. The balance can be improved by performing exercises that help in improving postural and joint mobility. Thus, the practice of Tai Chi Chuan could help improve these aspects. Tousignant et al.[29] evaluated some fall-related clinical variables (balance, gait, fear of falling, functional autonomy, self-actualization and self-efficacy) in 152 adults over 65 years old who were randomly assigned to either a supervised Tai Chi group or a usual physiotherapy group. Both exercise programs significantly improved fall-related outcomes but only the Tai Chi intervention group decreased the incidence of falls.

Pimentel & Scheicher[30] observed that sedentary elderly people had greater propensity to falls when compared to physically active ones, regarding the BBS score. They showed that at the pre-training, 34 elderly subjects scored less than 45 out of a total of 35 participants. While after the training 14 subjects showed a score lower than 45. It is stated that there is an increased risk of falls in individuals with a score lower than 45 points in the BBS.[31] Da Silva[32] conducted a Yang Style Tai Chi Chuan intervention in elderly people and found increases in the BBS score after 12 weeks of training. In the present study, we also observed an increase in the BBS score, with 12 weeks of Tai Chi Chuan practices, probably improving postural alignment and range of motion due to training.

Our results showed an improvement in the TUG performance in elderly subjects after six months of Tai Chi Chuan training. Similar results were shown by Da Silva,[32] who also found a significant decrease in the TUG time after only 12 weeks of Tai Chi Chuan in elderly. Murphy & Singh[33] evaluated the TUG, after practicing Tai Chi twice a week for 12 weeks. The results showed significant improvement in balance immediately after the intervention with the benefits remaining six months after intervention, which was not observed after 12 months.

Previous studies have shown that low walking speeds indicate increased risk of falls.[34] According to Li et al.,[35] practicing Tai Chi Chuan three times a week is effective in increasing walking speed after six months, suggesting a decrease in the risk of falls and an improvement in the functional balance. These authors assessed the TUG in elderly people involved in Tai Chi Chuan practices and compared them to a control group that did only stretching exercises. Significant improvements were observed in the group that practiced Tai Chi Chuan and the benefits were maintained at six months after intervention. In our study we observed significant improvements in body stability assessed by the Romberg test, in agreement with the results from the study of Hain et al.,[36] who found significant improvements in the balance of people of different ages. Likewise, the Tai Chi Chuan exercises used by McGibbon et al.[37] were effective when assessing gait in elderly people through several tests, including the Romberg test, showing significant improvements in balance.

One of the possible causes for the improvement in balance with practicing Tai Chi Chuan observed in this study may be explained by the training characteristics that seek to control the displacement of the center of body mass with postural alignment and range of motion of the joints of the lower body.[35] The results showed that Tai Chi Chuan training has significantly improved the balance of the elderly people who participated in this study.

Our data are in agreement with other studies that suggest improvements in proprioceptive and gait stability mechanisms, such as balance

and coordination, as a result of practicing Tai Chi Chuan, due to its diversity of movements.[1,38] Thus, Tai Chi Chuan may help reduce the occurrence of falls by improving the ability of postural control, especially in altered somato-sensorial situations, including visual and vestibular adverse conditions.[33,36,37,39,40]

One of the reasons that helped in the process of improving balance by practicing Tai Chi Chuan is the positioning of the legs, which need to be flexed, transferring the weight from one limb to the other while performing the exercises.[12] Lan et al.[41] found significant increase in the muscle strength of the knee extensors (18.1% in tests pre and post-tests 21.3%) and knee flexors (15.4% in tests pre and post-tests 15.9%) in a group of elderly people who underwent Tai Chi Chuan training program for 12 months.

The characteristics of the Tai Chi Chuan training adopted in our study remained the same from the beginning until the end of six weeks. However, the organization of exercise programs requires a good control on variables such as training intensity and volume.[42] The main goal should be to optimize the overload principle in an attempt to cause successive adaptations in the neuromuscular system. Maybe this is the reason why our study did not find differences in balance when comparing three and six months after starting Tai Chi Chuan training practice. Thus, if the volume and intensity of Tai Chi Chuan training had increased, it would be probably possible to promote metabolic and physiological changes in order to achieve a more satisfactory improvement in balance after six months of training.

Our study found an improvement in the balance of elderly people after starting the practice of Tai Chi Chuan. However, there were some limitations in this study, such as: (1) the absence of a control group; (2) not controlling variables that could influence balance (e.g. strength and flexibility); and (3) not evaluating kinematic or kinetic parameters related to balance.

CONCLUSION

The Tai Chi Chuan practice seems to be good for improving balance in elderly people. However, volume and intensity are fundamental for optimizing a training program, and controlling such parameters may contribute to the health and quality of life of the elderly.

Furthermore, results of this study can contribute to the Tai Chi Chuan integration as an option for the physical activity in public policies for aging. Since the falls and their complications are considered a public health problem, Tai Chi Chuan can improve the balance and prevent falls in elderly people.

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Recebido: 27/3/2013
Revisado: 28/11/2013
Aprovado: 22/1/2014