Turkish Journal of Geriatrics
2017;20 (3):232-241

■ Canan BİRİMOĞLU OKUYAN[1]
■ Naile BİLGİLİ[2]

RESEARCH

EFFECT OF TAI CHI CHUAN ON FEAR OF FALLING, BALANCE AND PHYSICAL SELF-PERCEPTION IN ELDERLY: A RANDOMISED CONTROLLED TRIAL

Abstract

Introduction: This study was aimed to examine the effects of Tai Chi Chuan on the fear of falling, balance, and physical self-perception in the elderly.

Materials and Method: This controlled trial using blocked randomization was stratified by sex, age, and history of falls and conducted with 44 elderly participants, of which 20 underwent Tai Chi Chuan training as experimental group and 24 served as an untrained control group. The experimental group underwent Tai Chi Chuan training for 12 weeks, twice a week, for 35-40 min/day under a research team member. The control group received no intervention. Data were collected from both groups by using a personal information form, the Modified Falls Efficacy Scale, the Physical Self-Perception Questionnaire, and the Tinetti Balance and Gait Assessment. After the exercise practice, each group was re-subjected to the same scales.

Results: Student's t-test and paired sample t-tests were used to analyze the data. The balance and physical self-perception of individuals in the Tai Chi Chuan group significantly improved compared with that in the control group ($p<0.001$). Additionally, individuals in the Tai Chi Chuan group demonstrated reduced fear of falling ($p<0.001$).

Conclusion: Tai Chi Chuan positively affects balance and physical self-perception, and reduced fear of falling in elderly individuals. As a result, the potential application of Tai Chi Chuan was suggested in various settings where elderly individuals inhabit.

Key Words: Aged; Accidental Falls; Tai Ji; Self Concept

Correspondance

Naile BİLGİLİ
Gazi University, Faculty of Health Sciences
ANKARA

Phone: 03122162620
Fax: 03122162636
e-mail: nbilgili@gazi.edu.tr

Received: 13/08/2017
Accepted: 10/08/2017

[1] Mustafa Kemal University, Hatay Health College HATAY
[2] Gazi University, Faculty of Health Sciences ANKARA

ARAŞTIRMA

YAŞLILARA UYGULANAN TAI CHI CHUAN EGZERSİZİNİN DÜŞME KORKUSU, DENGE VE FİZİKSEL BENLİK ALGISI ÜZERİNE ETKİSİ: RANDOMİZE KONTROLLÜ ÇALIŞMA

Öz

Giriş: Bu çalışma Tai Chi Chuan egzersizinin yaşlılarda düşme korkusu, denge ve fiziksel benlik algısı üzerine etkisini belirlemek amacıyla yapılmıştır.

Gereç ve Yöntem: Çalışma, cinsiyet, yaş ve düşme öyküsüne göre tabakalandırılmış randomize kontrollü bir çalışma olup, Tai Chi Chuan egzersizi uygulanan 20 deney grubu ve her hangi bir girişim uygulanmayan 24 kontrol grubu olmak üzere toplam 44 yaşlı bireyin katılımı ile gerçekleştirildi. Deney grubuna 12 hafta süre ile haftada iki kez, günde 35-40 dk. araştırmacı tarafından Tai Chi Chuan egzersizi yaptırıldı. Kontrol grubuna herhangi bir girişimde bulunulmadı. Araştırmada veriler her iki grupta, tanıtıcı özellikler bilgi formu, Modifiye Düşmeye Karşı Yetkinlik Ölçeği, Kendini Fiziksel Tanımlama Envanteri ve Tinetti Denge ve Yürüme Değerlendirmesi kullanılarak toplandı. Egzersiz uygulamasından sonra her iki gruba aynı ölçekler tekrar uygulandı.

Bulgular: Verilerin değerlendirilmesinde Student t-testi ve eşleştirilmiş örneklem t-testi kullanıldı. Tai Chi Chuan egzersizi uygulanan deney grubundaki bireylerin dengesinde ve fiziksel benlik algısında kontrol grubuna göre önemli derecede iyileşme oldu ($p<0.001$). Ayrıca Tai Chi Chuan grubundaki bireyler kontrol grubuna göre daha düşük düşme korkusu sergiledi, ($p<0.001$).

