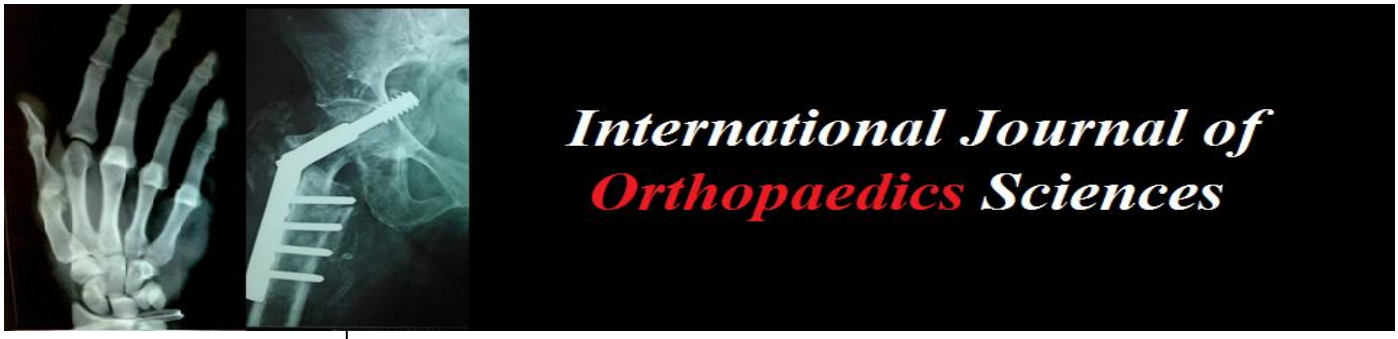


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# The effect of tai chi on balance, fear, and reduction of falls in older adults: A narrative review

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**Abstract**
Falls are considered one of the most serious problems faced by older adults due to their injuries and socio-economic implications. The aim of this review is to investigate the effect of Tai Chi training on geriatric patients in terms of balance and falls based on recent research data. Method: The PubMed, Google Scholar, and PEDro databases were searched with the following keywords: Tai-chi AND falls AND elderly OR older adults. The search was filtered for articles that were clinical studies or cross-over studies published in the last 10 years. Results: Eight studies were used in this review with a total sample of 1,110 older adults with or without a risk of falling. The findings of the studies included converge on the fact that Tai Chi has a positive effect on reducing falls and the fear of an impending fall while also improving balance. In six of the eight studies included the Tai Chi program seemed more effective than a control group, while in two studies it seemed equally effective as other means such as conventional physiotherapy and yoga. Discussion - Conclusions: The results show that Tai Chi training is accessible to older adults and seems to have a positive effect on fall risk and balance. However, the percentage of studies that support it is not sufficient nor do the results of this review prove the superiority of the Tai Chi method over other therapies. More thorough research is needed to confirm its efficacy.

**Keywords:** Falls, older adults, tai chi

## Introduction
Falls are estimated to be one of the biggest public health problems in older adults [1]. They are accompanied by injuries, loss of independence, and consequent reduction of activity and participation in the community leading up to premature mortality [1]. Fall-related complications are the leading cause of death from unintentional injury in people over 65, while instantly fatal falls in the same age group are the fifth leading cause of death [2]. As a consequence, falls are responsible for a significant social and financial burden for older adults, their families, and the community health services [3].
The causes of falls are multifactorial and are related to specific risk factors such as advanced age, balance deficits, wrong gait pattern, history of previous falls, polypharmacy, and fear of falling [4, 5]. Another major risk factor is the high morbidity of older adults as well as the occurrence of chronic diseases such as stroke, Parkinson's disease, and osteoarthritis of the knee. The occurrence of these diseases appears to be associated with an increased fall risk and with increased fall-related mortality rates [4].
The incidence of falls varies with age [2]. In the general population, 30-40% of people over the age of 65 fall each year worldwide [2]. This percentage increases to about 50% among people aged 80 and over [2] globally, about 30% of older adults fall at least once a year and 15% fall twice or more [1]. As the number of fall incidences increases, so will their impact due to the ever-increasing proportion of older adults worldwide. [6] The percentage of Australians over the age of 65 is projected to increase from 13% (3 million people) in 2010 to around 24% (9 million people) by 2050 [6].
Physiotherapy can play a key role in preventing falls in older adults [6-10]. Many of the functions of the human body that are affected due to aging can be improved through physiotherapy interventions, especially through the implementation of therapeutic exercise programs [6, 7].

