

Effect of Tai Chi Exercises on the Balance, Functional Gait, and Flexibility of Elderly Filipino Males

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Abstract: The objective of this study is to evaluate the effect of a 16-week Tai Chi Chuan exercise program on the balance, functional gait and sit-and-reach flexibility among selected elderly Filipino males. This research utilized a one-group pre-test and post-test quasi-experimental design. Forty healthy male Filipino respondents aged 55-60 years, with no prior experience or knowledge about Tai Chi Chuan, were recruited from an urban community in Pasay City, Philippines. All of the respondents participated in a 16-week exercise program that was held three times a week every morning. Balance, functional gait and sit-and-reach flexibility were measured at the beginning and the end of the Tai Chi Chuan exercise intervention. This study showed that Tai Chi offers potential benefits to the elderly males in terms of balance and other physical functions. Improvements were evident in functional balance, gait and flexibility. The study proves that Tai Chi should be an alternative method for elderly males to slow down the normal decline in balance, gait performance and physical flexibility.

1. Introduction

Tai Chi Chuan (Taijiquan) is a healing martial art that combines martial arts movements with energy circulation – known as *qi* or *chi*, breathing, and stretching Techniques [1]. Originally developed for self-defense, tai chi has evolved into a graceful form of exercises that's now used for stress reduction and a variety of other health conditions (Mayo Clinic, 2015). As a proven life-prolonging, healing, and rejuvenating exercise, Tai Chi have been found to be ideal for older people (Liang and Shu, 2005; The Telegraph, 2012). Researchers found that older people who regularly performed the traditional Chinese mind and body technique were less likely to suffer health problems and were physically stronger (Yeh, Wang, Wayne,Phillips, 2008). Tai Chi is ideal for the elderly as it is a low-impact, slow- motion exercise in which a person moves while breathing deeply and naturally, thus, focusing one's attention on bodily sensations, which is similar to some kinds of meditation (Harvard Health, 2015). In addition, Tai Chi has been proven to be beneficial in lowering certain risks that older people are most prone to. Such is the case for their vulnerability to falls which has been an important cause of morbidity among the elderly (Santos, da Silva, de Pinho, Gautério, Pelzer, and da Silveira, 2012). Santos et al. (2012) added that one of the most important physiological factors for falls is impaired balance. Many factors contribute to poor balance, including reduced strength, flexibility, and sensorimotor coordination as well as delayed information processing (Yu and Yang, 2012).

There are several cross-sectional and experimental studies proving how Tai Chi benefits the elderly by improving their balance and physical fitness. In 2012, Yu and Yang found that Tai Chi improved the balance and other physical functions such as flexibility and reaction time of elderly male subjects. The positive effect of Tai Chi on balance were further supported by the study of Konig, Galarza, Goulart, Lanferdini, Tiggeman, and Dias (2014). Their study saw significant improvement in balance through different evaluation methods after three and six months of Tai Chi intervention among elderly women. In an even earlier study, Li, Hamer, Fisher, and McAuley (2004) found that older people who practiced Tai Chi performed significantly better compared to non-practitioners. In addition, while both groups in their study exhibited deterioration in functional

balance measures during post-intervention follow-up, the Tai Chi group showed a significantly slower rate. Other studies proved the benefits of Tai Chi among elderly people by significantly improving different health indices such as blood pressure (Yeh, et al., 2008) and cognition (Chang, Tsai, Beck, Hagen, Huff, Anand, Roberson, Rosengren, and Beuscher, 2011). The findings of these studies support the health benefits of Tai Chi as a form of exercise among elderly men and women. While most studies have focused on evaluating Tai Chi through balance tests, this study aimed to further support Tai Chi's positive effect on other factors such as flexibility and functional gait that may affect balance.

The objective of this study was to evaluate the effect of a 16-week Tai Chi Chuan exercise program on the balance, functional gait, and sit-and-reach flexibility among selected elderly Filipino males. In due course, it is hypothesized that the Tai Chi Chuan intervention conducted three times a week for one hour per session in a span of 16 weeks was sufficient to produce positive changes among the target respondents' balance, functional gait, and flexibility.

