



The effect of tai chi exercise on gait speed and the rate of fall in elderly women

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Abstract

Background and aims: Decreased physical functioning and increased risk of fall are among the most common age-related problems among elderly people. This study aimed at assessing the effects of tai chi exercise on gait speed (GS) and fall rate among a group of elderly women in Iran.

Methods: This randomized controlled trial was conducted in 2018. Participants were sixty elderly women purposefully selected from comprehensive healthcare centers in Lahijan, Iran, and randomly assigned to an intervention and a control group. Study intervention was Yang-style tai chi exercise implemented in two group sessions per week for twelve consecutive weeks. GS was assessed before and after the intervention using the short physical performance battery and fall rate was assessed using a researcher-made self-report fall assessment checklist. The SPSS program for Windows (v. 18.0) was employed for data analysis at a significance level of less than 0.05.

Results: Between-group differences respecting the pretest and the posttest GS were not statistically significant ($P > 0.05$). Moreover, posttest fall rate in the intervention group was less than the control group.

Conclusion: Tai chi exercise is effective in increasing GS and reducing fall rate among elderly women and is recommended for elderly people.

Keywords: Tai chi exercise, Fall, Physical functioning, Gait speed

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Introduction

Aging is a natural biological process (1) and an undeniable part of life. Advances in healthcare sciences have resulted in improved life expectancy and elderly population growth, and hence, have increased the number of elderly people who need healthcare services (2,3). Estimates show that elderly population in developing countries will reach 16% of the global population by 2050 (4). The 2016 National Census in Iran also showed that elderly people aged over 65 years constituted 6.1% of the total population of Iran (5).

Although population aging is considered as a great healthcare achievement, it has turned into the main challenge of the 21st century and resulted in the increased need for healthcare and social services for maximizing elderly people's functional capacity, social contribution, and safety (6). Aging causes negative structural and functional changes in different body organs, systems, and tissues, and hence, results in impaired physiological functioning of most body systems, different problems in physical functioning, muscular flexibility, muscular strength, and balance, growing dependence in doing the activities of daily living, hospitalization, reduced quality

of life, and poor walking ability (7-9).

Walking is a fundamental skill which humans learn in the first year of life and attempt to independently maintain throughout life without the need for others' help or using assistive equipment such as walking sticks (10). Although walking is a complex, harmonic and dynamic skill (11) and one of the most difficult-to-learn skills for humans, it gradually turns into a simple task (12). Walking ability is indicative of muscular strength, stamina, balance, and flexibility and is considered as a major need of humans for safely performing their daily activities (13). However, aging considerably affects walking ability, so that after the seventh decade of life, gait speed (GS) reduces by 12%–16% and risk of fall increases due to reduced muscular strength and problems in balance (14).

Reduced GS is considered as a significant predictor of fall (15) and fall is a major threat to elderly people's health (16). A study showed that around 30% of elderly people above 65 years experience at least one fall incident each year (17). A study in Iran also showed that 20%–28% of elderly people in Iran experience fall (16). Fall is caused by different biological, socioeconomic, behavioral, and environmental factors (18) and is associated with many

different problems and complications. The World Health Organization reported fall as the third leading cause of chronic disability in the world (19). Fall affects not only elderly people's quality of life, but also the health, well-being, and quality of life of families and communities (14,16). It can result in severe fractures, particularly in the femoral neck, pelvis, and wrist, soft tissue injuries (20), hospitalization, loss of self-confidence, fear over another fall, limitations in joint movements, social isolation, dependence on others, increased financial costs, and even death (21,22). Fall is also considered as the first leading cause of injury and the fifth leading cause of injury-related death, particularly among elderly women (18). Studies showed that compared with men, women with a history of fall are more likely to experience imbalance, have greater fear over fall, and hence, are more at risk for frequent falls and fall-associated injuries (23,24). Although the overall rate of fall-induced death is greater among elderly men, the rate of fall-induced death among elderly women increases with age (25).

Given the high proportion of elderly population in Iran (about 7.3% of the total population), special attention should be paid to elderly issues (19) and nurses should use effective strategies to reduce fall among elderly people (26). Physical exercise is an important factor in preventing fall and its associated injuries and improving balance and walking ability among elderly people (27). Studies show that regular physical activity is an effective strategy for reducing physiological weaknesses and preventing or reducing fall rate among elderly people (28–33).

