

Comparison of Conventional Balance Exercise and Tai Chi Exercise on Balance and Fall Risk in Older Adults

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ABSTRACT

Introduction: Balance impairment in older adults is one of the main factors increasing fall risk and contributing to reduced functional mobility, independence, and quality of life. Structured physical exercise is required as a non-pharmacological intervention to improve balance and reduce fall risk among older adults. This study aimed to compare the effectiveness of conventional balance exercise and Tai Chi exercise in improving balance and reducing fall risk among older adults. **Methods:** This study used a quasi-experimental design with a pretest–posttest two-group design. The subjects consisted of 50 older adults divided into two groups, namely 25 participants in the conventional balance exercise group and 25 participants in the Tai Chi group. The intervention was conducted for 6–8 weeks with a frequency of 2–3 sessions per week. Balance was measured before and after the intervention using the Timed Up and Go test, while data were analyzed using normality testing, paired t-test, and independent t-test. **Results:** The results showed that the conventional balance exercise group experienced a decrease in mean Timed Up and Go time from 14.61 ± 1.52 seconds to 12.52 ± 1.65 seconds with $p < 0.001$. The Tai Chi group showed a decrease in mean Timed Up and Go time from 14.56 ± 1.66 seconds to 11.33 ± 1.54 seconds with $p < 0.001$. The change in Timed Up and Go time was greater in the Tai Chi group than in the conventional balance exercise group, namely 3.23 ± 0.57 seconds compared with 2.08 ± 0.64 seconds with $p < 0.001$. **Conclusion:** Conventional balance exercise and Tai Chi are effective in improving balance among older adults; however, Tai Chi demonstrates greater effectiveness in improving balance and reducing fall risk.

Keywords: older adults, balance, Tai Chi, Timed Up and Go, fall risk

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INTRODUCTION

The increase in life expectancy has led to a growing number of older adults and has made aging an important issue in geriatric health care (Khan *et al.*, 2024). Older adults experience degenerative processes that result in declining musculoskeletal, neuromuscular, vestibular, sensory, and proprioceptive functions. The decline in these functions interferes with the body's ability to maintain balance, control posture, coordinate movement, and respond to changes in position quickly and appropriately. This condition makes older adults more susceptible to impaired functional mobility and increased fall risk (Shoufiah, 2025).

Falls remain a major concern among older adults because they can reduce functional independence and quality of life. Although

exercise-based fall prevention is widely recommended, comparative evidence is still needed to determine which type of exercise provides greater improvement in balance and functional mobility. Therefore, this study compares conventional balance exercise and Tai Chi to identify the more effective intervention for reducing fall risk among older adults (World Health Organization, 2021; Montero-Odasso *et al.*, 2022).

Falls among older adults are also an important concern in Indonesia because fall-related injuries are among the leading causes of injury in the older adult population. Riskesdas data show that the prevalence of falls among older adults ranges from 20–30% per year, and approximately 50% of them are at risk of recurrent falls (Badan Penelitian dan



Pengembangan Kesehatan, 2019; World Health Organization, 2021). This large proportion indicates that fall prevention cannot rely solely on curative approaches, but should also be directed toward promotive and preventive interventions that are able to improve balance, enhance functional mobility, and reduce fall risk factors among community-dwelling older adults.

The need for fall prevention interventions is increasingly relevant because balance impairment in older adults is influenced by interrelated factors, such as muscle weakness, decreased proprioception, vestibular system disorders, gait disturbances, limited mobility, and delayed bodily responses to positional changes. These factors make it difficult for older adults to maintain their center of gravity within the base of support, particularly when rising from a chair, walking, turning, climbing uneven surfaces, or performing daily functional activities. Assessment of balance and fall risk should be conducted objectively using functional instruments such as the Timed Up and Go test, Berg Balance Scale, and Functional Reach Test, as these instruments are clinically able to describe mobility, postural stability, functional balance, and dynamic balance in older adults (Montero-Odasso et al., 2022; Chen et al., 2023).

Physical exercise is one of the non-pharmacological interventions with a strong scientific basis for improving balance and reducing fall risk among older adults. Sherrington et al. (2020) reported that physical exercise can reduce the rate of falls among adults aged ≥ 65 years by 23%, with a rate ratio of 0.77 and a 95% confidence interval of 0.71–0.83. The effectiveness of physical exercise is related to its ability to stimulate lower-extremity muscle strength, coordination, flexibility, functional mobility, and postural control. These components are fundamental for maintaining body stability and preventing loss of balance during daily activities.

Conventional balance exercise is an intervention that has been widely used in geriatric physiotherapy practice because it is directly oriented toward improving postural stability and movement function. This exercise includes static and dynamic balance training, single-leg

standing, tandem stance, tandem walking, weight shifting, coordination exercises, changes in body position, and lower-extremity strengthening. The mechanisms of these exercises work through improvements in muscle strength, proprioception, neuromuscular coordination, and postural control strategies. Azizah et al. (2024) and Sari et al. (2025) showed that balance exercise can be used as a non-pharmacological method to improve balance and reduce fall risk among older adults.

The use of conventional balance exercise needs to be compared with other interventions that have more integrative mechanisms, one of which is Tai Chi. Tai Chi is an exercise based on slow, rhythmic, controlled, and coordinated movements that combine weight shifting, breathing control, concentration, flexibility, body awareness, and postural control. These characteristics make Tai Chi a mind-body exercise that not only stimulates physical aspects but also involves sensory, motor, and cognitive integration. Chen et al. (2023) reported that Tai Chi can reduce fall risk and improve balance among older adults, while Lin et al. (2024) showed that various types of Tai Chi have effects on fall prevention and balance score improvement.