2. Methods

2.1. Research Design and Sampling

This research utilized a one-group pre-test and post-test quasi-experimental design. Forty male Filipino respondents aged 55-60 years, with no prior experience or knowledge about Tai Chi Chuan, were recruited from an urban community in Pasay City, Philippines. The exclusion criteria included the presence of health problems such as cognitive impairments, symptomatic cardiovascular diseases at moderate exertion levels, poorly controlled hypertension or symptomatic orthostatic hypotension, other neurological disorders, peripheral neuropathy of the lower extremities, crippling arthritis, and metastatic cancers. In addition, the respondents were not taking any medications that could affect their balance. All of the respondents were asked to refrain from changing their daily lifestyle routine. Informed consents were obtained from the respondents after thoroughly explaining the objectives and procedures of the study, including the benefits and risks of participation.

2.2. Exercise Intervention

All of the respondents participated in a 16-week exercise program that was held three times a week every morning. Each Tai Chi Chuan exercise session lasted 60 minutes. A certified Tai Chi Chuan instructor with one assistant facilitated each session in which the 24-posture simplified Tai Chi Chuan was utilized. In each session, the first 10 minutes were dedicated for warm-up exercises, the next 40 minutes were for the main Tai Chi Chuan exercise, and the concluding 10 minutes were reserved for cool-down exercises. Correct body positioning, joint angles, and form-to-form transitions were constantly monitored during the sessions.

2.3. Outcome Measures

Balance, functional gait, and sit-and-reach flexibility were measured at the beginning and the end of the Tai Chi Chuan exercise intervention. While functional gait and flexibility have been identified as contributing factors to balance, all three are important factors that have been associated with risk of falls among the elderly (Yu and Yang, 2012; Konig, et al., 2014).

2.4. Balance

Functional balance among the elderly respondents was evaluated using the Berg Balance Scale (BBS). It is based on 14 items common to everyday life. The maximum score that can be achieved in this scale is 56 and each item has an ordinal scale consisting of five options ranging from 0 to 4 points according to the level of difficulty (the higher the score, the better the balance). The test is simple, easy to administer, and safe for the evaluation of elderly subjects. (Berg, Wood-Dauphinée, Williams, and Gayton, 1989; Miyamoto, Lombardi, Berg, Natour, and Ramos, 2004)

2.5. Functional Gait

The 'timed up and go' test (TUG) is a simple, quick and widely used clinical performance-based measure of lower extremity function, mobility, and fall risk (Herman, Giladi, and Hausdorff, 2011). TUG is one of the more commonly used clinical tools for quantifying gait, dynamic balance abilities

and fall risk. In this study, TUG was mainly used to measure functional gait. It is a simple test in which the elderly respondents were asked to stand up from a chair (resting position), walk a distance of three meters and then return to the chair and sit again (with their backs on the backrest). The respondents were instructed to perform the task safely and as quickly as possible and their performances were analyzed by counting the time they needed to complete the test (Konig, et al., 2014). Before each test, a familiarization protocol was conducted so as to ensure safety and accurate results.

2.6. Sit-and-Reach Flexibility

Sit-and-reach flexibility was measured using a sit-and-reach apparatus. The evaluation protocol was patterned with the study of Yu and Yang (2012). All of the elderly respondents were asked to sit on the floor with their legs stretched out forward and their shoes removed. Both knees were locked and pressed flat to the floor (the tester assisted by holding them down). With the palms facing downward, the subjects reached forward along the measuring line as far as possible and held that position for one or two seconds while the distance was recorded in centimeters. The subjects were tested twice, and the better results were used.

2.7. Statistical Analysis

Descriptive Statistics was used (weighted mean) for the elderly respondents for both the pre and post-test measures. Inferential statistics, specifically, paired t-test was used in finding out the effect of the Tai Chi Chuan exercise intervention by identifying if there was a significant difference in the outcome measures between the pre-test and the post-test. The level of significance was set at $p < 0.05$.

