

# Evaluation and treatment of balance in the elderly: A review of the efficacy of the Berg Balance Test and Tai Chi Quan

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The purpose of this review of outcome studies was to determine whether the Berg Balance Test (BBT) can be considered a reliable predictor of a risk for falls in the elderly, and to review the efficacy of Tai Chi Quan in the physical therapy intervention of balance disorders in older adults as reported in the literature

The authors examined studies of the BBT, which showed that the two groups of people, fallers and non-fallers, have considerable differences among them. Fallers tended to be more variable in their characteristics as indicated by larger standard deviations. Based on these results, the authors suggest that patients who score high on the BBT should not be referred for further intervention, whereas patients who score 40 or less have a high probability of falls and require appropriate referrals. The BBT, which is relatively safe and simple, uses a quantitative scale, scoring is reproducible, and the strong internal consistency allows for easy interpretation of scores. The BBT has been shown to have moderately good sensitivity, and high specificity, and therefore is a good predictor of older adults who may have fall risks and may need assistive devices.

A big challenge, then, is to plan and implement an effective treatment technique to improve balance control. One recently identified intervention is Tai Chi Quan. Tai Chi is an ancient form of exercise for fitness and the martial arts which has been practiced in China for centuries. The second part of this report examines the efficacy of Tai Chi Quan as a treatment modality. A review of studies on Tai Chi Quan indicates that it has a positive effect on improving balance in the elderly, although

it has no effect on improving postural stability. The effects of Tai Chi on the treatment of balance still require extensive research. Although the articles reviewed indicate that Tai Chi does have a positive effect on balance, the methodology used in these studies needs to be improved.

Keywords: Berg Balance Test, Tai Chi Quan, balance, falls, elderly people

## 1. Introduction

In 1998 the National Institute of Health reported, among Americans age 65 and older, fall-related injuries are the leading cause of death due to unintentional injuries [8]. Research has shown that one in three persons over 65 years of age and almost one in two persons over 80 years of age will fall at least once each year [2]. Although only 5–20% of all falls result in serious injury or death, the psychological effects can lead to impaired mobility, loss of function, and an overall decrease in a person's quality of life [2,8]. The cost of acute care hospitalization, before factoring in rehabilitation and home-care services, amounts to an estimated \$10 million dollars every year [7].

Many researchers agree that a history of previous falls is the single most important risk factor for future falls. Impaired balance and gait, disabilities of the lower extremities, and foot problems have a high correlation with falls in the elderly [2]. Falling and the inability to get up after a fall are among the most feared problems for elderly adults and the fear itself may lead to increased falls [2,7]. Chronic conditions, such as orthopedic impairments, cardiac disorders, and decreased sensory perception, which lead to a decrease in function, may predispose older people to a risk of falling [2]. Such conditions may lead to a decreased ability to perform routine activities of daily living (ADLs), such as walking up and down stairs and mobility around the house [2].

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Table 1  
Berg balance test

1. Sitting to standing
2. Standing unsupported
3. Sitting unsupported
4. Standing to sitting
5. Transfers
6. Standing with eyes closed
7. Standing with feet together
8. Reaching forward with an outstretched arm
9. Retrieving object from floor
10. Turning to look behind
11. Turning 360°
12. Placing alternate foot on stool
13. Standing with one foot in front of the other foot
14. Standing on one foot

Adapted from Physical Therapy.  
1996; 76 : 579.

Researchers and clinicians report that a valid and reliable clinical assessment method, identifying a relative risk for falls, is needed for determining the appropriateness of referral into a fall prevention program. In addition, measures that quantify the risk of falling are potentially useful as a standard for evaluating outcomes following intervention [11]. The Berg Balance Test, which was designed to assess the ability of elderly people to maintain their standing balance, is examined in this report [9] (Table 1).

The specific purpose of this review of studies is to determine whether the Berg Balance Test (BBT) can be considered a reliable predictor of a risk for falls in the elderly, and to review the efficacy of Tai Chi Quan in the physical therapy intervention of balance disorders in older adults as reported in the literature.

## 2. Balance testing

Balance is defined as the ability of healthy and frail older adults to maintain postural stability during quiet standing, perturbed standing, and voluntary movement [13]. The maintenance of static balance, or in-place balance, is different from maintaining dynamic balance, or movement balance [13]. In static balance, the base of support (BOS) remains stationary and only the body's center of mass (COM) moves. The balance task is to maintain the COM within the BOS or the limit of stability [13]. In dynamic balance, both the BOS and COM are moving and the COM is not always kept within the BOS [13]. The Berg Balance Test provides a simple, safe and reasonably brief measurement of balance for elderly people [9].