Sonuç: Tai Chi Chuan egzersizinin yaşlı bireylerde denge ve fiziksel benlik algısını olumlu etkilediği, düşme korkusunu azalttığı bulundu. Sonuç olarak, Bu egzersizin yaşlı bireylerin yaşadığı her ortamda yaptırılabileceği önerisinde bulunuldu.

Anahtar Sözcükler: Yaşlılık; Düşme; Tai Chi Chuan; Benlik algısı

INTRODUCTION

The aging world population is one of the most important social changes of the 21st century. The number of individuals classified as "older persons," as a percentage of the total population, is increasing in almost all countries. Turkey is among several countries in which rapid shifts toward increased age within the general population has been observed. In addition to living longer, older persons of society seek a life that is as independent as possible, where cognition and intellect are maintained throughout the life of an individual. Many desire an active life style, with a high quality of life and general satisfaction with living. Unfortunately, age-related biological, psychological, and physiological changes may exert negative effects on the quality of life. Increase in the incidence and prevalence of health problems among the older persons decrease self-sufficiency in this population. Health impairments may also contribute to increase in both the frequency and severity of falls, with current estimates of fall prevalence in elderly populations being 30%-50% (1).

Previous investigations have revealed high fall rates among the Turkish elderly population. One study found that 47.5% of men and 56% of women living in nursing homes had fallen within the preceding year (2). The physical effects of the falls are also psychological and social consequences. Fear of falling (FOF) is common in the elderly, with estimates being 20%-85%, and is intensified in those with a history of falls (3,4). Fall-related injuries cause further FOF, leading to additional falls, thus feeding the vicious circle. Previous studies have primarily focused on the frequency of falls, FOF, negative health outcomes associated with falling, and the development and evaluation of therapeutic strategies to prevent or treat fall-related injuries (1).

Fall risk and FOF can be mitigated through planned nursing interventions. One such intervention involves motivating the older persons to engage in physical activity through structured instruction and encouragement. Programs that involve aerobic exercise or that improve balance and flexibility can be effective while increasing self-confidence (5).

Tai Chi Chuan (TCC) is a suitable exercise for older adults because of its low impact and low velocity. Moreover, TCC is a low-technology approach to conditioning that can be implemented with low costs and during the past 20 years, TCC has spread throughout Western countries and is offered in many local community services (6). The integrated physical and cognitive components in TCC could represent the additional value of TCC compared with other exercise programs which mainly focus on physical aspects only. Besides a variety of health-related benefits for older people are attributed to TCC, including improved balance control, improved cardiorespiratory functions, enhanced psychosocial well-being and reduced risk of falling (7). In several systematic studies and a meta-analysis, it is stated that TCC reduces the risk of falling and increases muscle strength, endurance and flexibility which affects the balance positively (7-10).

Improved self-confidence and physical self-perception have also been observed following TCC (11). Here, the concept of "physical self-perception" refers to self-awareness at the psychomotor level. It is how an individual perceives or assesses his or her own motor skills, such as coordination, as well as global physical fitness parameters, such as flexibility (12). Because of its ability to address physical, emotional, and spiritual domains of function, TCC is increasingly accepted as an effective strategy for improving physical and mental health in older persons (13). The specific aim of this project was to examine the effects of TCC on the FOF, balance, and flexibility, coordination, and self-confidence in older persons.

Hypotheses of the research

H1: The falling risk in the TCC group is lower compared to the control group.

H2: The FOF in the TCC group is lower compared to the control group.

H3: The flexibility, coordination and self-confidence perceptions in the TCC group is higher compared to the control group.

MATERIALS AND METHOD

Study Design and Sample Selection

This research is a randomized control group pretest–posttest design. The study sample was drawn from a population of 220 older persons living in a nursing home in Ankara, Turkey. To achieve a power of 90% with a margin of error of 0.05, the target sample size was determined to be 40 individuals using power analysis and sample size software. Taking into account the likelihood of attrition and participants lost to follow-up, a total of 56 older persons were included in the study sample.