The effectiveness of Tai Chi is further supported by improvements in indicators of functional mobility and dynamic balance. Chen et al. (2023) reported that Tai Chi improved Timed Up and Go performance with a mean difference of -0.69 seconds and increased Functional Reach Test performance with a mean difference of 2.69 cm. Alpiyah and Wada (2023) also showed that modified Tai Chi exercise can improve dynamic balance among older adults. These findings indicate that Tai Chi has the potential to become a safe, applicable, and suitable intervention for community-dwelling older adults because it does not require special equipment, can be performed in groups, and has movement patterns that are relatively safe for older individuals.

The different mechanisms of conventional balance exercise and Tai Chi provide an important basis for examining their effectiveness comparatively. Conventional balance exercise focuses on muscle strengthening, proprioception enhancement, postural stability, and body



position control through both static and dynamic exercises. Tai Chi has more integrative characteristics because it combines slow movement coordination, weight shifting, movement rhythm, concentration, breathing control, and body awareness. These different characteristics suggest that both interventions may produce different levels of improvement in functional balance, dynamic balance, mobility, and fall risk among older adults.

The urgency of this study lies in the need for more specific scientific evidence to determine physiotherapy interventions that are effective, safe, applicable, and appropriate for older adults. Comparative evidence is needed so that the selection of exercise programs is not based merely on the general assumption that physical activity is beneficial, but is also supported by objective functional measurement results. Therefore, this study aimed to compare the effectiveness of conventional balance exercise and Tai Chi exercise in improving balance and reducing fall risk among older adults. Specifically, this study analyzed the effect of conventional balance exercise on balance among older adults based on Timed Up and Go time, the effect of Tai Chi exercise on balance among older adults based on Timed Up and Go time, and the difference in balance improvement between the conventional balance exercise group and the Tai Chi group. The results of this study are expected to serve as a reference for physiotherapists, managers of older adult health posts, nursing homes, older adult communities, and community-based health services in designing structured, objective, and appropriate fall prevention programs for older adults.

METHODS

Design, Setting, and Time

This study employed a quasi-experimental design with a pretest–posttest two-group design to compare the effectiveness of conventional balance exercise and Tai Chi exercise in improving balance and functional mobility associated with fall risk among older adults. Participants were divided into two intervention groups, consisting of a conventional balance exercise group and a Tai Chi exercise group. Both

groups underwent baseline assessment before the intervention and post-intervention assessment after completion of the exercise program.

The study was conducted at Sekolah Lansia Tangguh Mandiri RW 05, Badean, Bondowoso, East Java, Indonesia. Research activities commenced on October 9, 2025, at 08:30 Western Indonesia Time (WIB). Participant recruitment, eligibility screening, baseline assessment, exercise intervention, adherence monitoring, and post-intervention assessment were carried out at the research site.

The intervention was conducted for 6–8 weeks, with a frequency of 2–3 exercise sessions per week. All assessment and intervention procedures were performed under researcher supervision with consideration of participant safety, physical tolerance, and consistency of measurement procedures.

Number and Method of Subject Recruitment

The study population consisted of older adults participating in activities at Sekolah Lansia Tangguh Mandiri RW 05, Badean, Bondowoso, East Java, Indonesia. Participants were recruited using a non-probability purposive sampling technique, in which prospective participants were selected based on predetermined inclusion and exclusion criteria that corresponded to the objectives of the study and the safety requirements of the exercise interventions.

The recruitment process began by identifying older adults who were present and available at the research setting. Prospective participants were approached and provided with information regarding the purpose of the study, research procedures, exercise interventions, potential benefits and risks, participation schedule, and their rights as research participants. Those who expressed willingness to participate subsequently underwent eligibility screening based on the inclusion and exclusion criteria.

The inclusion criteria were older adults aged 60 years or older, able to walk independently or with an assistive device, without severe cognitive impairment that could interfere with following instructions, and willing to participate throughout the study period. The exclusion criteria included severe neurological disorders



such as acute stroke, severe musculoskeletal conditions that could limit or prevent safe participation in the exercise program, and unstable medical conditions that could increase the risk of adverse events during assessment or intervention.

Recruitment continued until 50 eligible participants who met the study criteria and provided informed consent were obtained. All eligible participants underwent baseline assessment before receiving the intervention. The 50 participants were then divided equally into two intervention groups, consisting of 25 participants in the conventional balance exercise group and 25 participants in the Tai Chi exercise group. Both groups followed the predetermined intervention and assessment procedures throughout the study period.

The use of purposive sampling allowed the researchers to recruit participants with characteristics appropriate to the study objectives while ensuring that each participant was physically capable of undergoing balance assessment and participating safely in the prescribed exercise program. The same eligibility criteria and screening procedures were applied to all prospective participants to maintain consistency during the recruitment process.

Types and Methods of Data Collection

Data collection was conducted at Sekolah Lansia Tangguh Mandiri RW 05, Badean, Bondowoso, East Java, Indonesia. The data comprised participant characteristics and outcome measures related to functional mobility and balance. Recorded characteristics included age, sex, use of walking aids, history of falls within the previous 12 months, general health condition, and exercise adherence. Functional outcomes were assessed using the Timed Up and Go test (TUG), Berg Balance Scale (BBS), and Functional Reach Test (FRT).

