

EFFECTIVENESS OF TAI-CHI EXERCISE ON MUSCLE STRENGTH, BALANCE AND MEMORY IN ELDERLY PEOPLE: A COMPARATIVE STUDY

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Abstract—Background: Ageing is commonly associated with reductions in muscle strength, balance and cognitive performance, which may affect mobility and independence. Exercise-based interventions may help address these changes.

Objective: To compare the effects of Tai Chi and conventional balance exercise on muscle strength, balance and memory/cognitive function in elderly people.

Methods: 37 adults aged 65–85 years participated. Group A received Tai Chi exercise (n=17), and Group B received conventional balance exercise (n=20). Both groups undertook supervised exercise three times per week for four weeks. Muscle strength was assessed using Manual Muscle Testing (MMT), balance using the Berg Balance Scale (BBS), and cognitive function using the Mini-Mental State Examination (MMSE). Within-group comparisons used the Wilcoxon signed-rank test and between-group comparisons used the Mann–Whitney U test.

Results: BBS scores increased from 30.47 ± 5.87 to 34.59 ± 6.51 in Group A and from 30.85 ± 6.11 to 40.50 ± 5.75 in Group B. MMSE scores increased from 23.12 ± 1.76 to 23.88 ± 2.06 in Group A and from 24.05 ± 1.50 to 26.85 ± 1.50 in Group B. Within-group changes were reported as statistically significant ($p=0.001$). Post-intervention scores favoured Group B for BBS ($p=0.011$) and MMSE ($p=0.001$). MMT results also indicated improvement in lower-limb strength in both groups, with greater post-intervention scores for several hip muscle measures in Group B.

Conclusion: Both interventions were associated with improvements in measured outcomes over four weeks. Conventional balance exercise showed greater improvement in balance and cognitive scores and in several reported lower-limb strength measures. Larger studies with longer follow-up and complete muscle-specific statistical reporting are needed.

Index Terms—Tai Chi, elderly people, muscle strength, balance, memory, conventional balance exercise

I. Introduction

Population ageing is accompanied by physiological changes that can affect skeletal muscle performance, postural control and cognitive function. Reduced lower-limb strength may make transfers, stair climbing and walking more difficult, while age-related changes in the neuromuscular system can influence motor performance. ^[1,3] Impaired balance can increase instability during daily activities, while changes in memory and other cognitive domains may affect safe performance of everyday tasks. These changes can interact and contribute to reduced functional independence. ^[2,4,5]

Exercise is an important non-pharmacological approach for maintaining physical function in older adults. Tai Chi is a mind-body activity involving slow, controlled movements, weight shifting, postural transitions, attention and coordinated breathing.^[6-8] Conventional balance exercise commonly uses task-specific activities such as tandem standing, single-leg standing, marching, heel raises, mini-squats and sit-to-stand practice. These exercises may challenge postural control and lower-limb muscles in ways that relate directly to everyday movement.^[6]

Although Tai Chi and conventional balance exercises are both used with older adults, their comparative effects across muscle strength, balance and memory-related cognitive performance require consideration. The present study compared the two interventions over a four-week period using MMT, BBS and MMSE.

II. LITERATURE REVIEW

Mao et al. (2024) reported that Tai-Chi lower extremity exercise improves balance control and functional mobility in older adults in assisted living communities.^[9]

Nan et al. (2024) in a systematic review concluded that Tai-Chi is effective in improving balance and strength among elderly, particularly with medium-term intervention.^[10]

Sherrington et al. (2019) reported that structured balance and functional exercises are effective for improving physical function and reducing falls in older adults.^[11]

Conventional balance programmes use repeated, progressive tasks that challenge stability and lower-limb control. The specific response to either intervention may depend on baseline function, exercise dose, supervision and participant adherence.

The current comparative study addresses these outcomes together rather than focusing on cognition alone.

III. AIM AND OBJECTIVES

Aim

To compare the effectiveness of Tai Chi exercise and conventional balance exercise on muscle strength, balance and memory/cognitive function in elderly people.