Individuals were excluded from participation if they were diagnosed with neurological disease, cardiovascular disease, dementia, or scored less than 24 points on the Mini Mental Status Examination. Those already engaged in a regular exercise program were also excluded.

A blocked randomization method was used to stratify participants with respect to age (65-74 years and ≥75 years), sex, and history of falling. All study procedures were conducted over a 4-month period between March and June of 2015.

Instruments

Tinetti Balance and Gait Assessment (TBGA)

This assessment was firstly created by Mary Tinetti in 1986 to make evaluations in the patients with high falling risk (14). The adjustment of the TGBA to the Turkish society was done by Ağırcan (2009) and the Cronbach alpha value was found as 0.97. Scoring is done on a three-point scale with a range on each item of 0-2 with 0 representing the most impairment. Individual scores are then combined to form three scales: Gait Scale, Balance Scale and then and overall Gait and Balance score. The maximum score for gait is 12 points while the maximum for balance is 16 points with a total maximum for the overall Tinetti Instrument of 28 points (15).

In this study, since the assessment of the change in balance performance via TCC exercise was aimed, only the balance assessment compound of the TBGA was used. The total score of the first 9 items gives the balance score and the higher the score, the better the performance.

The Modified Falls Efficacy Scale (MFES)

MFES comprising 14 items consists of the questions regarding some specific activities performed indoors and outdoors such as dressing up, bathing, crossing the street etc. (16). The MFES evaluates the sense of security about each activity performed without falling on a scale ranges between "0" (completely insecure) and "10" (completely secure). The total score is calculated by dividing the sum of the values of the answers for each question to the number of answered questions. It is assumed that higher total score is, higher sense of security and therefore the lower fear of falling (16).

A Turkish validity and reliability study of the MFES was conducted by Birimoğlu and Bilgili (2016). The Cronbach alpha value of the MFES was 0.97 and the internal stability of the scale items ranged between 0.73-0.99 (17).

Physical Self-Description Questionnaire (PSDQ)

The scale was created by Marsh (1996) (18), and the Turkish adjustment of the scale was done by Aşçı (2000) (19). This scale measuring physical self-perception includes a total of 11 sub-scales, 9 of which are physical-self-concept compounds (health, coordination, physical activity, body fat ratio, sports skills, appearance, strength, flexibility and durability) and 2 are general self-concept compounds (general physical competence and self-confidence), and the sub-scales can be used separately. The PSDQ consists of 70 items and a 6-point Likert-type scale which ranges between "completely false=1" and "completely true=6". Possible facet scores range from 70 to 420. The

internal consistency coefficient Cronbach alpha of the sub-scale of the PSDQ ranged between 0.87 and 0.98 (19). In our study, coordination, flexibility, and self-confidence sub-dimensions were used and the internal consistency coefficient Cronbach alpha of the sub-dimensions of the scale was stated as 0.88 for flexibility, 0.87 for coordination and 0.68 for self-confidence perceptions. Higher PSDQ score means higher coordination, flexibility and self-confidence perceptions.

Procedure

Experimental and Control Groups

Participants assigned to the experimental group completed a standardized 12-week program of TCC. The exercises were performed by the first researcher with TCC certification and also same researcher carried out all sessions. TCC sessions were conducted twice per week, using the Yang Style of TCC (20) (Figure 1).

Figure 1. Yang Style of TCC

Each session included 5 min of warm-up exercise, 30 min of TCC practice, and 5 min of cool-down exercise. Each form of TCC emphasized multidirectional weight shifting, awareness of body alignment, and multisegmental movement coordination (20).

An additional "make up" session was conducted once per week to accommodate participants who had to miss a regularly scheduled session. Six elderly individuals who could not regularly participate in the 12-week program were excluded from the experimental group and the study was completed with the remaining 20 subjects. Participants assigned to the control group did not receive any specialized intervention and participated only in usual care exercises over the study period. Six participants from the control group were also excluded from the study as they refused to perform the posttest and as they were absent for a long time; therefore, data of 24 participants were analyzed. After the completion of the program, post-tests (TBGA, MFES, and PSDQ) were reapplied to both groups by a nursing home physiotherapist.