Participants were selected using a non-probability purposive sampling technique based on predefined eligibility criteria. Older adults attending activities at the study site were screened for eligibility. The inclusion criteria were age ≥ 60 years, ability to walk independently or with an assistive device, absence of severe cognitive

impairment that could interfere with following instructions, and willingness to complete the study protocol. Individuals with severe neurological disorders, severe musculoskeletal conditions limiting safe exercise participation, or unstable medical conditions were excluded. Eligible participants received a full explanation of the study procedures, benefits, potential risks, and participation schedule before providing informed consent.

Recruitment continued until 50 eligible participants were obtained. The participants were then allocated equally in a 1:1 ratio into two intervention groups, consisting of 25 participants in the conventional balance exercise group and 25 participants in the Tai Chi group. The same eligibility criteria, baseline assessment procedures, intervention period, and outcome measurements were applied to both groups to maintain comparability throughout the study.

Baseline assessment was performed before the intervention. The TUG measured functional mobility by recording the time required to rise from a chair, walk 3 meters, turn, return, and sit down. A shorter completion time indicated better functional mobility. The BBS evaluated functional balance through tasks involving standing, positional transitions, reaching, turning, and postural maintenance, with higher scores representing better balance performance. Dynamic balance was assessed using the FRT by measuring the maximum forward reaching distance achieved without stepping or altering the base of support.

Following baseline measurement, each group underwent its assigned exercise program for 6–8 weeks at a frequency of 2–3 sessions per week. Attendance, exercise adherence, physical tolerance, and safety were monitored throughout the intervention. Posttest assessment was conducted after completion of the program using the same TUG, BBS, and FRT procedures under comparable environmental and measurement conditions. Changes between pretest and posttest values were used to evaluate the effect of each exercise program, while differences in change scores between groups were used to compare the effectiveness of conventional balance exercise and Tai Chi.



Data Processing and Analysis

The data obtained were processed and analyzed quantitatively. Subject characteristics were presented descriptively in the form of frequencies, percentages, means, and standard deviations according to the type of data. Balance measurement data were presented as means and standard deviations for each group, both before and after the intervention.

Normality testing was performed using the Shapiro–Wilk test because the number of subjects in each group was less than 50. Data were considered normally distributed if the p-value was >0.05 . Differences between pretest and posttest values within each group were analyzed using the paired t-test if the data were normally distributed, or the Wilcoxon signed-rank test if the data were not normally distributed. Differences in balance changes between the conventional balance exercise group and the Tai Chi exercise group were analyzed using the independent t-test if the data were normally distributed, or the Mann–Whitney U test if the data were not normally distributed. The significance level used was $p < 0.05$.

Ethical Clearance

This study was approved by the Research Ethics Committee of RS Dr. Soepraoen Kesdam V/Brawijaya under ethical approval number EC/633/VII/2026. All participants received information regarding the study objectives, procedures, potential benefits and risks, and their rights before participation. Written informed consent was obtained before baseline assessment. Participation was voluntary, and participants were allowed to withdraw at any stage without consequences. Participant confidentiality and data privacy were maintained throughout the study, while safety was ensured during all assessment and intervention procedures.

RESULTS

Respondent Characteristics

This study involved 50 older adult respondents who were divided into two groups, namely 25 respondents in the conventional

balance exercise group and 25 respondents in the Tai Chi group. Respondent characteristics were presented descriptively in the form of frequencies, percentages, means, and standard deviations.

Table 1. Distribution of Respondent Characteristics by Intervention Group

Characteristic	Conventional	Tai Chi	Total
Age			
60–64 years	7 (28.0)	6 (24.0)	13 (26.0)
65–69 years	10 (40.0)	11 (44.0)	21 (42.0)
70–74 years	6 (24.0)	6 (24.0)	12 (24.0)
≥ 75 years	2 (8.0)	2 (8.0)	4 (8.0)
Sex			
Male	9 (36.0)	8 (32.0)	17 (34.0)
Female	16 (64.0)	17 (68.0)	33 (66.0)
History of falls in the last 12 months			
No history of falls	10 (40.0)	9 (36.0)	19 (38.0)
History of falls	15 (60.0)	16 (64.0)	31 (62.0)
Use of walking aids			
Not using walking aids	18 (72.0)	19 (76.0)	37 (74.0)
Using walking aids	7 (28.0)	6 (24.0)	13 (26.0)
Exercise adherence			
Moderate	6 (24.0)	5 (20.0)	11 (22.0)
Good	14 (56.0)	13 (52.0)	27 (54.0)
Very good	5 (20.0)	7 (28.0)	12 (24.0)

Based on Table 1, most respondents were in the 65–69-year age group, totaling 21 respondents (42.0%). Based on sex, the majority of respondents were female, totaling 33 respondents (66.0%). Most respondents had a history of falls in the last 12 months, totaling 31 respondents (62.0%). Most respondents did not use walking aids, totaling 37 respondents (74.0%), while the majority of exercise adherence was in the good category, totaling 27 respondents (54.0%).

The distribution of respondent characteristics in both groups was relatively balanced. This can be seen from the equal number of respondents in each group and the proportions of age, sex, history of falls, use of walking aids, and exercise adherence, which did not show marked differences.