Tai-Chi (TC) is characterized by a sequence of gentle, low impact, and coordinated movements [11]. It is considered a suitable form of exercise for older adults, because it causes minimal pressure on the joints and the cardiovascular system [11]. Current data show that group exercise as well as multifactorial interventions seem to prevent the falls of older adults living in a community with a high risk of falls [6]. However, it is not clear to date whether TC can effectively reduce the number of falls in older adult patients. The aim of this review is to investigate the effectiveness of various forms of TC in balancing and reducing falls in older adults.

## Method

The PubMed, Google Scholar, and PEDro were searched during the period March-April 2022. Boolean combinations with the following keywords were used to search for articles: Tai-chi AND falls AND elderly OR older adults. Articles that were clinical studies or cross-over studies and were published in English in the last 10 years were applied as study selection filters.

## Results

From all the sources that appeared in the search, first the titles and the summaries of the articles were evaluated and then the full texts were checked. Seven clinical trials and one cross-over study were found to meet the criteria set and included in this review. The sample was 1,110 older adults in total from 60 years and over with or without a risk of falling. Below are the characteristics of the studies included in this review, while Table 1 summarizes the findings of each research.

**Table 1:** Details of the included studies

| Author-Year | Number of participants | Intervention duration | Intervention | Outcome measures | Conclusions |
|---|---|---|---|---|---|
| Hosseini *et al.* [12] | 60 | 8 weeks | Group 1: Tai Chi<br>Group 2: no intervention | ▪ TUG<br>▪ Tinetti<br>▪ FES-I | Tai Chi seems to significantly improve balance and fear of falling in older adults. |
| Konig *et al.* [13] | 27 | 6 months | Tai Chi group | ▪ TUG<br>▪ BBS<br>▪ Romberg | The Tai Chi program benefits balance of older adults. |
| Mortazavi *et al.* [14] | 60 | 10 weeks | Group 1: Tai Chi<br>Group 2: daily activities | ▪ FES-I<br>▪ BBS | Tai Chi exercise helps reduce fear of falling in older adults. |
| Okuyan & Bilgil [15] | 44 | 12 weeks | Group 1: Tai Chi<br>Group 2: regular exercises | ▪ MFES<br>▪ Tinetti | Tai Chi exercise helps to reduce the fear of falling in older adults. |
| Penn *et al.* [11] | 50 | 8 weeks | Group 1: individualized Tai Chi<br>Group 2: traditional Tai Chi<br>Group 3: no intervention | ▪ TUG<br>▪ BBS<br>▪ Functional-Reach | Individualized Tai Chi program benefits older adults more than traditional Tai Chi. |
| Taylor *et al.* [16] | 684 | 20 weeks | Group 1: Tai Chi 1 session/week<br>Group 2: Tai Chi 2 sessions/week Group 3: low-level exercise program | ▪ Diary<br>▪ Step test | The evaluated parameters (number of falls and balance) equally improved between the groups. |
| Tousignant *et al.* [17] | 152 | 15 weeks | Group 1: Tai Chi<br>Group 2: physiotherapy | ▪ BBS<br>▪ Foam and dome<br>▪ SAFE | There was no significant positive change in the Tai Chi group, more than in the physiotherapy group. |
| Saravanakumar *et al.* [18] | 33 | 14 weeks | Group 1: Tai Chi<br>Group 2: yoga<br>Group 3: regular care | ▪ BBS<br>▪ RCF | Both interventions (Tai Chi and yoga) improve balance and reduce number of falls in older adults. |

## Literature review

Hosseini *et al.* [12] examined TC efficacy in balance and fear of falling in 60 older adults. The participants were randomly divided into two groups. The first group (intervention group) underwent a TC program, while the second group (control group) did not receive any intervention. The duration of intervention was 55 minutes with a frequency of two times per week for eight weeks. The parameters of balance and fear of falling were checked before the intervention and after eight weeks with the following tests: the Timed Up-and-Go (TUG) test, the Tinetti (balance) scale, and the Falls Efficacy Scale International (FES-I). The results showed that the exercise group showed a significant reduction in the score of the fear of falling ($p<.001$) as well as an improvement in the balance and scores of the TUG and Tinetti tests ($p<.001$) after the intervention compared to the control group. In conclusion, the study showed that TC makes significant progress in balance and fear of falling in older adults.