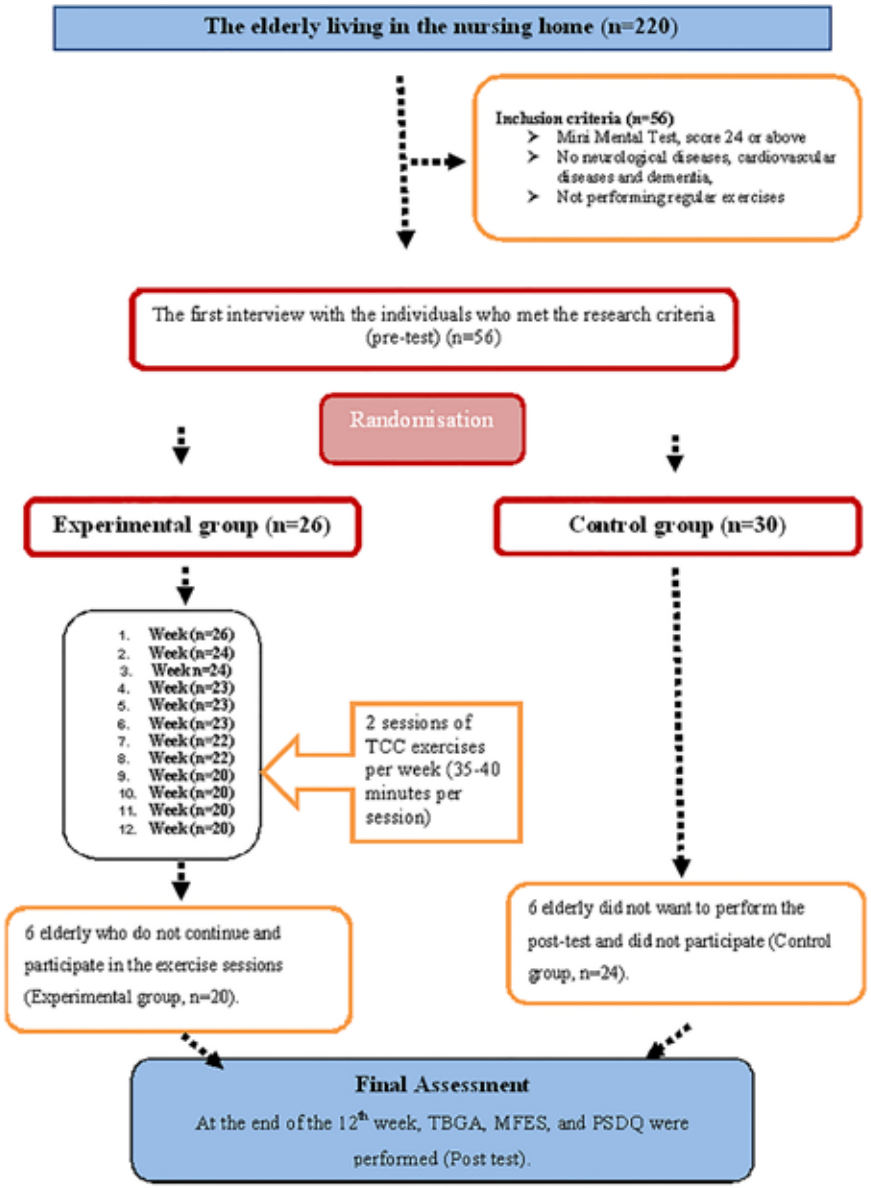

Figure 2. Schematic representation of the study plan

Data Analysis

Statistical Package for Social Sciences (SPSS) 20.0 software was used for statistical analyses. Our data showed normal distribution and besides descriptive statistics, independent samples t-test was performed to analyze the differences between the experimental and control groups in the FOF, balance and physical self-perception scores. In addition, paired samples t-test was conducted to determine differences among the pre and post test scores of the experimental group.