Tai chi exercise is a useful physical exercise for elderly people. It is an ancient Chinese martial exercise with controlled, regular, and slow movements associated with deep breathing, concentration, and appropriate body posture. It includes many different balance exercises involving the slow transfer of balance from one leg to the other and hence, can improve balance and walking speed and prevent fall among elderly people (34,35). A study showed that tai chi exercise can improve walking ability through improving muscular strength, muscular flexibility, reaction time, balance, and posture control (15). Another study reported that Yang-style tai chi exercise improved gait parameters and musculoskeletal flexibility among healthy elderly women (36). Moreover, two meta-analyses also reported the effectiveness of tai chi exercise in reducing fall (17,37) and improving balance (37) among elderly people. Similarly, a study showed that tai chi exercise reduced fall among elderly people by 25% (38). However, there are limited studies into the effects of tai chi exercise on elderly people in Iran. Therefore, the present study was conducted to assess the effects of tai chi exercise on GS and fall rate among a group of elderly women in Iran.

Methods

Design

This randomized controlled trial was conducted in 2018.

Participants and setting

Participants were 60 elderly women selected from comprehensive health care centers in Lahijan, Iran. Inclusion criteria were an age of 60–74 years, a history of at least one fall in the past year, risk of fall (as determined by a score of 7 or more for the Fall Screening Tool) (39), agreement for participation, ability to speak in Persian, basic literacy skills, no affliction by mental disorders (as determined by a score of 8 or more for the ten-item Abbreviated Mental Test) (40), no self-report experience of performing tai chi exercise in the past twelve months, ability to perform the activities of daily living (as determined by a score of 12 or more for the Activities of Daily Living Instrument) (41), no medical contraindication to physical exercise, and no hearing or visual impairment. Exclusion criteria were voluntary withdrawal from the study, self-report inability to complete the tai chi exercise intervention of the study, and irregular participation in tai chi exercise sessions. Eligible participants were invited to the study through telephone contact. Each two participants were matched with each other respecting characteristics such as age, weight, body mass index, educational level, chronic illnesses, and medication intake and then, were randomly assigned to an intervention and a control group.

Instruments

Data collection instruments were a demographic questionnaire, the short physical performance battery, the Fall Screening Tool, and a researcher-made fall assessment checklist. The short physical performance battery is a standard and specific instrument for physical functioning assessment in elderly people. It consists of three subscales, namely balance, GS, and lower limb muscular strength. This instrument was first translated into Persian through the forward-backward translation method. Accordingly, two experienced English-Persian translators translated the instrument into Persian and then, two other translators back-translated the Persian translation into English. After that, the face validity of the Persian instrument was assessed and confirmed by ten instructors of Ramsar and East Guilan Faculties of Nursing and Midwifery, Ramsar and Langroud, Iran. The reliability of the instrument was also confirmed in a former study with a Cronbach's alpha of 0.87 (42). Reliability assessment in the present study also showed a test-retest correlation coefficient of 0.86. For GS assessment, each participant was provided with explanations about the GS test and then, was asked to stand behind the start line and start walking with the "Ready, start" command. A chronometer was used to measure the total duration of the test. The first author accompanied the intended participant throughout the test in order support her. The GS test was twice performed for each participant and the shortest duration was documented for her. The possible total score of the test was 0 ("Complete disability") to 4 ("Highest functional ability"). The scoring of the test was as follows: score 4: walking of the four-meter length of the test in less than

4.82 seconds; score 3: walking in 4.82–6.20 seconds; score 2: walking in 6.21–8.70 seconds; score 1: walking in more than 8.70 seconds; and score 0: inability to perform the test. Pretest GS assessment was performed by the first author, while posttest GS assessment was performed by a research assistant who was blind to the pretest GS scores. The Fall Risk Screening Instrument was used to assess the risk of fall. The cutoff score of the instrument was 7, denoting that participants with scores 7 or more were at risk for fall. The validity and reliability of this instrument were assessed and confirmed in a former study with a Cronbach's alpha of 0.71 (39).

The researcher-made self-report fall assessment checklist was used to document fall incidents. The checklist consisted of five items on different aspects of fall incident, namely occurrence of fall incidents, number of fall incidents, place of fall incidents, associated injuries, and need for medical services for fall (23,43). Ten instructors of Ramsar and East Guilan Faculties of Nursing and Midwifery, Ramsar and Langroud, Iran, assessed and confirmed the face and content validity of the checklist while its reliability was confirmed with a Cronbach's alpha of 0.87. The checklist was provided to all participants and they were asked to document any fall incident and its characteristics during the first three months after the study intervention. At the end of each month during the three-month post-intervention fall assessment period, participants referred to the study setting, delivered their checklists to the first study author, and received a new checklist for the next month. The first author made weekly telephone contacts with each participant to remind her of completing the checklist.