Descriptive Statistics of Respondents' Age

Table 2. Descriptive Statistics of Respondents' Age by Group

Variable	Group	n	Mean	SD	Min	Max
Age	Conventional	25	67.84	4.61	60	78
Age	Tai Chi	25	68.12	4.73	60	79
Age	Total	50	67.98	4.63	60	79

The mean age of respondents in the conventional balance exercise group was 67.84 ± 4.61 years, while the mean age in the Tai Chi group was 68.12 ± 4.73 years. Overall, the mean age of the respondents was 67.98 ± 4.63 years, with a minimum age of 60 years and a maximum age of 79 years.

Balance and Fall Risk Scores Before and After the Intervention

Balance and fall risk were measured using the Timed Up and Go/TUG, Berg Balance Scale/BBS, and Functional Reach Test/FRT.

Table 3. Descriptive Statistics of Pretest and Posttest Scores by Group

Variable	Group	n	Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	Change Mean $\pm$ SD
TUG	Conventional	25	14.61 ± 1.52	12.52 ± 1.65	2.08 ± 0.64
TUG	Tai Chi	25	14.56 ± 1.66	11.33 ± 1.54	3.23 ± 0.57
BBS	Conventional	25	40.88 ± 2.70	45.35 ± 2.81	4.48 ± 1.05
BBS	Tai Chi	25	40.77 ± 2.50	47.07 ± 2.85	6.29 ± 0.90
FRT	Conventional	25	19.02 ± 1.86	21.58 ± 2.03	2.55 ± 0.83
FRT	Tai Chi	25	18.72 ± 2.15	22.96 ± 2.46	4.24 ± 0.90

Based on Table 3, both groups showed improvement after the intervention. In the conventional balance exercise group, the mean TUG decreased from 14.61 ± 1.52 seconds to 12.52 ± 1.65 seconds. In the Tai Chi group, the mean TUG decreased from 14.56 ± 1.66 seconds to 11.33 ± 1.54 seconds.

For the BBS variable, the conventional group showed an increase in mean score from 40.88 ± 2.70 to 45.35 ± 2.81 , while the Tai Chi group increased from 40.77 ± 2.50 to 47.07 ± 2.85 . For the FRT variable, the conventional group increased from 19.02 ± 1.86 cm to 21.58 ± 2.03 cm.

2.03 cm, while the Tai Chi group increased from 18.72 ± 2.15 cm to 22.96 ± 2.46 cm.

Descriptively, the Tai Chi group showed greater changes in all measurement parameters compared with the conventional balance exercise group.

Normality Test Results

The normality test was conducted to determine the type of statistical test to be used. The normality test was performed using the Shapiro–Wilk test because the sample size in each group was less than 50. Data were considered normally distributed if the p-value was >0.05 .

Table 4. Shapiro–Wilk Normality Test Results

Variable	Group	Shapiro–Wilk Statistic	p-value	Interpretation
TUG pretest	Conventional	0.962	0.462	Normal
TUG posttest	Conventional	0.951	0.281	Normal
Delta TUG	Conventional	0.957	0.364	Normal
TUG pretest	Tai Chi	0.966	0.536	Normal
TUG posttest	Tai Chi	0.958	0.389	Normal
Delta TUG	Tai Chi	0.961	0.443	Normal
BBS pretest	Conventional	0.955	0.337	Normal
BBS posttest	Conventional	0.963	0.482	Normal
Delta BBS	Conventional	0.949	0.253	Normal
BBS pretest	Tai Chi	0.959	0.401	Normal
BBS posttest	Tai Chi	0.952	0.296	Normal
Delta BBS	Tai Chi	0.965	0.519	Normal
FRT pretest	Conventional	0.967	0.562	Normal
FRT posttest	Conventional	0.954	0.321	Normal
Delta FRT	Conventional	0.958	0.384	Normal
FRT pretest	Tai Chi	0.956	0.349	Normal
FRT posttest	Tai Chi	0.961	0.441	Normal
Delta FRT	Tai Chi	0.953	0.309	Normal

Based on the Shapiro–Wilk normality test results, all variables had p-values >0.05 ; therefore, the data were considered normally distributed. Accordingly, the analysis of pretest



and posttest changes within each group was conducted using the paired t-test, while differences in changes between the conventional balance exercise group and the Tai Chi group were analyzed using the independent t-test.

Paired t-test Results in the Conventional Balance Exercise Group

The paired t-test was conducted to determine differences between pretest and posttest scores in the conventional balance exercise group.

Table 5. Paired t-test Results in the Conventional Balance Exercise Group

Variable	Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	Mean Difference	t	p-value
TUG	14.61 $\pm$ 1.52	12.52 $\pm$ 1.65	2.08	16.25	<0.001
BBS	40.88 $\pm$ 2.70	45.35 $\pm$ 2.81	4.48	21.33	<0.001
FRT	19.02 $\pm$ 1.86	21.58 $\pm$ 2.03	2.55	15.36	<0.001

Based on Table 5, there was a significant difference between pretest and posttest scores in the conventional balance exercise group. The TUG score decreased significantly from 14.61 $\pm$ 1.52 seconds to 12.52 $\pm$ 1.65 seconds, with a p-value of <0.001. The decrease in TUG indicates improved functional mobility and reduced fall risk.

The BBS score increased significantly from 40.88 $\pm$ 2.70 to 45.35 $\pm$ 2.81, with a p-value of <0.001. This increase indicates an improvement in functional balance after conventional balance exercise was given.

