

Effects of Yang Style Tai Chi Exercises Combined with Mental Imagery Training on Balance and Fall Prevention in Elderly

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Abstract

Objectives: The objective of this study was to examine the effects of Yang style Tai Chi exercises combined with mental imagery training on balance and fall prevention in the elderly.

Methodology: It was a Randomized control trial, done on sixty patients. Participants were randomly assigned to either experimental group (63.94 ± 2.4 years) receiving motor imagery training with Tai Chi exercises while the control group (63.51 ± 2.7 years) performed only Tai Chi exercises for 8 weeks. Berg balance scale (BBS), Timed Up & Go test (TUG) mental imagery questionnaire-revised (MIQ-RS) and fall efficacy scale (FES) was used to evaluate the outcomes at baseline, 4th week and after 8th week of training.

Results: The results showed that 38(63.3%) were males and 22 (36.6%) were females. BBS, TUG test, MIQ-RS, and FES showed significant ($p < 0.001$) improvement within-group analysis, whereas between-group analysis showed non-significant improvement ($p > 0.001$) on all outcome measures except mental imagery questionnaire which showed significant difference post-intervention in both groups.

Conclusion: It is concluded that there was no significant difference between the groups while within-group significant difference was observed which showed that both techniques have equal effects on balance and fall prevention in the elderly.

Keywords: Balance; Fall; Elderly; Mental imagery; Tai chi exercises

Introduction

Fall is defined as any unintentional positional change that results in a person coming to rest on the ground floor, or other lower surface. The risk of fall increases dramatically with age [1]. Older adults, unintentional injuries are the fifth leading cause of death, and falls constitute two-thirds of these days [2]. Falls are the most serious common condition present in older adults causing injuries, social isolation, and psychological difficulties [3]. Deficiency or impairment in balance increases the risk of fall thus making it difficult to perform functional activities [4]. Decrease in balance ability resulting from aging triggers motor and gait disabilities in elderly people, which greatly affects their mobility in day-to-day life [5]. They are the serious cause of mortality and morbidity which leads to immobility and premature nursing care [5,6]. Falls occurred in more than one-third of the elderly aged 65 years and older annually [7]. The incidence of falls rises steadily from Middle age and peaks in persons older than 80 years. Approximately 30-50% of people living in long-term care institutions fall each year, and 40% of them experienced recurrent falls. Approximately 25% to 35% of people over age 65 years experiences more falls every year [7] several factors may influence the fall risk in the elderly to a great extent. Environmental hazards are the leading cause of falls, accounting for about 25 to 45 percent in most studies [8]. Major risk factors of fall among elderly population weakness, mobility impairment, balance and gait disturbance, Dizziness, vertigo, drop attacks, postural hypotension, visual impairment, and syncope are known to cause falls [9]. Lower extremity muscle weakness is a significant risk factor for falls, increasing the odds of falling fourfold. History of falls and gait or balance deficits increases the risk threefold [10]. Other high-risk situations that can cause or contribute to falls are the use of an assistive device, visual deficit, arthritis, and impaired activities of daily living, depression, cognitive impairment [11]. Use of medications has been strongly associated with an increased risk of falls. In particular, the use of psychotropic medications, have been Implicated in increasing the

risk of falls. Tai chi exercises have more beneficial and health effects to maintain the good, physical, psychological conditions in older adults [12]. In previous studies have shown beneficial effects of Tai Chi on the cardiorespiratory system, flexibility, muscle strength, and body fat composition in middle-aged and elderly individuals [13,14]. Likewise, studies suggested that older adults who had been practicing Tai Chi Chuan for years had better balance and functional fitness compared to sedentary older adults [13]. Another study o mental imaginary concluded that the link between attentional demands, postural oscillations, static balance, and the prevention of falls among the elderly is of importance [15]. The reduction of attentional demands reflects the automaticity of a task [16]. It has been shown that mental imagery is an effective technique, not only in reducing anteroposterior postural oscillations but also in interpreting the postural control tasks more automatically [16,17]. Therefore, this technique may be considered effective among the elderly population, to contribute to improving their static balance and preventing falls [18]. A study was done by Page SJ, et.al with the title of a randomized efficacy and feasibility study of imagery in acute stroke. Published in 2001 and concluded that the Imagery technique is a clinically feasible intervention and Imagery, in association with therapy, appears to be a noninvasive, efficacious

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complement to traditional therapy. The current study was planned to fill the gap by finding out the combined effect of Yang style Tai Chi exercises with mental imagery training on balance and prevention of falls among older adults.