Ethical Considerations

The study has been approved by the Institutional Ethnics Committee of the university (no:25901500-201) and the Ministry of Family and Social Policies (no:73595336-605.01-7552). The study was conducted in accordance with the principles of the Declaration of Helsinki. Participation in this study was voluntary.

RESULTS

23 men (mean age 72.56, sd=5.8) and 21 women (mean age 78.85, sd=6.8) completed the study. Six participants assigned to the experimental group were unable to complete the 12-week TCC program and were therefore excluded from the final analysis.

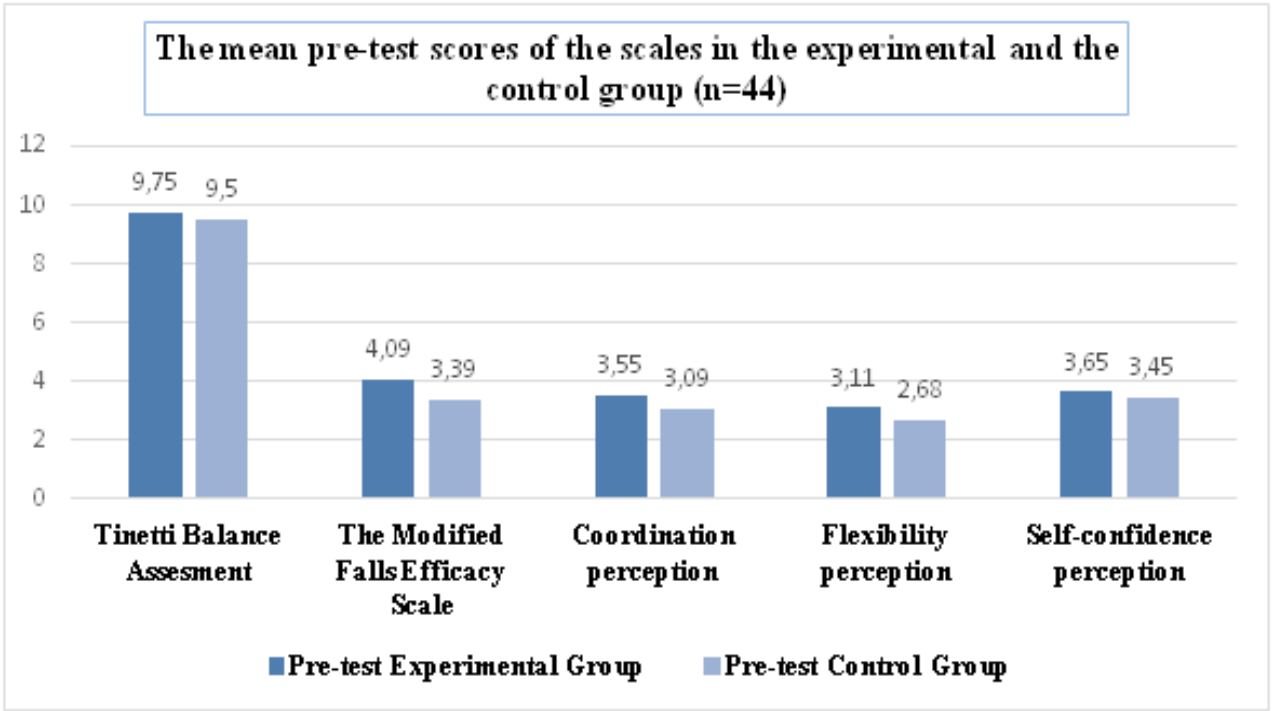

Figure 3. The mean pre-test scores of the scales in the experimental and the control group.

It was found that the Tinnetti balance scale scores of the older persons in the experimental group increased, and there was a significant difference between their pre and post-test scores ($p<0.01$).

Similarly, it was found that the MFES scores of the older persons in the experimental group also increased, and there was a significant difference between their pre and post-test scores ($p<0.01$).

In addition, there was a significant difference in the sub-dimensions of the PSDQ scores that are the coordination, flexibility, and self-confidence perceptions before and after TCC in the experimental group, and the post-test scores increased ($p<0.01$).