The BBT consists of 14 subtests that are scored using a 0–4 scale (see Table 1), each of which is administered in a specific order. The maximum score is 56, and scores below 45 are considered indicative of balance impairment [2,5,11].

In a study by Newton [7], a group of 251 older adults, aged 60–95, with a mean age of 74.3 years ( $SD = 7.7$ ), of different ethnic backgrounds. The majority was African American (70%); the other two groups in the study were Hispanic (16%) and Caucasian (12%). The researchers examined the balance ability of older adults living independently. Participants were recruited from health fairs and senior centers. A BBT mode of 53 (maximum, 56 points) was reported on the group. Thirty-one participants (13%) scored 40 or below on the BBT and 16 (6%) scored the maximum of 56. Based on the low BBT score for the 31 people who scored below 40, the researcher determined the need for an assistive device. The results of the balance assessment of the sample indicated overall good balance abilities. The researchers suggested that the order of the test items may be modified when screening community-dwelling active older adults, preferably starting with the sixth item then moving forward or backward in the original order of the BBT test.

Shumway-Cook and colleagues [11] conducted a study on predicting the probability for falls among this population of community dwelling older adults (Table 2). The study incorporated 44 volunteers age 65 and above who lived independently within the community. Exclusion criteria included neurological or musculoskeletal diagnoses that could account for possible imbalance and falls. Participants were classified as fallers and non-fallers. A faller self-reported two or more falls within the past six months prior to the study. "A fall was defined as any event that led to an unplanned, unexpected contact with a supporting surface." Falls secondary to unavoidable environmental hazards were not included. Therefore, 22 Participants were classified as fallers, and 22 as non-fallers.

Each participant completed a Health Status Questionnaire, providing information on age, residential status, marital status, medical history, current co-existing medical conditions, self-reported history of imbalance, type of assistive device used for ambulation and prescription medications used. Also, each participant completed a Balance Self Perception Test to describe his or her perception of balance and perceived risks for falls and their interference with ADLs. Scores ranged from 0–60, with a higher score indicating an increased level of self-confidence. The Berg Balance Test was used to measure balance.

Table 2  
Summary of the studies

Study	Sample	Purpose	Results
Schumway-Cook et al. [11]	<i>N</i> = 44 2 Groups, Fallers vs Non Fallers Ages 65 and older Independent community dwellers	Develop a model for predicting the likelihood of falls among community dwelling older adults; BBT and Dynamic Gait Index used; sensitivity and specificity of BBT were measured.	BBT Specificity = 86% Sensitivity = 77% <i>R</i> = 0.76 between the BBT and Self
Harada et al. [5]	<i>N</i> = 53 1 Group 7 men and 46 women Ages 62–96, mean = 83.3 2 residential care facilities	Test the usefulness of 4 established clinical measures of balance, including the BBT.	BBT Specificity = 78% Sensitivity = 84%
Bogle-Thorbahn and Newton [2]	<i>N</i> = 66 1 Group 16 men and 50 women Ages 69–94, mean 79.2 ( <i>SD</i> = 6.2) 2 independent lifecare communities	Test the sensitivity and specificity of the BBT as a predictor for falls in the elderly population.	BBT Specificity = 96% Sensitivity = 53%
Newton [7]	<i>N</i> = 251 1 Group 53 men and 199 women Ages 60–95, mean 74.3 ( <i>SD</i> = 7.7) Senior centers and health fairs	Determine the balance abilities of independent older adults, living in the inner city, using 3 types of tests, including the BBT.	BBT mode of 53 (maxi- mum score is 56). 31 subjects (13%) scored 40 and below. 16 subjects (6%) scored 56, perfect score.
Berg et al. [1]	<i>N</i> = 38 1 Group Ages 60–93, (mean 73) Senior residence, independent living, and hospital in- patients, with balance impairments	The validity and reliability of the BBT as a measure of balance for the elderly population.	Interrater reliability ICC = 0.98 Intrarater reliability ICC = 0.99 Internal consistency Cronbachs alpha = 0.96

Results showed the two groups to demonstrate considerable differences among the various tests conducted. Fallers tended to be more variable in their characteristics as indicated by larger standard deviations. The highest Spearman correlations  $r = 0.76$  were found between the Berg Balance Scale and the Balance Self-Perceptions Test. The authors created a model comparing the BBT and each participant's history of imbalance, which related to the probability of falling.