Materials and Methods

This was a randomized control trial, registered in Clinical Trials.gov Identifier: NCT04766112. After taking approval from the ethics committee of Riphah College of Rehabilitation Sciences, Riphah International University Islamabad, and Basharat Hospital Rawalpindi. The sample size was calculated through an Open-Epi calculator with 95% confidence interval (CI), power 80% while using the mean and standard deviation of the primary outcome measure based on literature. Non-probability convenience sampling technique was used and the sample size for this study. According to inclusion criteria those patients with age above 60 having fall problems, or at least one history of fall in the last 6 months with Berg balance score 21 to 40, intellectually ready to take in an activity program as evaluated with the SMMSE should be greater than 24 out of 30. Subjects were excluded if they: took medications that could affect balance; had a history of frequent falling; had vision problems, and had musculoskeletal/ neuromuscular/ cardiovascular impairments that restricted exercise.

Study participants and intervention program

The following tools were used for assessment, Berg Balance scale, fall efficacy Scale (FES), Timed Up and Go test (TUG), The Movement Imagery Questionnaire (MIQ-RS). Patients reported with fall problems were randomized into 2 groups i.e. Experimental Group and the Control Group with the help of the sealed envelope method. The patients in the experimental group received Yang style Tai chi exercise combined with mental imagery training which consists of different positions and the Control group received only Yang style Tai chi exercises and the outcomes of both groups were evaluated at baseline, 4th and at 8th week.

After screening for inclusion and exclusion criteria, subjects were provided with detailed information regarding the purpose of the study, procedures and tests, and the scheduled time of the TC exercise. If the subject agreed to proceed, he/she signed the informed consent form

as approved by Institutional Review Board (IRB). The patients in the experimental group received Yang-style Tai chi exercise combined with mental imagery training. The Control group received only Yang-style Tai chi exercises only (Table 1, 2). The flow of participants is shown in CONSORT Figure 1.

Measurement

Berg Balance Scale

The BBS is a 14-item scale that quantitatively assesses balance and risk for falls in an older community. The scale requires 10 to 20 minutes to complete and measures the patient's ability to maintain static or dynamic balance. The items are scored from 0 to 4, with a score of 0 representing an inability to complete the task and a score of 4 representing independent item completion [19]. A global score is calculated out of 56 possible points. Scores of 0 to 20 represent balance impairment, 21 to 40 represent acceptable balance, and 41 to 56 represent good balance [20]. It is also best in the assessment of psychometric properties, and the scale has shown to be a valid and reliable measure of balance and reliability of BBS was high with ICC=0.92 [21].

Fall efficacy Scale

This tool measures fear of falls in older adults. FES is a self-administered 14 item scale, where individuals are instructed to score their concern of falling during an activity on a 4point Likert scale with 1 as not concerned at all and 4 as very concerned [22]. The item scores are summed up to obtain a total, with the higher the score, the higher being the concern for falling. Excellent test-retest reliability, and validity in both community-dwelling and geriatric nursing home-dwelling individuals [23].

Timed Up and Go test (TUG)

The TUG test is most obvious and frequently used for the assessment of a person's mobility. It measures the time which is needed a patient to stand up from a chair with arm supports, 3m walk, turn back or come back to the chair and sit down [24]. The reliability of the TUG test was high, with an ICC of 0.99 for within-session reliability

Table 1: Intervention protocol

Experimental group	Control group
<p>The Experimental Group received Yang-style Tai chi training combined with mental Imagery training which consists of different positions. These exercises were performed three times a week and total for eight weeks.</p> <p>A certified TC instructor handled the class for the whole program. TC has many styles, and we found that the Yang style was the most appropriate because it had the important characteristics relevant to MI and somatosensory enhancement. These characteristics included slow coordinated movement, weight shifting with wide steps, a one-leg stance, stretching, and mental concentration, Grasping the sparrows tail left; Grasping the sparrows tail Right; Cloud Hands; Repulse Monkey; Part wild horse Mane; Brush knee Twist step; Lift kick left; Lift kick Right;</p> <p>The exercise was conducted over a thick mat and with shoes off for greater sensory enhancement and challenge as indicated in previous studies. In this study, we used MI strategies, for example, subjects were asked to concentrate on the sequence of each movement in TC. Also, they were asked to mentor the exercise visually from the TC instructor before they executed any movement. Then, they were instructed to do and feel the movement sequence while they visually were watching themselves in the front of the mirror with supervision from the instructor to correct any movement if needed to achieve better outcomes as reported in a previous study.</p>	<p>The Control group received Yang style Tai chi exercises which comprise of different positions: weight shifting with wide steps, a one-leg stance, stretching, and mental concentration, Grasping the sparrows tail left; Grasping the sparrows tail Right; Cloud Hands; Repulse Monkey; Part wild horse Mane; Brush knee Twist step; Lift kick left; Lift kick Right.</p> <p>These exercises were performed three times a week and total for eight weeks.</p>