Table 1. The mean pre-and post-test scores of the scales in the experimental group.

Scales	Pre-Test mean±SE		Post-Test mean±SE		t test, p value	
Tinetti Balance Assesment	9.75	1.88	12.9	1.83	9.64	**0.000**
MFES	4.09	1.56	6.54	2.03	9.46	**0.000**
PSDQ						
Coordination perception	3.55	0.83	4.65	0.72	6.31	**0.000**
Flexibility perception	3.11	1.07	4.07	1.02	5.17	**0.000**
Self-confidence perception	3,65	0,52	4,25	0,39	4,76	**0,000**

Table 2. The mean pre-and post-test scores of the scales in the control group.

Scales	Pre-Test mean±SE		Post-Test mean±SE		t test, p value	
Tinetti Balance Assesment	9.50	1.50	9.33	1.73	1.163	0.257
MFES	3.39	1.21	3.38	1.07	0.102	0.920
PSDQ						
Coordination perception	3.09	0.64	3.15	0.55	-1.476	0.153
Flexibility perception	2.68	0.60	2.76	0.43	-1.252	0.223
Self-confidence perception	3.45	0.36	3.45	0.36	0.000	1.000

It can be noticed that there is no significant difference between the pre and post-test scores of the Tinetti balance scale in the control group ($p>0.05$). Likewise, no significant difference was found between the pre and post-test scores of the older persons in the control group regarding the MFES and the sub-dimensions of the coordination, flexibility, and self-confidence perceptions of the PSDQ ($p>0.05$).

Table 3. The mean post-test scores of the scales in the experimental and the control group.

Scales	Experimental Group mean±SE		Control Group mean±SE		t test, p value	
Tinetti Balance Assesment	12.90	1.83	9.33	1.73	-6.584	**0.000**
MFES	6.54	2.03	3.38	1.07	5.607	**0.000**
PSDQ						
Coordination perception	4.65	0.72	3.15	0.55	7.562	**0.000**
Flexibility perception	4.07	1.02	2.76	0.43	5.354	**0.000**
Self-confidence perception	4.25	0.39	3.45	0.36	6.941	**0.000**

When the post-test scores of Tinetti balance scale, MFES and the sub-dimensions of the coordination, flexibility, and self-confidence perceptions of the PSDQ in the experimental and the control groups were viewed; it can be seen that the scores in the experimental group is higher and the difference between two groups is statistically significant ($p<0.01$).

DISCUSSION

Balance problems in the older persons exert considerable effects on fall risk and may adversely impact daily activities and social relationships (8). Targeted exercise programs such as TCC can improve balance and produce positive effects on the quality of life (9). Tousignant et al. reported that in a cohort of 152 older persons who underwent TCC, factors relating to fall risk decreased, ultimately resulting in fewer total falls (21). Another study, conducted by Konig et al. (2014), found that a 12-week TCC exercise program improved balance in older persons (22). A further review of 24 studies suggested that TCC produced beneficial effects on aging-related deficits in posture and balance, decreased fall risk, improved the performance of daily living activities, and increased the perception of overall health (8). Furthermore, it was found in the current study that TCC had a positive effect on balance, and thus, it reduced the risk of falling.

In this study, completion of the TCC program was associated with reductions in the FOF. Targeted exercise programs, such as TCC, improve muscle strength and balance, thereby reducing the FOF and increasing perceived self-confidence (21,23). These findings are in agreement with those of Loggbe et al., who concluded that TCC had a significant and positive effect on the FOF (7). Our findings are also in agreement with those of another Japanese study, where the experimental group demonstrated reduced FOF following an 8-week TCC program (5). In this study, the FOF was assessed via the MFES. Average MFES scores significantly increased for participants in the experimental group ($p<0.01$, Table 1), a finding that was not observed in control group participants.