The statistics indicate that the BBT appears to be the best single predictor of fall status. A declining BBT score was associated with increasing fall risk, although the relationship is non-linear. In the range of 56 to 54, each 1-point drop in the BBT was associated with a 3–4% increase in fall risk. If the participant scored between 54 to 46, a 1-point change indicated a 6–8 % increased chance of falls. Finally, with a score below 36,

fall risk was nearly 100%. Therefore, a 1-point change on the BBT can lead to different predicted probabilities of falls, depending on the baseline score.

Based on their results the authors suggest patients who score high on the BBT should not be referred for further intervention, whereas patients who score 40 or less have a high probability of falls and require appropriate referrals. These recommendations are based on validity indices of sensitivity and specificity. Sensitivity measures the frequency with which the Berg test accurately detects a participant who is indeed a faller. Specificity indicates how often the Berg test accurately registers high scores when in fact the participant is a non-faller [10]. In the reported study, the statistical analysis showed the best sensitivity (91%) and specificity (82%) were attained using the BBT in conjunction with the self-report measure questionnaire; 20/22 fallers and 18/22 non-fallers were correctly classified

using this combination of measurements. Based on all the results, the BBT has been shown to be a good predictor of falls in the elderly [11].

Harada and colleagues [5] also examined the BBT for its sensitivity and specificity in their application of the test as a screening tool for referral to physical therapy intervention. Their study viewed the usefulness of four established measures of balance, gait and subjective perception of a fear of falling among elderly individuals living in residential care facilities. A convenience sample of elderly subjects was obtained from two licensed residential care facilities. Of the 53 participants between the ages of 62–96 years (with a mean age of 83.3), 46 participants were female and 7 were male. Fifty percent of the participants required an assistive device to ambulate. The sensitivity and specificity levels of four clinical measures were tested in their application as physical therapy screening tests. The tests in the study included the BBT, the Balance Subscale of Tinetti's Performance-Oriented Mobility Assessment (POMA), Gait Speed, and the Tinetti Fall Efficacy Score.

Results indicate that at the cutoff score of 48 of a maximum 56, the BBT demonstrates a specificity level of 78% and a sensitivity of 84%, significantly better than other tests performed in this study. A combination of two clinical measures, the BBT and Gait Speed, yielded the most reliable sensitivity level, viz. 91%; performed in tandem, these two tests effectively screen for purposes of referring elderly adults for physical therapy intervention. The authors further suggest that the strength of the BBT lies in its detailed grading scale, which appears to have the best potential for detecting balance impairment.

Bogle-Thorbahn and Newton [2] hypothesized, in their study, that the BBT can demonstrate sensitivity for predicting falls in a population of elderly persons residing in life-care communities. Sixty-six subjects, 16 men and 50 women, age range = 69–94 (mean age of 79.2 years ( $SD = 6.2$ ), volunteered from one of two life-care communities. Initially and at six months after the initial balance test, each participant completed a questionnaire including a history of previous falls and current activity level. A fall was defined as the unexpected contact of any part of the body with the ground; near-falls were not included. Most participants who reported falls, were closer to the cutoff score of 45 and below, rather than further away. Participants with lower scores and a high level of impairment were inclined to have compensation strategies or used some type of external support to prevent falls. There was no correla-

tion found between types of impairment and falls risk, however. The sensitivity of the BBT to predict falls as compared to the initial fall frequency was 53% (9/17; i.e., the BBT predicted that 17 people would incur a fall when indeed only nine did), whereas the specificity of the measure to identify non-fallers was 96% (46/48, thus establishing the BBT's ability to identify non-fallers).

The BBT was found to have a high specificity, initially of 96% and 92% at the six-month follow up. In other words, participants who scored above 45 were unlikely to fall. A low sensitivity (53%) for identifying people with an increased risk of falling was reported in this study. The BBT was found to be an important tool, however, in identifying the need for an assistive device in the older adult [2]. In addition, this study reports that the BBT has a strong interrater reliability of  $r_s = 0.88$ .