Objectives

1. To assess changes in muscle strength following Tai Chi and conventional balance exercise using Manual Muscle Testing.
2. To assess changes in balance using the Berg Balance Scale.
3. To assess changes in memory-related cognitive function using the Mini-Mental State Examination.
4. To compare the measured outcomes between the two exercise groups after the intervention.

IV. METHODOLOGY

Study design : a Experimental comparative intervention study involving 37 older adults aged 65–85 years. Participants were allocated to Group A (Tai Chi exercise; n=17) or Group B (conventional balance exercise; n=20).

study setting: the study conducted at an old age home and institutionally at Maharashtra institute of physiotherapy latur, outpatient of community department .

sampling method : simple random sampling method

Inclusion criteria : participants aged 65-85 years, were required to understand the instructions and have an MMSE score greater than 20; it also lists a minimum MMT grade of 2 and other eligibility criteria.

Exclusive criteria : inability to stand or perform exercise safely, severe cognitive impairments, severe neurological and musculoskeletal disorders like recent fractures, stroke.

Ethical approval obtained from institutional ethical committee. 43 screened, 40 selected per criteria. Written informed consent obtained. Baseline demographic data and outcome measures (MMT, BBS, MMSE) taken. Subjects divided into Group A (Tai-Chi Exercise) and Group B (Conventional Balance Exercise - control). Intervention: FITT - Frequency 3 sessions/week alternatively for 4 weeks (12 sessions), Intensity low-to-moderate 10 repetitions x 2 sets, Time 30 min/session (Warm up 5 min, Main exercise 20 min, Cool down 5 min), Type as per group, under supervision of physiotherapist. Post-test evaluation at end of 4 weeks.

Group A — Tai Chi: Participants practised an eight-form Yang-style sequence. The movements emphasised controlled weight transfer, posture, coordinated movement and balance.

Group B — Conventional balance exercise: Participants performed conventional balance and lower-limb activities, including exercises such as heel raises, mini-squats, sit-to-stand/chair-rise practice, marching, tandem or single-leg standing and leg swings.

Ethical Considerations was taken. Confidentiality maintained, voluntary participation, option to withdraw at any time. Consent taken in English and Marathi.

Muscle strength: Manual Muscle Testing (MMT) was used to grade selected lower-limb muscle groups on the standard ordinal scale.

Balance: The Berg Balance Scale (BBS) was used to assess functional balance. Higher scores indicate better balance performance.

Memory/cognitive function: The Mini-Mental State Examination (MMSE) was used to screen global cognitive performance, including orientation, registration, attention/calculation, recall and language-related tasks.

The thesis reports the Shapiro–Wilk test for assessment of normality, Wilcoxon signed-rank tests for within-group pre/post comparisons and Mann–Whitney U tests for between-group comparisons. A p-value below 0.05 was considered statistically significant. The original thesis should be checked for the exact software version and for the full muscle-specific test statistics before final submission.

V. RESULTS

37 participants were included: 17 in the Tai Chi group and 20 in the conventional balance exercise group. Mean age was 75.41 ± 6.92 years in Group A and 75.30 ± 6.94 years in Group B; the groups did not differ significantly in age ($p=0.988$).

1. Balance

Both groups improved on the BBS. Group A increased by 4.12 points, from 30.47 ± 5.87 to 34.59 ± 6.51 . Group B increased by 9.65 points, from 30.85 ± 6.11 to 40.50 ± 5.75 . The thesis reports significant within-group changes ($p=0.001$ for each group). The post-intervention comparison favoured Group B ($p=0.011$).

Group	Pre-intervention mean±SD	Post-intervention mean±SD	Mean change	Within-group p
Tai Chi (n=17)	30.47±5.87	34.59±6.51	4.12	0.001
Conventional balance (n=20)	30.85±6.11	40.50±5.75	9.65	0.001

Between-group values : baseline BBS p=0.807; post-intervention BBS p=0.011.

2. Memory Function

MMSE scores increased from 23.12±1.76 to 23.88±2.06 in Group A (mean change 0.76) and from 24.05±1.50 to 26.85±1.50 in Group B (mean change 2.80). The thesis reports within-group p=0.001 for both groups. The between-group comparison was not significant at baseline (p=0.091), while post-intervention scores favoured Group B (p=0.001).