In another study [13], the effect of TC exercise on balance in 27 older adults was studied. All participants received a 60-minute intervention two times per week for six months. Balance ability was tested with the TUG test, the Berg Balance Scale (BBS), and the Romberg test before, after three, and after six months of training. The measurements showed a significant improvement in balance through the improvement of the TUG ($p\leq.01$), BBS ($p\leq.01$), and Romberg ($p\leq.01$) test scores after three and six months compared to before TC training. However, comparing the scores during the three and six months of intervention, there were no significant differences ($p = .15$). Therefore, the authors conclude that practicing TC can positively affect the balance in older adults.

In the study of Mortazavi *et al.*, [14] the effect of TC training on fear of falling in 60 older adults was investigated. Participants were randomized into two groups of equal size. One group (intervention group) participated in a TC program, while the other group (control group) continued their daily activities. The protocol was applied for three 20-minute sessions per week for 10 weeks. The fear of falling was tested with the help of standard questionnaires and the BBS and FES-I tests before the intervention, at the end of the fourth and eighth week, and at the end of the program. The analysis of the results showed a 33.6% reduction in the fear of falling in the exercise group in contrast to the control group ($p<.001$). The measurements also showed that, while the initial values of fear before the intervention did not show

significant differences, the differences between the groups after the fourth, eighth, and 10th week were considered statistically significant ($p<.05$). Therefore, the researchers concluded that TC exercises can reduce the fear of falls in older adults.

The study of Okuyan and Bilgili [15] focused on the efficacy of TC in fear of falling and in balance of 44 older adults. Participants were randomly divided into two groups. One group (experimental group, n = 20) received TC exercise, while the other group (control group, n = 24) participated in routine exercises. The duration of exercise was 30 minutes twice per week for 12 weeks. Balance was assessed with the Tinetti test and fear of falling with the Modified Falls Efficacy Scale (MFES) before and after the intervention. The results showed that balance improved significantly ($p<.001$) and fear of falling decreased ($p<.001$) in the intervention group compared to the scores before exercise. The control group showed no statistically significant differences before and after the intervention in the Tinetti and MFES scores ($p>.05$). On the contrary, differences were found that were considered statistically significant between the two groups with the experimental group showing greater progress in the evaluated parameters ($p<.001$). Consequently, TC seems to improve balance and reduce fear of falling in older adults.

In another study [11], the effect of a simplified and more personalized Tai-Chi exercise book on balance in 50 older adults was investigated. The participants were divided into three groups. The first group received a personalized TC exercise program (individualized Tai-Chi (i-TC), n = 20), the second group practiced a traditional TC program (traditional Tai-Chi (t-TC), n = 15), while the third group (control group, n = 15) did not participate in any intervention. The duration of the intervention was three 30-minute sessions per week for eight weeks. Balance was assessed with the BBS, the TUG test, and the Functional-Reach test before the intervention and after eight weeks. At the end of the training period, the i-TC group showed significant improvements in all three balance tests ($p<.001$ - $.005$), while in the t-TC group only the BBS score improved ($p<.05$). The results suggest that the personalized TC program is more beneficial for older adults than traditional TC.

Taylor *et al*. [16] compared TC and a low-impact exercise program to reduce falls and improve balance in 684 older adults. Participants were assigned to three groups. One group received TC one time a week (TC1, n = 233), the other group practiced TC two times a week (TC2, n = 220), and the last group (control group) participated in a low-level exercise program (LLE, n = 231). The program in each group lasted about 60 minutes and was implemented for 20 weeks. Incidents of falls were measured using diaries where subjects recorded the number of falls per month, while balance was assessed with the step test. The parameters were tested before and after the intervention and during the monitoring of 11 and 17 months. The results showed a statistically significant improvement in all groups in both balance ($p<.01$) as well as number of falls ($p<.01$). However, the incidence rate ratio was not statistically different between the TC1 and LLE groups or the TC2 and LLE groups. In conclusion, fall reduction rates and balance equally improved between groups.