Table 2: Groups, the sessions in experimental and control group

Groups	Total no. of session	No. of Repetitions in 1 st and 2 nd week	No. of Repetitions in 3 rd and 4 th week	No. of Repetitions in 5 th and 6 th week	No. of Repetitions in 7 th and 8 th Week
Experimental Group	24 session	10 reps	15 reps	20 reps	25 reps
Control Group	24 session	10 reps	15 reps	20 reps	25 reps

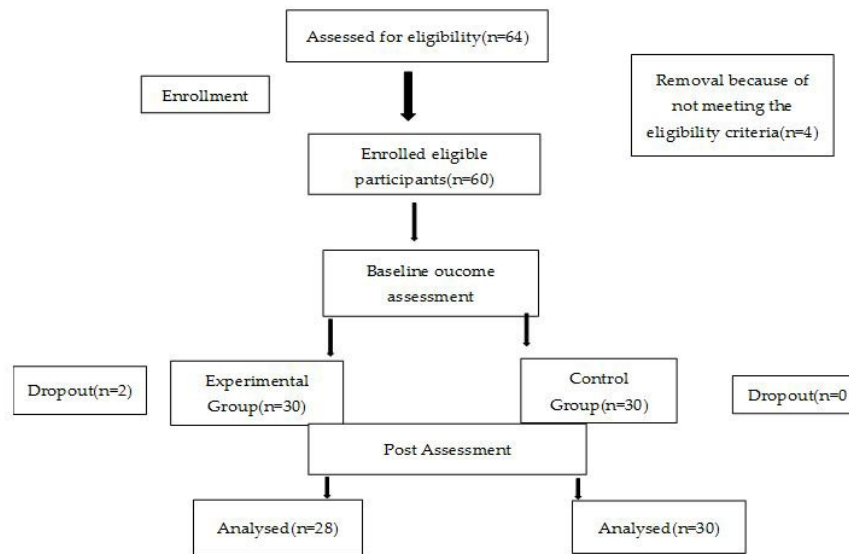


Figure 1: CONSORT showing the process of participant recruitment and experiment implementation.

and 0.99 for test-retest reliability [25,26].

The Movement Imagery Questionnaire (MIQ-RS)

The MIQ-RS is a 14-item questionnaire that rates one's ability to imagine. The questionnaire consists of 7 visual and 7 kinesthetic items and requires 25–30 minutes to administer [27]. Test-retest examination showed high degrees of reliability ICC range:83-0.99) [28].

Statistical Analysis

Data were analyzed using IBM version SPSS 23. The demographic characteristics of the subjects were compared between the groups. The normality of data was checked at baseline to recognize the normal distribution of the data. Shapiro Wilk test indicated that data was not normally distributed for all four tests included in the study. Since the distribution of these variables was not approximately normal, the baseline scores and differences between post and pre-measures for BBS, FES, TUG, and MIQ were compared between the two groups using the Mann-Whitney U test. In each study group, comparisons between post and pre-measures after the TC exercise were assessed using the Wilcoxon Signed rank test. For the different balance tasks, changes between post and pre-measures were examined using paired t-test and between experimental and control groups using an independent t-test. The level of significance was set at $p \leq 0.05$.