In addition to its physical benefits, TCC may exert positive effects on physical self-perception (24). Physical self-perception is a core component of self-confidence and general self-perception. Defined as the self-perception and assessment of the individual at psychomotor level, physical self-perception appears to change following exposure to exercise programs (12). The effects of TCC on physical self-perception were assessed through the administration of the PSDQ. Participants who completed TCC demonstrated significant improvements in PSDQ sub-scales of perceived coordination, flexibility, and self-confidence (Table 3). These findings are in line with those of Aşçı that physical activity increases physical skills and physical compatibility level, resulting in a positive change on individual self-perception (12). Because of beneficial effects on the motor coordination, balance, body consciousness, and the overall function of muscles, tendons and joints, especially by increasing the articular function of sub-extremities and body consciousness, TCC may enhance individual perception of safety while performing wide-ranging activities such as walking, lying down, getting up, and running (12). In the present study, significant improvements in PSDQ sub-scale scores of perceived self-confidence, coordination, and flexibility are consistent with other results reported within the literature (5,13).

TCC is a suitable exercise for older adults because of its low impact and low velocity. Moreover, TCC is a low-technology approach to conditioning that can be implemented with low costs and during the past 20 years, TCC has spread throughout Western countries and is offered in many local community services (6). The integrated physical and cognitive components in TCC could

represent the additional value of TCC compared with other exercise programs which mainly focus on physical aspects only (7). Besides a variety of health-related benefits for older people are attributed to TCC, including improved balance control, improved cardiorespiratory functions, enhanced psychosocial well-being and reduced risk of falling (7-10).

In conclusion, TCC have provided positive evidence that TCC practitioners have better balance, muscle strength and improved proprioception than those without TCC practice (6,9,13,22,24). This evidence leads to the suggestion that TCC might be beneficial to patients with FOF, balance and physical self-perception who have poor muscle strength and balance control associated with a higher risk of falling and FOF.

Based on the results of this study, a standardized 12-week TCC program improved balance and increased perceived flexibility, coordination, and self-confidence. Accordingly, it was revealed that TCC exercise decreased the FOF and fall risk in the elderly and all hypotheses were approved.

ACKNOWLEDGEMENTS

The authors thank to the participating older persons and the physiotherapist of the nursing home. We also thank to the contributions of Dr. Emine Çağlar in coding and analysis data. The authors have no conflicts of interest to declare. This research was not supported by funding.

REFERENCES

1. WHO Global Report on Falls Prevention in Older Age. [Internet] Available from: http://www.who.int/violence_injury_prevention/publications/other_injury/falls_prevention.pdf?ua=1 html, Accessed: 10.03.2016.
2. Kibar E, Aslan D, Karakoç Y, Kutsal YG. Frequency, risk factors and preventive approach to fall among aged population living in a nursing home in Ankara. TAF Prev Med Bull 2015;14(1):23-32. (In Turkish).
3. Apaydın K, Kırımlı E, Kalaça Ç, et al. The incidence of falls and related factors in the elderly living in residential homes. Turkish Journal of Geriatrics 2012;15(1):40-46. (in Turkish).
4. Gillespie LD, Robertson MC, Gillespie WJ, et al. Interventions for preventing falls in older people living in the community. The Cochrane Library 2012;12(9):CD007146. (PMID:19370674).
5. Zhang JG, Ishikawa-Takata K, Yamazaki H, Morita T, Ohta, T. The effects of Tai Chi Chuan on physiological function and fear of falling in the less robuts elderly: an intervention study for preventing falls. Arch Gerontol Geriatr 2006;42:107-116. (PMID:16125805).
6. Verhagen AP, Immink M, van der Meulen A, Bierma-Zeinstra SMA. The efficacy of Tai Chi Chuan in older adults: a systematic review. Family Practice 2004;21:107–113. (PMID:14760055).
7. Loggbe IHJ, Verhagen AP, Rademaker ACHJ, Bierma-Zeinstra SMA, Van Rossum E, Faber MJ. The effects of Tai Chi on fall prevention, fear of falling and balance in older people: a meta-analysis. Prev Med 2010;51:222-7. (PMID:20558197).
8. Maciaszek J, Osinski W. The effects of Tai Chi on body balance in elderly people a review of studies from the early 21st century. Am J Chin Med 2010;38(2):219-29. (PMID:20387220).
9. Liu H, Frank A. Tai Chi as a balance improvement exercise for older adults: a systematic review. J Geriatr Phys Ther 2010;33:103-9. (PMID:21155504).
10. Wayne PM, Kiel DP, Krebs DE. The effects of Tai Chi on bone mineral density in postmenopausal women: a systematic review. Archives of Physical Medicine and Rehabilitation 2007;88(5):673-80. (PMID:17466739).
11. Yeh GY, Chan CW, Wayne PM, Conboy L. The impact of Tai Chi exercise on self-efficacy, social support, and empowerment in heart failure: insights from a qualitative sub-study from a randomized controlled trial. Plos One 2016;11(5):e0154678. (PMID:27177041).
12. Aşçı FH. Comparison of physical self-perception with regard to gender and physical activity level. Hacettepe University, J Sport Sci 2004;15(1):39-48. (in Turkish).