3. Results

Figure 1 presents the mean of the outcome measure pertaining to balance pre- and post-intervention. After the 16-week Tai Chi Chuan exercise intervention, functional balance significantly improved ($p = 0.02$).

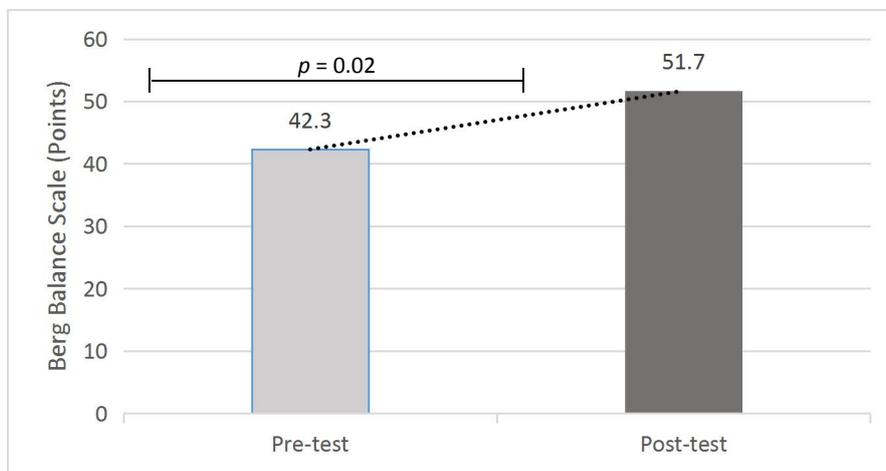


Figure 1 Comparison of functional balance before and after the 16-week Tai Chi Chuan intervention

Figure 2 shows the mean of the outcome measure pertaining to functional gait pre- and post-intervention. Functional gait, which was tested using the Timed Up & Go test, is statistically better after the respondents underwent the Tai Chi intervention ($p = 0.00$).

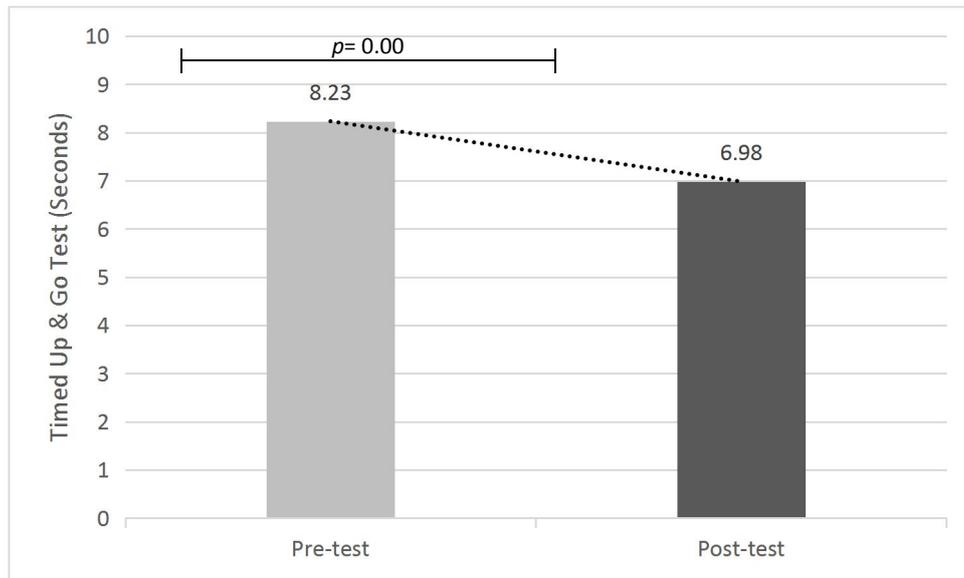


Figure 2 Comparison of functional gait before and after the 16-week Tai Chi Chuan intervention

Figure 3 illustrates the mean of the outcome measure pertaining to flexibility pre- and post-intervention. After the 16-week Tai Chi intervention, the sit-and-reach flexibility of the respondents significantly improved ($p = 0.02$).