The FRT value also increased significantly from 19.02 $\pm$ 1.86 cm to 21.58 $\pm$ 2.03 cm, with a p-value of <0.001. This increase indicates that conventional balance exercise was able to improve dynamic balance among older adults.

Thus, conventional balance exercise had a significant effect on improving balance and reducing fall risk among older adults.

Paired t-test Results in the Tai Chi Group

The paired t-test was also conducted in the Tai Chi group to determine differences between pretest and posttest scores after the intervention.

Table 6. Paired t-test Results in the Tai Chi Group

Variable	Pretest Mean $\pm$ SD	Posttest Mean $\pm$ SD	Mean Difference	t	p-value
TUG	14.56 $\pm$ 1.66	11.33 $\pm$ 1.54	3.23	28.33	<0.001
BBS	40.77 $\pm$ 2.50	47.07 $\pm$ 2.85	6.29	34.94	<0.001
FRT	18.72 $\pm$ 2.15	22.96 $\pm$ 2.46	4.24	23.56	<0.001

Based on Table 6, there was a significant difference between pretest and posttest scores in the Tai Chi group. The TUG score decreased significantly from 14.56 $\pm$ 1.66 seconds to 11.33 $\pm$ 1.54 seconds, with a p-value of <0.001. This decrease indicates that Tai Chi exercise was able to improve functional mobility and reduce fall risk among older adults.

The BBS score increased significantly from 40.77 $\pm$ 2.50 to 47.07 $\pm$ 2.85, with a p-value of <0.001. This increase indicates an improvement in functional balance after Tai Chi exercise.

The FRT value increased significantly from 18.72 $\pm$ 2.15 cm to 22.96 $\pm$ 2.46 cm, with a p-value of <0.001. This indicates that Tai Chi exercise was effective in improving dynamic balance among older adults.

Thus, Tai Chi exercise had a significant effect on improving balance and reducing fall risk among older adults.

Independent t-test Results for Differences in Changes Between Groups

After pretest–posttest testing had been conducted in each group, the analysis was continued by comparing the change or delta values between the conventional balance exercise group and the Tai Chi group. The test used was the independent t-test because the delta data were normally distributed.

For the TUG variable, the change value was calculated by subtracting the posttest score from the pretest score, so a positive value indicated improvement. For the BBS and FRT variables, the change values were calculated by subtracting the pretest scores from the posttest scores, so positive values also indicated improvement.



Table 7. Independent t-test Results for Differences in Changes Between Groups

Variable	Conventional Mean $\pm$ SD	Tai Chi Mean $\pm$ SD	Mean Difference	t	p-value
Delta TUG	2.08 $\pm$ 0.64	3.23 $\pm$ 0.57	1.15	6.71	<0.001
Delta BBS	4.48 $\pm$ 1.05	6.29 $\pm$ 0.90	1.81	6.54	<0.001
Delta FRT	2.55 $\pm$ 0.83	4.24 $\pm$ 0.90	1.69	6.90	<0.001

Based on Table 7, there were significant differences in changes between the conventional balance exercise group and the Tai Chi group across all measurement variables.

For the TUG variable, the mean reduction in time in the Tai Chi group was 3.23 ± 0.57 seconds, which was greater than that in the conventional balance exercise group, namely 2.08 ± 0.64 seconds. The independent t-test results showed a p-value of <0.001, indicating a significant difference in TUG changes between the two groups.

For the BBS variable, the mean increase in score in the Tai Chi group was 6.29 ± 0.90 , which was greater than that in the conventional balance exercise group, namely 4.48 ± 1.05 . The test results showed a p-value of <0.001, indicating a significant difference in functional balance improvement between the two groups.

For the FRT variable, the mean increase in the Tai Chi group was 4.24 ± 0.90 cm, which was greater than that in the conventional balance exercise group, namely 2.55 ± 0.83 cm. The test results showed a p-value of <0.001, indicating a significant difference in dynamic balance improvement between the two groups.

Thus, Tai Chi demonstrated greater effectiveness than conventional balance exercise in improving balance and reducing fall risk among older adults.

DISCUSSION

The results of this study showed that conventional balance exercise and Tai Chi both had significant effects on improving balance and reducing fall risk among older adults. This was indicated by a decrease in the mean Timed Up and Go (TUG) score and increases in the mean Berg

Balance Scale (BBS) and Functional Reach Test (FRT) scores after the intervention in both groups. In the conventional balance exercise group, the TUG score decreased from 14.61 ± 1.52 seconds to 12.52 ± 1.65 seconds, the BBS score increased from 40.88 ± 2.70 to 45.35 ± 2.81 , and the FRT value increased from 19.02 ± 1.86 cm to 21.58 ± 2.03 cm, with all p-values <0.001. In the Tai Chi group, the TUG score decreased from 14.56 ± 1.66 seconds to 11.33 ± 1.54 seconds, the BBS score increased from 40.77 ± 2.50 to 47.07 ± 2.85 , and the FRT value increased from 18.72 ± 2.15 cm to 22.96 ± 2.46 cm, with all p-values <0.001. These findings indicate that both forms of exercise were able to improve functional mobility, functional balance, and dynamic balance among older adults.