Results

According to above mentioned eligibility criteria, six participants were excluded due to some medical issues. A final total of sixty participants was include in the present study but two participants drop out from the experimental group due to schedule conflict (n=2), so 58 participants completed the study, mean age of experimental group was 63.94 ± 2.4 years and control group age was 63.51 ± 2.7 years. In the data, there were 36(63.3%) males and 22(36.6%) females. All females were housewives and males were enjoying retired life. At baseline there was no significant difference on all outcome measures between the experimental and control group ($p > 0.05$)

After 8 weeks the mean Berg Balance score improved significantly in within group ($p < 0.01$). However, there was no significant difference

between the two groups ($p = 0.96$). Similar findings were observed for the TUG test in between groups, it was non-significant ($p = 0.09$) and in the within-group, it was significant ($p < 0.05$). FES also showed similar findings in between groups, it was non-significant ($p = 0.23$) and in within-group, it was significant ($p < 0.05$). Whereas MIQ-RS showed significant improvements in within and between group analysis ($p = 0.001$). Within groups showed balance improvements (figure 2) for the various tasks however, this improvement did not differ between groups (Table 3).

Discussion

The purpose of this study was to evaluate the effects of Yang style Tai Chi exercises combined with mental imagery training on balance and fall prevention in elderly, the main findings of this study was TC exercises combined with mental imagery showed comprehensive improvement in experimental group as compared to TC exercises alone. After the 8-week of intervention participants score on BBS and TUG was significantly improved in both groups. A study was conducted, and they concluded as Tai Chi exercises have potential to decrease the prevalence of fall in older population. Tai Chi exercises shows the positive effects on balance and rapid decrease in fall related injuries. This study support the results of recent study with slightly difference in treatment plan they included only Tai Chi and recent study gives the results of Tai Chi along with mental imagery scale [1]. Literature indicated that elderly patients fall due to poor balance in this regard Tai Chi training were most suitable because they are more smooth, and slow patients feel comfortable and understanding with it [2,29]. Recent study also shows the similar results in control group patients improve their strength and balance by using Tai Chi exercise while addition of imagery training boost up the level of balance [30].

Risk of fall was measured by fall efficacy scale in both experimental and control group, the results shows that there was a significant improvement in balance and marked reduction in risk of fall in both groups with decrease of p value of 0.42 to 0.23 while within group $p < 0.001$. Previous study shows significant decline in risk of fall in older adults by mental imagery training [31]. So the findings of this study strongly correlate with the recent study [32]. The results indicated that after 8-weeks of training older adults demonstrated significant

Table 3: Between group analysis for BBS, FES, TUG & MIQ-R.

Variables	Group	Median(IQ)	Z value	P value
BBS at Baseline	Experimental	31(3.8)	-0.629	0.529
	Control	33.2(5.4)		
BBS at 4 th Week	Experimental	43.2(6)	-0.477	0.5633
	Control	43.7(8.4)		
BBS at 8 th Week	Experimental	51(7.7)	-0.039	0.969
	Control	50.4(8.2)		
FES at Baseline	Experimental	55.6(5.4)	-0.801	0.423
	Control	55.3(4.6)		
FES at 4 th Week	Experimental	45.8(6.8)	-0.439	0.660
	Control	48(5.8)		
FES 8 th Week	Experimental	37(6.6)	-1.198	0.231
	Control	38(6.5)		
TUG at Baseline	Experimental	3(1.1)	-1.084	0.278
	Control	2.8(1.2)		
TUG at 4 th Week	Experimental	2.2(1.2)	-0.375	0.707
	Control	2.3(-9.7)		
TUG at 8 th Week	Experimental	1.4(1.9)	-1.692	0.091
	Control	1.6(-1.1)		
Visual Imagery Baseline	Experimental	64(12)	-0.418	0.676
	Control	64(5.6)		
Visual Imagery 4 th Week	Experimental	81.5(9)	-5.875	0.000***
	Control	68(6.7)		
Visual Imagery 8 th Week	Experimental	94(12.2)	-6.027	0.001***
	Control	69(5.9)		
Kinesthetic Imagery Baseline	Experimental	54.6(12)	-0.593	0.553
	Control	55(6.4)		
Kinesthetic 4 th Week	Experimental	72.8(4.9)	-5.876	0.001***
	Control	58(7.7)		
Kinesthetic 8 th Week	Experimental	89(19.1)	-6.069	0.001***
	Control	59.2(5)		
MIQR Total Score Baseline	Experimental	119(23)	-0.418	0.676
	Control	119(12)		
MIQR Total Score 4 th Week	Experimental	154(13)	-6.047	0.001***
	Control	125(13)		
MIQR Total Score 8 th Week	Experimental	183(32)	-6.067	0.001***
	Control	128(11)		