13. Lu X, Hui-Chan CW, Tsang WW. Effects of tai chi training on arterial compliance and muscle strength in female seniors: A randomized clinical trial. Eur J Prev Cardiol 2013;20:238-45. (PMID:22345677).

14. Tinetti ME. Performance-oriented assessment of mobility problems in elderly patients. J Am Geriatr Soc 1986;34:119-26. (PMID:3944402).

15. Ağırcan D. Validity and reliability of Turkish version of Tinetti Balance and Gait Assassment. MSc Thesis. Pamukkale University, Institute of Health Sciences, Denizli, 2009. [Internet] Available from: http://docplayer.biz.tr/6104802-Tinetti-balance-and-gait-assessment-in-tinetti-denge-ve-yurume-degerlendirmesi-turkce-ye-uyarlanmasi-gecerlilik-ve-guvenilirligi.html. Accessed:10.7.2017. (in Turkish).

16. Hill KD, Schwarz JA, Kalogeropolous AJ, Gibson SJ. Fear of falling revisited. Arch Phys Med Rehabil 1996;77:1025-9. (PMID:8857881).

17. Birimoglu C, Bilgili N. The validity and reliability of the Turkish version modified falls efficacy scale. Journal of Nurse Care 2016;5:4. [Internet] Available from: https://www.omicsonline.org/proceedings/validity-and-reliability-of-the-turkish-version-modified-falls-efficacy-scale-54216.html Accessed: 20.7.2017.

18. Marsh HW. Physical self-description questionnaire: Stability and discriminant validity. Res Q Exerc Sport 1996;67(3):249-64. (PMID:8888413).

19. Marsh HW, Marco IT, Aşçı FH. Cross cultural validity of the Physical Self-Description Questionnaire: Comparison of factor structures in Australia, Spain and Turkey", Research Quarterly for Exercise and Sport 2002;73(3):257-70. (PMID:12230332)

20. Li F, Fisher KJ, Harmer P, and Shirai M. A simpler eight-form easy tai chi for elderly adults. Journal of Aging and Physical Activity 2003;11:206-18.

21. Tousignant M, Corriveau H, Roy PM, Desrosiers J, Dubuc N, Hébert R. The effect of supervised Tai Chi intervention compared to a physiotherapy program on fall-related clinical outcomes: A randomized clinical trial. Disabil. Rehabil 2012;34(3):196-201. (PMID:21958377).

22. Konig PR, Galarza E, Albuquerque-Goulart NB, Lanferdini FJ, Tiggeman, CL, Dias PC. Effects of Tai Chi Chuan on the elderly balance: a semi-experimental study. Rev Bras Geriatr Gerontol 2014;17(2):373-81.

23. Yat-Wa-Justina L, Chi Man TA. Randomized trial comparing Tai Chi with and without cognitive-behavioral intervention (CBI) to reduce fear of falling in community-dwelling elderly people. Arch Gerontol Geriatr 2014;59:317-25. (PMID:24953768).

24. Wang C, Bannuru R, Ramel J, Kupelnick BS, Schmid CH. Tai Chi on psychological well-being: systematic review and meta-analysis. BMC Complement Altern Med 2010;10:23. (PMID:20492638).