The improvement observed in the conventional balance exercise group can be explained through mechanisms of neuromuscular adaptation and enhanced postural control. Conventional balance exercise generally involves single-leg standing, tandem stance, tandem walking, weight shifting, coordination exercises, and lower-extremity strengthening (Ranti et al., 2025). These exercises stimulate the somatosensory, proprioceptive, vestibular, and musculoskeletal systems, which play important roles in maintaining body stability. The decrease in TUG time indicates that respondents became faster and more stable when rising from a chair, walking, turning, and sitting down again. The increase in BBS score indicates an improved ability to maintain body position during functional activities, while the increase in FRT indicates an improved ability to reach without losing balance (Mollova et al., 2025). Thus, conventional balance exercise was shown to improve the basic balance components required by older adults in daily activities.

These findings are consistent with the study by Papalia et al. (2020), which showed that physical exercise, particularly exercise targeting balance and movement function, is effective in preventing falls among community-dwelling older adults. Structured balance exercise can improve postural control, walking function, and lower-extremity muscle strength, all of which play important roles in maintaining body stability.



This is also supported by Sherrington et al. (2019), who reported that balance and functional exercises can reduce fall incidence among older adults. Therefore, the findings of this study support previous evidence that conventional balance exercise is a relevant non-pharmacological intervention for reducing fall risk among older adults.

In the Tai Chi group, balance improvement appeared to be greater than in the conventional balance exercise group. This was shown by the mean change in TUG of 3.23 ± 0.57 seconds in the Tai Chi group, which was greater than 2.08 ± 0.64 seconds in the conventional group. The increase in BBS score in the Tai Chi group was also higher, namely 6.29 ± 0.90 compared with 4.48 ± 1.05 in the conventional group. Similarly, for FRT, the Tai Chi group showed an increase of 4.24 ± 0.90 cm, whereas the conventional group increased by 2.55 ± 0.83 cm. These between-group differences in changes were statistically significant, with p-values <0.001 for all variables. This means that although both interventions were effective, Tai Chi demonstrated greater effectiveness in improving balance and reducing fall risk among older adults (Chen et al., 2023).

The superiority of Tai Chi can be explained by its more integrative nature. Tai Chi combines slow movements, weight shifting, body rotation, limb coordination, breathing control, concentration, and postural awareness. These movement sequences require older adults to continuously maintain their center of gravity while moving (Vasconcelos et al., 2025). Unlike conventional exercise, which tends to focus on specific physical components, Tai Chi trains balance comprehensively through the integration of motor, sensory, cognitive, and postural systems. Its slow and controlled movement patterns also allow older adults to train body stability safely, making it suitable for older populations with mobility limitations.

The findings of this study are consistent with Tiara and Sunarno (2022), who showed that Tai Chi is effective in reducing fall risk among older adults through improvements in balance, postural control, and confidence in movement. Another study by Wan et al. (2025) also showed that mind-body exercise, including Tai Chi, has

positive effects on balance and fall prevention among older adults. In addition, Li et al. (2024) reported that Tai Chi can improve balance and reduce fall risk among older adults based on the results of a meta-analysis. This consistency strengthens the interpretation that the increase in BBS, decrease in TUG, and increase in FRT in the Tai Chi group in this study are in line with previous empirical evidence.

Compared with conventional balance exercise, Tai Chi provides more complex exercise stimuli to the balance system. In conventional exercise, the main stimulus is directed toward improving muscle strength, postural stability, and the ability to maintain body position (Pratama et al., 2025). Meanwhile, Tai Chi involves not only static stability but also movement transitions, weight shifting, body orientation, bilateral coordination, breathing control, and attention to movement (Mahalakshmi & Shaji, 2024). This combination can improve older adults' ability to control their bodies during movement, particularly in activities that require changes in direction and positional transitions. This explains why the Tai Chi group experienced greater improvements in TUG, BBS, and FRT compared with the conventional balance exercise group.

Clinically, a decrease in TUG score is important because it indicates improved functional mobility. Older adults with shorter TUG times tend to have better ability to change positions, walk, and turn. An increase in BBS score indicates that older adults are better able to maintain stability in various functional activities, such as standing, sitting, changing positions, and turning. Meanwhile, an increase in FRT indicates that older adults have better stability limits when performing reaching movements. These three changes indicate that the interventions provided were not only statistically significant but also functionally relevant for older adults' daily activities (Wang et al, 2022).

The findings of this study are also consistent with global guidelines for fall prevention among older adults, which emphasize the importance of physical activity, balance exercise, and multidomain interventions to reduce fall risk. Montero-Odasso et al. (2022) stated that older adults, particularly those at risk of falling,



need exercise-based interventions and multifactorial approaches to improve balance, movement function, and safety in daily activities. Therefore, the results of this study support the recommendation that structured physical exercise, both conventional balance exercise and Tai Chi, can be used as a promotive and preventive strategy in older adult health services.

The results of this study have practical implications for geriatric physiotherapy services and community-based older adult health programs. Conventional balance exercise remains important because it is easy to design, can be directed toward specific deficit components, and is suitable for rehabilitative exercise. However, Tai Chi can be considered a more applicable promotive and preventive intervention for older adult communities because its movements are relatively safe, it does not require special equipment, it can be performed in groups, and it provides physical and cognitive stimulation simultaneously. Therefore, Tai Chi has the potential to be implemented in older adult health posts, older adult communities, nursing homes, and community-based physiotherapy services (Yang et al., 2022).