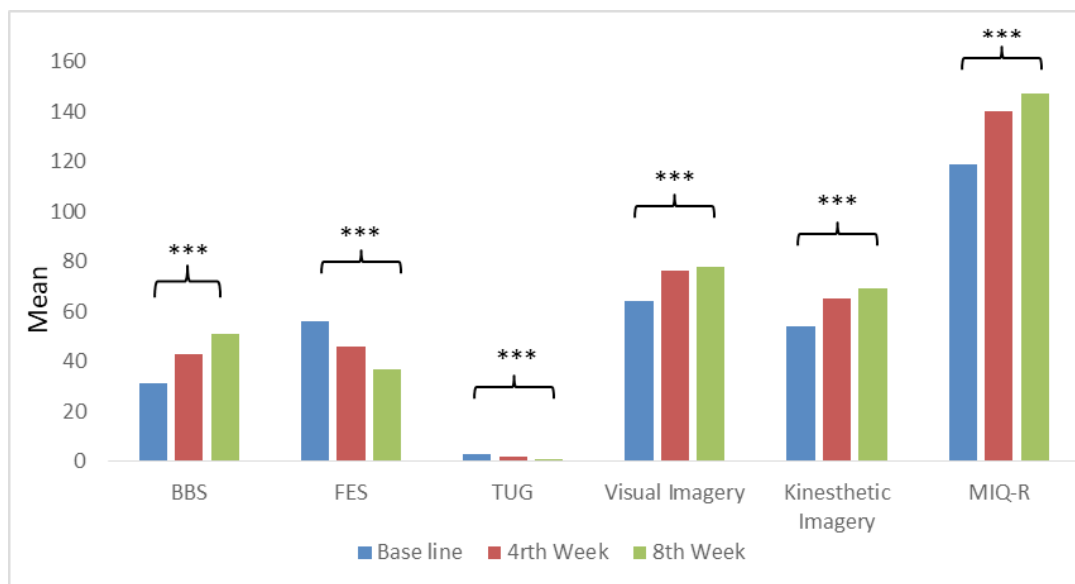


Figure 2: Mean of BBS, FES, TUG, MIQ-RS of within group (* Significant difference between pre and post exercise).

improvement on gait, balance and decrease fall risk [33,34]. It is worth mentioning that the value of these parameters of the older participants were consistent with those reported in a previous study and participants overall muscular strength and flexibility increased, which created positive effects on their mobility level [35]. Wingert JR, Corel CE et al. done a study in 2020 and they concluded that community based Tai Chi trainings boost up the balance in elderly population. Tai Chi also improves the sensory motor changes especially faster hip abductors muscle contraction speed, and improved hip proprioception. Results are somewhat similar to the current study as balance was improved ($P=0.001$) within group analysis [36].

A systemic review was done by Huang HW, Nicholson N et al. in 2019 and they concluded that Tai Chi training can diminish fall hazard in elderly population and improves dynamic equilibrium control and adaptability of people with balance and vestibular problems [36,37]. Similar results was observed in recent study and concluded that both constant pain and fear of falling can produce movement limitation and increased risk of fall among weak elderly population. Mental Imagery Training decreases the risk of fall and improves functional status of the patients [38,39]. In conclusion, an 8-week Tai chi training may change gait parameters, lower-limb flexibility, and range of motions to decrease risk of falls in older adults [39].

Study Limitations

This study has examined the mobility level, balance, and risk of fall in elderly, individual gait parameters, like step length, stride length, speed and accuracy were not measured. In future studies, it is recommended to use kinetic and kinematic data for gait assessment and functional status. As TC improves muscle flexibility and joints range of motion, it was not examined individually so future studies should also examine this.

Conclusion

Based on the findings of this study, it is concluded that both techniques have equal effects in improving mobility, and functional status of older adults. TC when combined with MI produces positive effects on balance and marked reduction in the risk of fall.

Acknowledgments

Author Contributions: Misbah Ghous and Farah Naqvi conceived and designed the experiments; performed the experiments; Sania Khawar Kiyani and Iqbal Tariq analyzed the data; Aroosa Tariq and Mehwish Butt contributed reagents/materials/analysis tools; and wrote the paper.

Conflicts of Interest:

The authors declare that they have no conflicts of interest.

Institutional Review Board: This study was approved by the research ethics committee of Riphah College of Rehabilitation Sciences, Riphah International University Islamabad, and Basharat Hospital Rawalpindi.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

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