A study by Berg and colleagues [1] addresses the validity and reliability of the BBT as a measure of balance in an elderly population of 38 participants, ranging in age from 60–93 (mean age of 73 years), living in senior residences, independently, or as hospital in-patients at the time of the test. All participants had a balance impairment, which was defined as having fallen in the past two months or having received treatment in physical or occupational therapy to retrain balance. Six experienced physical therapists viewed and rated the participants as recorded on videotape. The inter-rater reliability intraclass correlation coefficient (ICC) for the total score was 0.99. In order to measure intrarater reliability, four of the therapists repeated the review of the test. The ICC values ranged from 0.71 to 0.99.

The five different studies reviewed in this report are summarized in Table 2, including comparative findings of the BBT's strengths and weaknesses as a balance-assessment tool. Discrepancies in the BBT's sensitivity ratings among the different studies may be explained by the different cutoff scores employed in each of the studies. The test's specificity was found to be high throughout, indicating that the BBT is a strong predictor of non-fallers who score 45 and above. The strong interrater and intrarater reliability reported in the Berg study [1] confirms the overall reliability of the BBT.

### 3. Strengths of the BBT

The authors of the studies reviewed preferred the BBT since it does not require sophisticated equipment and can be conducted in a short amount of time, ap-

proximately 15–20 minutes [2,5,7,11]. The BBT is a relatively safe and simple test for elderly persons [1, 11] it uses a quantitative scale, and scoring, which is easily reproducible, can be readily interpreted because of the test's strong internal consistency [1]. With training, various health care professionals can administer the BBT especially if physical therapy services are not available. In addition, the screening procedure for subjects would be less costly for future research [5]. The BBT was found to have a strong interrater reliability [1, 2,7]. The subtests of the BBT are designed to discriminate between good and poor balance scores [1]. The BBT was shown to have a good sensitivity and specificity, and is, therefore, a good predictor of falls risk in older adults who may, therefore, need assistive devices. It is a good method of screening appropriate candidates for physical therapy fall prevention intervention.

#### 4. Weaknesses of the BBT

The risk of falls is multi-factorial: environmental hazards need to be taken into account along with the BBT to get a true score of a subject's functional falls risk [2]. The BBT would be an even better diagnostic tool if it tested functional and environmental aspects, such as responses to uneven surfaces or external stimuli [1]. The BBT should also include some more challenging subtests, such as stair mobility without the use of any railing, and needs to be modified for active community-dwelling adults who tended to score high on the BBT [1]. As is, the BBT is not appropriate for highly active older adults with minimal deficits, because it is not challenging enough to detect subtle balance deficiencies [1,7].

#### 5. Balance treatment

Use of the BBT, however, enables professionals to quickly and safely detect more serious balance dysfunction. A big challenge, then, is to plan and implement an effective treatment technique to improve balance control.

Once patients are referred for treatment, using the BBT or any of the other balance tests, a variety of options can be explored. One recently identified intervention is Tai Chi Quan. Tai Chi is an ancient form of exercise, for fitness and the martial arts, which has been practiced in China for centuries [3,4,12]. It is a non-vigorous form of exercise that incorporates strength,

flexibility, proper breathing and balance. Slow movements, or "aforms", are performed in a measured and flowing manner, involving static and dynamic balancing tasks that are self paced, non stressful, and progressive [3,4]. A number of variations, or schools, exist in the Tai Chi model including Yang, Chen, Wu, Wu-Hao and Sun [3]. Because it is non-vigorous, Tai Chi is used extensively by the geriatric population in China to promote physical fitness [12]. In the west, Tai Chi has been studied as a tool for improving quality of life for the elderly, specifically in terms of balance and reducing falls risk [3,4].

Wolf and colleagues [12] studied the effects of Tai Chi Quan and computerized balance training on postural stability in elderly people. The participants in this study consisted of persons over the age of 70 who were free of progressive illnesses such as Parkinson's or Alzheimer's. There were three groups, each consisting of 24 subjects. The first group (mean age of 77.7,  $SD = 6.5$ ) received computerized balance training for one hour a week for 15 weeks. The second group (mean age 75.2,  $SD = 4.9$ ) received Tai Chi training, and met for one hour twice a week for 15 weeks. The third group (mean age 77.7,  $SD = 5.6$ ) served as the control group and received education on fall management and other topics related to the geriatric population; they met once a week for 15 weeks for one-hour sessions. A postural assessment was taken before, immediately after, and four months following the study, using a computerized balance testing system. Testing analyzed postural sway under four conditions: quiet standing with eyes open, quiet standing with eyes closed, toes up with eyes open, and toes up with eyes closed. A questionnaire was used to determine fear of falling. Subjects later reported the onset of first falls or multiple falls which occurred after the study was completed.