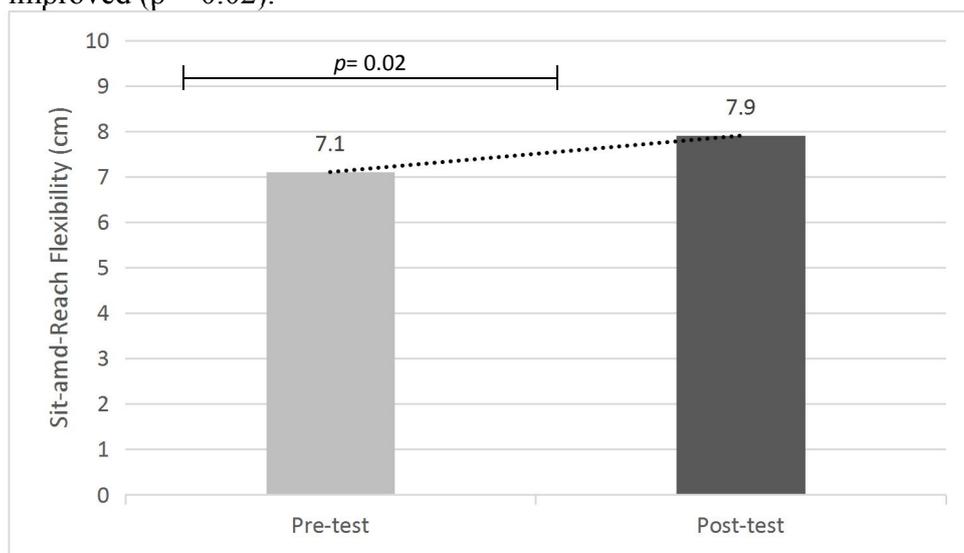


Figure 3 Comparison of measure of flexibility before and after the 16-week Tai Chi Chuan intervention

4. Discussion

This study shows that Tai Chi offers potential benefits to the elderly in terms of balance and other physical functions. Improvements were evident in functional balance, gait, and flexibility. Tai Chi Chuan or Tai Chi is a widely practiced Chinese martial art. It consists of a series of postures combined in slow, smooth, graceful movements and is considered a low intensity exercise that is claimed to develop balance, coordination, and help maintain strength and emotional health (Wu, 2002).

Balance is a required component in the execution of postural control. The capacity to maintain balance decreases with age which results in an increased risk of falls and fractures among the elderly (Nicken, 2010). These findings suggest that Tai Chi exercise may positively influence balance

abilities among older males during the course of 16 weeks of training. Furthermore, flexibility is an important factor in maintaining balance. One possible explanation for this finding is that Tai Chi is a mind-body practice that combines meditation with slow, gentle, graceful movements. It is considered a complex, multi-component intervention that integrates physical, psychosocial, emotional, spiritual, and behavioural elements (Wayne, et al., 2011) and features constant swinging, shifting, and turning in all directions, including left, right, forward, and backward. This activity requires a high degree of concentration and coordination between mind and body and among the different body parts. The motor system, the nervous system and the proprioceptive systems are all mobilized during Tai Chi exercise.

The results of this study proved that Tai Chi could improve the ability to stay balanced and increase muscle strength and flexibility. Moreover, it was also found out that Tai Chi is a form of exercise that can improve the flexibility of the body and mind, as well as adjust breathing, and can increase the cooperation among the hands, eyes and whole body with the mind. Tai Chi can boost the control of the mind on the body and improve the reaction capacity of the respondents. This study shows that the respondents who were subjected to Tai Chi for 16 weeks possessed better trunk and hamstring flexibility than they experienced during their previous sedentary lifestyles. This finding is confirmed by the findings of Lan et al. (2012), who reported significantly superior performance among older Tai Chi practitioners with more than 10 years of experience than their sedentary counterparts with respect to hip joint flexibility, as measured by their stand and reach test scores. Lan et al, et al (2015) found out in their study that the maintenance and development of levels of flexibility closely related to balance are important components of a general health enhancement program during the aging process.