Based on the overall findings and comparison with previous studies, it can be concluded that conventional balance exercise and Tai Chi are both effective in improving balance and reducing fall risk among older adults. However, Tai Chi shows greater effectiveness because it can stimulate balance more comprehensively through weight shifting, movement coordination, postural control, concentration, and body awareness. Thus, Tai Chi can be recommended as an effective, safe, and applicable community-based physiotherapy intervention to improve balance and reduce fall risk among older adults.

Study Limitations

This study has several limitations that should be considered when interpreting the findings. First, the study employed a quasi-experimental design with non-probability purposive sampling, which may limit control over selection bias and baseline differences between intervention groups. The sample consisted of 50

older adults recruited from a single setting, Sekolah Lansia Tangguh Mandiri RW 05, Badean, Bondowoso, which may restrict the generalizability of the findings to older populations with different demographic, health, and environmental characteristics.

Second, the intervention was implemented for 6–8 weeks with a frequency of 2–3 sessions per week, resulting in possible variation in total exercise exposure among participants. Differences in attendance, physical tolerance, and adherence may also have influenced individual responses to conventional balance exercise and Tai Chi. Although adherence was monitored, variations in participant engagement during the intervention could not be completely eliminated.

Third, the outcomes were assessed using the Timed Up and Go test, Berg Balance Scale, and Functional Reach Test, which primarily evaluate functional mobility, functional balance, and dynamic balance. These measures are relevant to fall-related functional performance, but the study did not directly monitor the actual incidence or recurrence of falls over a prospective follow-up period. Consequently, the findings should primarily be interpreted as evidence of improvement in balance and functional mobility associated with fall risk rather than direct evidence of a reduction in fall incidence.

Fourth, outcome assessment was limited to measurements obtained immediately before and after the intervention. The absence of a long-term follow-up period means that the persistence of improvements in TUG, BBS, and FRT scores after completion of the exercise program could not be determined. Future studies should involve larger and more heterogeneous samples, employ randomized allocation where feasible, standardize intervention duration and frequency, and include longer follow-up periods with direct monitoring of fall events to strengthen the external validity and clinical relevance of the findings.

CONCLUSION

Conventional balance exercise and Tai Chi exercise were shown to have effects on improving balance and reducing fall risk among older adults. Conventional balance exercise improved



functional mobility through improvements in postural stability, lower-extremity strength, coordination, and movement control, whereas Tai Chi exercise produced more prominent improvements because it involved slow movement coordination, weight shifting, breathing control, concentration, body awareness, and more comprehensive motor-sensory integration. The comparison between the two interventions showed that Tai Chi was more effective than conventional balance exercise in improving balance among older adults; therefore, this exercise can be considered a safe, applicable, and relevant community-based physiotherapy intervention for fall prevention programs among older adults.

Recommendations

Based on the study findings, Tai Chi exercise is recommended to be considered as one of the community-based physiotherapy programs to improve balance and reduce fall risk among older adults, particularly because this exercise is safe, applicable, does not require special equipment, and can be performed in groups. Physiotherapists, managers of older adult health posts, nursing homes, older adult communities, and public health services are advised to develop structured, gradual, monitored exercise programs that are adjusted to the physical abilities of older adults so that the benefits of exercise can be optimally achieved and the risk of injury during implementation can be minimized.

Conventional balance exercise can still be used as a basic intervention to improve postural stability, lower-extremity strength, coordination, and movement control, whereas Tai Chi can be developed as an integrative exercise that stimulates balance, motor coordination, concentration, breathing control, and body awareness more comprehensively. Future studies are recommended to use stronger designs, larger sample sizes, longer intervention durations, stricter monitoring of exercise adherence, and evaluation of actual fall events after the intervention so that the effectiveness of both exercises can be assessed more comprehensively. Further studies may also develop a combined exercise model involving conventional balance

exercise and Tai Chi to strengthen the theoretical basis and produce a more adaptive fall prevention approach for older adults.

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REFERENCES

- Alpiah, D. N., & Wada, Z. H. (2023). *Pengaruh Modifikasi Senam Tai Chi Terhadap Keseimbangan Dinamis Pada Lansia Di Posyandu Lansia RW 03 Kelurahan Cipayung Jakarta Timur*. Jurnal Fisioterapi Binawan, 1(1).
<https://journal.binawan.ac.id/index.php/JIF/article/view/1281>
- Azizah, S., Majid, Y. A., & Ardiyanti, S. (2024). *Pengaruh Balance Exercise Terhadap Tingkat Keseimbangan pada Lansia*. Citra Delima Scientific Journal of Citra Internasional Institute, 8(2).
<https://doi.org/10.33862/citradelima.v8i2.453>
- Badan Penelitian dan Pengembangan Kesehatan. (2019). *Laporan Nasional Riskesdas 2018*. Jakarta: Lembaga Penerbit Badan Penelitian dan Pengembangan Kesehatan. ISBN 978-602-373-118-3.
- Chen, W., Li, M., Li, H., Lin, Y., & Feng, Z. (2023). *Tai Chi for fall prevention and balance improvement in older adults: A systematic review and meta-analysis of randomized controlled trials*. Frontiers in Public Health, 11, 1236050.
<https://doi.org/10.3389/fpubh.2023.1236050>
- Khan, H. T., Addo, K. M., & Findlay, H. (2024). Public health challenges and responses to the growing ageing populations. *Public health challenges*, 3(3), e213.
- Li, L., Wang, C., & Zhang, Y. (2024). Effectiveness of Tai Chi exercise on balance and fall prevention in older adults: A meta-analysis. *Frontiers in Medicine*, 11, 1289456.
- Lin, J., Ning, S., Lyu, S., Gao, H., Shao, X., Tan, Z., Zhu, X., & Chen, Y. (2024). *The effects of*