The results demonstrated that the balance-training group showed improvements in postural stability, while the Tai Chi and the educational groups did not. However, it was discovered that the Tai Chi group was less afraid of falling and experienced a delayed onset of first or multiple falls as compared to the other groups. The Tai Chi practitioners also reported greater confidence and awareness of their body movements and placement. This enabled them to recognize if their balance was disturbed and, as a result, to brace themselves and prevent falling even though they demonstrated no improvement in postural stability as indicated by the tests performed on the computerized balance system. In short, members of the Tai Chi group had a better sense of their balance limitations rather than an improvement in their postural stability.

Wolf and colleagues suggested that Tai Chi can be an effective mode of treatment for improving balance and preventing falls in the elderly by enhancing their proprioceptive and kinesthetic awareness.

Kutner and colleagues [6] looked at a larger sample of the same group of participants which Wolf and colleagues investigated, and examined the self-perceived benefits of Tai Chi. In Kutner's study, the participants in the Tai Chi group reported (a) a noticeable effect on their lives; (b) that their sense of confidence had improved; (c) that their performance of ADLs was affected by the intervention; (d) a change in their normal physical activities; and (e) that they had benefited from the intervention. Participants in the group receiving computerized balance training and in the Tai Chi group reported a perception of having gained a better sense of balance, and feeling more secure in their ambulation, than the educational group which served as a control. In addition, members of the Tai Chi group had a decreased fear of falling compared to the balance-training and educational groups. The Tai Chi practitioners reported in exit interviews that they felt less likely to lose their balance if disturbed and felt more secure in movement [12].

Downing and colleagues [3] detail a study reported previously by Yan (1998) of 38 nursing-home residents, 29 females, 9 males, 76–89 years of age (no mean was reported), which compared Tai Chi to a walking/jogging program. Twenty-eight participants learned and practiced the 24 forms of Tai Chi, and 10 participants performed a low intensity walking/jogging program. The participants were supervised for 45 minutes, three times a week for eight weeks. Participants were tested individually for dynamic balance control including time maintaining balance and frequency of losing balance, and for arm-movement performance including smoothness and velocity.

Participants who practiced Tai Chi showed a reduced frequency of losing balance and increased time spent successfully maintaining their balance, compared to the walking/jogging participants. In addition, the Tai Chi group participants demonstrated a post-test improvement in smoothness of arm movement compared to pre-test findings [3].

Hain and colleagues [4] studied 17 women and 5 men, who practiced Tai Chi over eight weeks. Participants were divided into three age groups for analysis: 20–60, 61–75 and 76 years or older. Tai Chi was taught for one hour a week to classes of 10. Participants were instructed to do home exercise for 30 minutes a day. Compliance was not measured. One new form was

taught each week by two physical therapists and one Tai Chi instructor.

Balance testing prior to and upon completion of the study were performed via a number of tests such as posturography, through the use of an instrument called Balance Master (trade name), the Romberg test (a commonly accepted routine balance test), the Reach test (an item on the BBT) and the Dizziness Handicap Inventory (DHI) questionnaire, a measure of perceived disability caused by dizziness. These tests were administered, before and after, to determine balance and its impact on participants' performance of ADLs. A repeated measures analysis of variance found significant improvement in all participants for posturography (Balance Master) and on the DHI. Trends toward improvement were noted for the Romberg while no improvement was found for the Reach test [3].

## 6. Strengths of Tai Chi Quan

The studies done by Wolf [12] and Kutner [6] (Table 3) indicate that Tai Chi has a positive effect on improving balance in the elderly, although it has no effect on postural stability. Postural sway actually increased in subjects who received Tai Chi training [12]. Tai Chi may improve balance by improving proprioceptive and kinesthetic awareness; making individuals more aware of their postural limitations and allowing them to make adjustments to prevent falls [6,12]. Both articles dealt only with elderly subjects who were independent and free from any debilitating disease. The effect of Tai Chi on nursing home patients, or patients in a population who are not independent, was not addressed.

The two studies by Downing [3] and Hain [4] (Table 3) indicate that Tai Chi can improve balance and perceptions of balance, thus reducing falls risk. A number of flaws in the studies warrant further research into the use of Tai Chi as a treatment for balance in the elderly. None of the studies compared Tai Chi to conventional physical therapy. One compared Tai Chi to walking/jogging, and the other did not compare Tai Chi to any other method of treatment [3,4]. In the study by Downing, the subjects were mostly women and were not divided evenly into the two groups; in addition, subjects were all nursing home residents so the applicability of this study to seniors who are independent is questionable [4].