Similarly, Chyu, et al. (2010) also found out in their study that Tai Chi exercises incorporate whole body exercises and some isotonic exercises. Performing Tai Chi exercises can help build muscles on the back and the lower limbs, which can subsequently increase muscle strength. On the other hand, Taylor, et al. (2012) discussed about the steps of Tai Chi which focus on the exchange between deficiency and excess. The so-called 'deficiency and excess' (Xu Shi in Chinese) is the proportion of the body weight excreted on the feet; the foot that withstands more body weight is referred to as 'excess,' and the foot with less body weight is referred to as 'deficiency.' 'The exchange between deficiency and excess' actually refers to the change of body weight between each foot. This theory fully emphasizes the capacity to control the distribution of the body weight and adjust the gestures. With the guidance of this theory and cooperation of a series of movements made while standing with a single leg, standing with two legs, or standing with the other leg, the capacity of the elderly to stay balanced and adjust their steps is improved.

The results indicate that, after the 16-week intervention period, functional gait, which was tested using the Timed Up & Go test, is statistically better after the respondents underwent the Tai Chi intervention ($p = 0.00$). Moreover, the sit-and-reach flexibility of the respondents also significantly improved ($p = 0.02$). It is worth mentioning that the value of the gait speed of the respondents at the baseline in the present study were consistent with those reported in a previous study (Maki, 2007). Wayne et al. (2015) reported that the gait speeds for healthy adults have been shown to range from 1.05 to 1.43 m/s. Reductions in gait speed, stride length, ranges of motion, and force momentum in hip and knee joints are common in older adults [34,35,36]. In particular, the reduction in freely selected gait speed is an indicator of risk of falls [37]. Previous studies have shown that the kinematic parameters of the knee and ankle joints have a positive relationship with gait speed (Kirkwood, et al., 2007). In particular, Kwon, et al. (2015) found that between the pre-swing and the mid-swing, the peak values of the flexion and the external rotation of the knee joint and the peak values of the plantar-flexion of the ankle joint significantly increased with the increase of gait speed.

Meanwhile, a large number of studies have shown that strength training programs have a beneficial impact on gait efficacy (Lamoureux et al., 2013), including slowing down the decline

in gait function due to age. However, with regard to hip flexibility, a few studies have shown that the stretching training program is better than the strength training program to retard the normal, age-related contraction of the muscle groups of the pelvis and hip, like the gluteal and rotator (Christiansen, et al., 2008). The results of the study indicate that the 16-week helped in improving the balance, functional gait, and sit-and-reach flexibility among selected elderly Filipino males. This probably is associated with the “Loosen Waist and Hips (Song Yao Song Kua)” guideline of Tai Chi. From a martial arts standpoint, when the waist and hips are loose, the power generated by the lower limbs can easily be transmitted to the arms. To adhere to this principle, the upper body must be upright and the stance must be comfortable, which may be effective in improving the flexibility of the hip and ankle. Lastly, the Tai Chi pattern includes many movements, which require people to go down on their knees and their waists; this is good for many joints because it increases the movement of the joints and improves flexibility (Lelard, et al, 2010).

However, psychological gains from Tai Chi have been demonstrated only in the elderly, and there is a need therefore to establish benefits in younger age cohorts for whom balance is seldom problematical. In general, there is a paucity of research on the benefits of Tai Chi for the non-elderly population, possibly because of the unwarranted perception that Tai Chi is an exercise appropriate only for the elderly.

5. Conclusion

In conclusion, Tai chi is effective in improving balance, functional gait, and sit-and-reach flexibility among selected elderly Filipino males. Therefore, the Tai Chi Chuan intervention conducted three times a week for one hour per session in a span of 16 weeks was sufficient to produce positive changes among the target respondents’ balance, functional gait, and flexibility.

Given the results of the study, it should be thought of as an alternative method for older adults to slow down the normal decline in gait performance and physical flexibility. Future studies should run a similar randomized controlled trial with a large sample size to confirm the beneficial effects of Tai chi on gait parameters and musculoskeletal flexibility in different populations such as healthy female older adults, and those older adults with high risk for falls and those inflicted with disorders like Parkinson’s disease and peripheral neuropathy.

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