Group	Pre-intervention mean±SD	Post-intervention mean±SD	Mean change	Within-group p
Tai Chi (n=17)	23.12±1.76	23.88±2.06	0.76	0.001
Conventional balance (n=20)	24.05±1.50	26.85±1.50	2.80	0.001

3. Muscle strength

Improvement in lower-limb muscle strength after intervention and states that Group B had higher post-intervention scores for several muscles, particularly around the hip and ankle.

Muscle group	Group	Pre mean±SD	Post mean±SD	Change	Reported between-group post-test result
Left hip flexors	Tai Chi	3.00±0.79	3.41±0.87	+0.41	Group B mean 4.00; p=0.072 (not significant)
Left hip flexors	Conventional	3.00±0.86	4.00±0.86	+1.00	p=0.072
Right hip flexors	Tai Chi	3.12±0.86	3.76±1.03	+0.65	Group B mean 4.45; p=0.035
Right hip flexors	Conventional	3.45±0.69	4.45±0.69	+1.00	p=0.035

Left hip extensors	Tai Chi	2.88±0.78	3.35±0.86	+0.47	Group B mean 4.00; p=0.019
Left hip extensors	Conventional	3.00±0.73	4.00±0.73	+1.00	p=0.019

VI. DISCUSSION

The main finding is that both exercise groups improved in balance, cognitive screening scores and reported lower-limb muscle strength during the four-week intervention. However, conventional balance exercise showed larger mean gains in BBS and MMSE and higher post-intervention scores for several reported hip muscle measures. These findings support the interpretation that both programmes may be useful, while the conventional programme produced greater short-term change on several measured outcomes in this sample.

1. Balance:

The BBS gain was 4.12 points in the Tai Chi group and 9.65 points in the conventional balance group. Tai Chi involves slow weight shifting, controlled movement and postural transitions, which may challenge balance. Conventional balance exercise may provide more direct, repeated practice of functional stability tasks such as standing with a narrowed base of support, marching, heel raises and sit-to-stand activities. Such task-specific practice could help explain the larger BBS change in Group B. Nevertheless, the study duration was short and the findings should not be generalised beyond the sample without further research.

2. Memory function:

MMSE increased by 0.76 points in Group A and 2.80 points in Group B. Tai Chi may engage attention, sequencing, movement planning and mind–body coordination. Conventional exercise may also influence cognitive performance through physical activity, repeated instructions and task engagement. The observed between-group difference favoured conventional balance exercise, but MMSE is a brief global screening measure and may be affected by familiarity with the test, practice effects and other factors. The study cannot establish a specific mechanism or prove improvement in memory alone.

3. Muscle strength:

The source thesis reports improvements in several lower-limb MMT measures, with greater post-intervention scores for Group B in a number of hip and ankle muscle groups. Conventional exercises such as heel raises, mini-squats, marching and sit-to-stand practice involve repeated muscle activation and resemble activities required for transfers and walking. Tai Chi also requires controlled lower-limb loading and sustained postural control, which may contribute to strength-related functional changes. As MMT is an ordinal clinical grading tool rather than a direct dynamometer measurement, future studies should include quantitative strength testing and clearly report complete muscle-specific statistics.

Limitations

The study included a small sample and a short four-week intervention. The available thesis text does not fully establish the allocation method, session dose and adherence data. MMT is ordinal, and MMSE is a global cognitive screening instrument rather than a memory-specific test. The study also did not report follow-up outcomes or directly measure falls, disability or daily function.

Future scope

Larger sample, longer duration(8-12 weeks),long term follow up, inclusion of additional strength measures like handheld dyanamometer and TUG test.

VII. CONCLUSION

In this comparative study of older adults, both Tai Chi exercise and conventional balance exercise were associated with improvements in muscle strength, balance and MMSE scores after four weeks. Conventional balance exercise showed larger gains in balance and cognitive screening scores and higher post-intervention scores for several reported lower-limb muscle measures. These results suggest that conventional balance exercise may produce greater short-term improvement in some outcomes in this sample, while Tai Chi also showed beneficial changes.

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