Upper extremities play a role in balance, enabling people to catch themselves in the act of falling. Tai Chi, which incorporates a large amount of arm move-

Table 3  
Review of studies on Tai Chi efficacy

Study	Sample	Purpose	Resytkts
Wolf et al. [12]	<i>N</i> = 72 3 groups Ages 70 and up, mean of the total sample not reported. A group of independent community dwelling residents free from debilitating illness	Determine the ability of Tai Chi to improve postural stability as compared to a computerized balance training group and an educational group. Also, to analyze the effects of training on fear of falling. And on preventing falls.	The Tai Chi group had no increase in postural stability as compared to the other groups. The Tai Chi group had a decreased fear of falling as compared to the other two groups and also had a longer onset to first falls and a decrease in multiple falls.
Kutner et al. [6]	<i>N</i> = 130 3 groups Ages 70 and up, mean of the total sample not reported. A group of independent community dwelling residents free from debilitating illness	Determine the effects of Tai Chi, computerized balance training and education on improving balance and preventing falls.	The Tai Chi group had more of a decreased fear of falling and less falls as compared to the other two groups.
J.H. Downing and J. Yan [3]	<i>N</i> = 38 2 groups Ages 76–89, mean of the total sample not reported. Nursing home residents with history of minimal to no exercise	Determine the ability of Tai Chi to improve dynamic balance control and smoothness and velocity of arm movements versus a walking/jogging program.	Tai Chi exercise group had increased time on maintaining balance and reduced frequency of losing balance. Also demonstrated improvement in smoothness of arm movements as compared to walking/jogging group.
T.C. Hain et al. [4]	<i>N</i> = 22 3 groups (by age, for analysis) Ages 20–76, mean of the total sample not reported. Self-selected from the community via newspaper ad seeking participants with mild balance disorder	Determine the ability of 8 weeks of Tai Chi training to increase balance and perceived disability via a number of assessment tools.	Subjects showed significant improvement in posturography and DHI measures. Trends toward improvement for Romberg test and MOS survey. No improvement in Reach test.

ments, could improve the velocity and smoothness of arm movements, which does not in itself affect balance. The applicability of studying smoothness and velocity of arm movements is therefore questionable [4]. The study by Hain would have been more informative had another method of balance training been incorporated into the study and compared to the Tai Chi group.

Some measures of balance showed improvement following eight weeks of Tai Chi training, which could be due to the physical activity, not Tai Chi [3]. In addition, though scores on the Balance Master did improve, there was no significant improvement in Forward Reach and Romberg tests, which should have shown some improvement [3]. In retrospect, all four of the studies reviewed had serious flaws, the most obvious being small sample size, gender asymmetry and unequal population. We recommend that further research be done uti-

lizing broader population ranges in comparing Tai Chi to conventional Physical Therapy for balance training in the elderly.

## 7. Weakness of Tai Chi Quan

The studies done by Wolf [12] and Kutner [6] Both articles used small sample sizes, which decreased the statistical power. Both articles suggest that Tai Chi has an effect on balance. There was no definite physiological or anatomical explanation of how Tai Chi created these changes to enhance balance [6,12]. In addition, the outcomes of the study done by Wolf and colleagues [12] were compiled by using a computerized balance system to determine postural stability; this could have had a major effect on the results inasmuch

as the balance training group was trained on the computerized system and was familiar with its workings.

## 8. Conclusion

The Berg Balance Test has been shown to be an effective tool for assessment of balance in the elderly [1, 2,5,7,11]. With the modifications mentioned above, the BBT can be a more efficient and broader based assessment tool. The effects of Tai Chi on the treatment of balance still requires extensive research. Although the articles reviewed indicate that Tai Chi has a positive effect on balance, some of the assessment methods were insufficient to detect any improvement in postural stability.

## 9. Recommendations for further research

Future study should incorporate a large sample size of the elderly representing various lifestyles. Balance should be tested by the BBT prior to and upon completion of Tai Chi as a treatment intervention. We recommend study of the efficacy of the BBT as a treatment intervention in itself, utilizing the individual items as therapeutic modalities. In addition, treatment should compare Tai Chi to traditional balance training exercises.

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