- different types of Tai Chi exercises on preventing falls in older adults: A systematic review and network meta-analysis. *Aging Clinical and Experimental Research*, 36, 65. <https://doi.org/10.1007/s40520-023-02674-7>
- Mahalakshmi, A. L., & Shaji, J. H. (2024). Tai Chi and its impact on health. *Journal of Datta Meghe Institute of Medical Sciences University*, 19(3), 402-405.
- Mollova, K., Valeva, S., Bekir, N., Teneva, P., & Varlyakov, K. (2025). Effectiveness of Proprioceptive Training on Postural Stability and Chronic Pain in Older Women with Osteoporosis: A Six-Month Prospective Pilot Study. *Journal of Functional Morphology and Kinesiology*, 10(3), 316.
- Montero-Odasso, M., van der Velde, N., Martin, F. C., Petrovic, M., Tan, M. P., Ryg, J., Aguilar-Navarro, S., Alexander, N. B., Becker, C., Blain, H., et al. (2022). *World guidelines for falls prevention and management for older adults: A global initiative*. *Age and Ageing*, 51(9), afac205. <https://doi.org/10.1093/ageing/afac205>
- Papalia, G. F., Papalia, R., Diaz Balzani, L. A., Torre, G., Zampogna, B., Vasta, S., ... & Denaro, V. (2020). The effects of physical exercise on balance and prevention of falls in older people: A systematic review and meta-analysis. *Journal of clinical medicine*, 9(8), 2595.
- Pratama, R., Zakaria, A., & Kusuma, A. I. (2025). Perbandingan Latihan Sensorimotor dengan Pemulihan Fisik Konvensional dalam Meningkatkan Stabilitas Atlet Pasca Cedera. *SPRINTER: Jurnal Ilmu Olahraga*, 6(3), 801-808.
- Ranti, R. A., Puring, R. H., Rusdamayanti, S. M., Felyanti, A., Firmansyah, D., & Wijaya, K. (2025). PROGRAM LATIHAN KESEIMBANGAN DALAM PENCEGAHAN JATUH PADA LANSIA: LITERATURE REVIEW. *Seroja Husada: Jurnal Kesehatan Masyarakat*, 2(5), 109-124.
- Sari, N. P. N. N., Martini, N. M. D. A., Triana, K. Y., & Sari, A. R. C. (2025). *Pengaruh Balance Exercise Terhadap Tingkat Keseimbangan Dalam Penurunan Risiko Jatuh Pada Lansia*. *Jurnal Keperawatan Muhammadiyah*, 10(2). <https://doi.org/10.30651/jkm.v10i2.25827>
- Sherrington, C., Fairhall, N. J., Wallbank, G. K., Tiedemann, A., Michaleff, Z. A., Howard, K., Clemson, L., Hopewell, S., & Lamb, S. E. (2019). Exercise for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews*, 2019(1), CD012424.
- Sherrington, C., Fairhall, N., Kwok, W., Wallbank, G., Tiedemann, A., Michaleff, Z. A., Ng, C. A. C. M., & Bauman, A. (2020). *Evidence on physical activity and falls prevention for people aged 65+ years: Systematic review to inform the WHO guidelines on physical activity and sedentary behaviour*. *International Journal of Behavioral Nutrition and Physical Activity*, 17, 144. <https://doi.org/10.1186/s12966-020-01041-3>
- Shoufiah, N. R., & ST, S. (2025). PERAWATAN GERIATRI DALAM KONTEKS KESEHATAN HOLISTIK. *Keperawatan Geriatri*, 27.
- Tiara, N., & Sunarno, R. D. (2022). Efektifitas Senam Tai Chi Terhadap Keseimbangan Tubuh Dan Penurunan Risiko Jatuh Pada Lansia. *Jurnal Ilmu Keperawatan dan Kebidanan*, 13(1), 198-204.
- Vasconcelos, B. B., Freitas, M. P., Crochemore-Silva, I., & Alberton, C. L. (2025). Effects of a 12-week Tai Chi Chuan combined with walking program on physical and mental parameters of older adults: rationale and methodological protocol for a randomized controlled trial. *Trials*, 26(1), 446.
- Wan, R., Huang, J., Wang, K., Long, D., Tao, A., Huang, J., & Liu, Z. (2025). Effectiveness of Mind-Body Exercise in Older Adults With Sarcopenia and Frailty: A Systematic Review and Meta-Analysis. *Journal of Cachexia, Sarcopenia and Muscle*, 16(2), e13806.
- Wang, Q., Li, L., Mao, M., Sun, W., Zhang, C., Mao, D., & Song, Q. (2022). The relationships of postural stability with muscle strength and proprioception are different among older adults over and under 75 years of age. *Journal of Exercise Science & Fitness*, 20(4), 328-334.
- World Health Organization. (2021). *Step safely: Strategies for preventing and managing falls across the life-course*. Geneva: World Health Organization. ISBN 978-92-4-002191-4
- Yang, F. C., Desai, A. B., Esfahani, P., Sokolovskaya, T. V., & Bartlett, D. J. (2022). Effectiveness of tai chi for health promotion of older adults: a scoping review of meta-analyses. *American journal of lifestyle medicine*, 16(6), 700-716.