Another study [17] compared the impact of TC exercise with a physiotherapy protocol on balance and fear of falling in 152 older adults. The participants were randomly divided into two groups. The first group was trained in TC (n = 76), while the second group underwent physiotherapy (n = 76). The duration of each session was 60 minutes two times a week for 15 weeks. Balance was assessed with the BBS and "Foam and dome" tests, while the fear of falling with the Survey of Activities and Fear of falling in the Elderly (SAFE). The above parameters were measured in three time periods: before the intervention (T1), after the intervention (T2), and 12 months after its end (T3). After analyzing the measurements, it appeared that both groups showed significant progress in balance and fear of falling between the T1 and T2 time periods. In contrast, during T3 a statistically significant decrease in balance and an increase in fear of falling was found. The results of the study suggest that for the variables of balance and fear of falling, there was no greater improvement in the TC group than in the physiotherapy group.

Finally, a study [18] compared the efficacy of a modified TC training and yoga application to balance and reducing the number of falls in 33 older adults. The participants were divided into three groups. The first group received TC intervention (n = 11), the second group underwent a yoga program (n = 11), and the third group participated in a regular care program (control group, n = 11). The duration of each exercise session was 30 minutes two times per week for 14 weeks. Balance was assessed with the BBS before and after the intervention and cases of falls were examined through this Residential Care Facility (RCF). Fall data were collected over three time periods: six months before the test, during exercise, and six months after the intervention. Regarding the balance parameter, the yoga group showed an improvement in the mean scores of the BBS (+8.8) after 14 weeks, while the TC and control groups showed a decrease of three points. In terms of the incidence of falls, only the yoga group showed a partial reduction (-2) after the intervention. For the TC group the fall incidences remained the same, although for the control group they increased by 1.8. Also, during the 14 weeks all three groups showed reduced mean scores on falls; especially the TC group did not experience any fall incident. However, the differences between the groups found for both parameters were not considered statistically significant. The findings of the study equally support the application of modified TC and yoga in older adults to improve balance and fall incidence.

## Discussion

The aim of this review was to present recent data on the efficacy of interventions involving TC protocols that have been applied to older adults at high risk of falls to improve their balance and reduce falls. The results show that the implementation of a TC program has a positive effect and is appropriate as a means of exercise to reduce the number of falls, to improve balance, and to reduce fear of impending fall. In most of the included studies there was evidence that TC training improves balance and at the same time helps to reduce the incidence of falls in older adults (Table 1).

However, although the efficacy of TC is clear in studies that a TC protocol compares to a control group [11, 12, 14], in cases where its efficacy is compared to another method, its superiority over the other method is unclear [17, 18]. The findings of this review are consistent with those of Nyman [19], who also found in his review the lack of evidence about the efficacy of TC against other similar interventions in reducing falls in older adults.

Regarding the appropriate parameters of a TC program, it seems that eight weeks is a sufficient period of implementation to make adjustments related to the reduction of falls [11, 12], while in terms of frequency it appears that two sessions per week is sufficient. There is also evidence to support that equally positive results can be obtained with a frequency of once a week [16]. These findings contradict the findings of a recent systematic review [2], where it was found that the fall preventive effect of TC seems to increase with exercise frequency based on research that implemented protocols with a frequency of three or four times a week.

The results of this review also indicate that individualized programs seem to be more effective than group programs [11],

which may be explained by the fact that a personalized TC program can better meet the needs of each older adult and effectively cover their balance deficits. However, it is not clear whether personalized TC programs can improve adherence to exercise. According to Nyman [19], 71-81% of community-dwelling older adults are adherent to class-based Tai Chi interventions. More research is therefore needed to provide more evidence on the efficacy between individualized or group programs.

## Conclusions

Older adults with balance disorders and episodes of falls seem to benefit from TC interventions. However, more research is needed with a larger sample of participants to support the efficacy of the method and to establish it as a fall prevention measure.

## Conflict of Interest

Not available

## Financial Support

Not available

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