Intervention

The study intervention for participants in the intervention group was Yang-style tai chi exercise implemented in two group sessions per week for twelve consecutive weeks. Each session lasted sixty minutes and consisted of warm-up exercises (10 minutes), main tai chi exercises (forty minutes), and cool-down exercises (10 minutes). The main tai chi exercises were ten exercises of the 24-exercise Yang-style tai chi exercise which were performed consecutively as a ten-exercise form. The study intervention was implemented in a public gym in Lahijan, Iran, under the supervision of the first author and a physical trainer who was expert in tai chi exercise. Tai chi-specific music was also played during sessions. Participants were provided with the opportunity to sit on chair and take a two-minute rest between tai chi forms. Moreover, they were asked to report any abnormal symptoms such as chest pain, dizziness, vomiting, etc. during the intervention. All intervention sessions were held in 08:00–9:00 and hence, all participants were asked to take a light breakfast before the sessions. At the beginning of the study intervention, a medical specialist examined all participants in the intervention group and approved their ability to perform tai chi exercise. Moreover, necessary arrangements

respecting any need for hospitalization and emergency medical care delivery to participants were made with the emergency department of a local hospital. Participants in the control group had their routine daily activities and received no tai chi exercise intervention.

Data analysis

The SPSS program for Windows (v. 18.0) was employed for data analysis. Study data were described using the measures of descriptive statistics (namely mean, standard deviation, and frequency) and were analyzed using the chi-square, the Wilcoxon's, the Mann-Whitney U, and the Fisher's exact tests. The level of significance was set at less than 0.05.

Results

In total, sixty elderly women in two thirty-person groups participated in this study. One participant from the intervention group voluntarily withdrew from the study and hence, the study was completed with 29 participants in the intervention group and thirty participants in the control group.

The results of the chi-square and the Fisher's exact tests indicated no significant differences between the study groups in terms of participants' age, gender, marital status, employment status, educational level, body mass index, use of assistive equipment for mobility, and history of chronic illnesses ($P > 0.05$; Table 1).

There were no significant between-group differences respecting GS at pretest ($P = 0.641$) and posttest (0.862) (Table 2). However, within-group comparisons also revealed that while GS did not significantly change in the control group ($P = 0.739$), it significantly increased in the intervention group ($P < 0.001$) (Table 2). The pretest-posttest difference in the mean of GS in the intervention group was also significantly greater than the control group (0.517 vs. 0.33; $P < 0.001$).

At posttest, fall rate in the intervention group was less than the control group (17.24% vs. 26.67%; Table 3). The most common fall-associated injury in the intervention group was erosion (60%), while the most common fall-associated injuries in the control group were erosion (37.5%) and bruising (37.5%) (Table 3).

Discussion

The aim of this study was to assess the effects of tai chi exercise on GS and fall rate among a group of elderly women in Iran. Findings indicated that tai chi exercise significantly improved GS among elderly women. This is in line with the findings of most previous studies. For example, a study showed that eight-week tai chi exercise significantly improved GS, stride length, pelvic flexibility, and ankle flexibility (36). Another study reported that tai chi exercise had significant positive effects on balance, physical functioning, walking, and flexibility among elderly men (15). Similarly, a study showed that tai chi exercise was associated with significant improvements

Table 1. Between-group comparisons concerning participants' socio-demographic characteristics

Characteristics		Groups				Test results
		Intervention		Control		
		No.	%	No.	%	
Age (y)	60–65	17	58.62	17	56.67	$P=0.197^a$ df=2
	65.1–70	7	24.14	3	10	
	70.1–74	5	17.24	10	33.33	
Body mass index (kg/m ²)	20–25	12	41.38	6	20	$P=0.195^a$ df=2
	25.1–30	16	55.17	22	73.33	
	30 and more	1	3.45	2	6.67	
Educational level	Primary	9	31.03	10	33.3	$P=0.256^a$ df=2
	Secondary	3	10.35	6	20	
	Diploma	14	48.28	13	43.3	
	University	3	10.34	1	3.3	
Marital status	Married	22	75.76	20	66.7	$P=0.354^a$ df=2
	Single	1	3.45	0	0	
	Widowed	6	69/20	10	33.3	
Employment status	Farmer	2	6.9	1	3.3	$P=0.186^a$ df=2
	Housewife	25	86.2	26	86.7	
	Retired	2	6.9	3	10	
Use of assistive equipment for mobility	Yes	9	31.03	12	40	$P=0.372^b$ df=1
	No	20	68.97	18	60	
Afflicting chronic illnesses	None	2	6.9	3	10	$P=0.791^a$ df=3
	Hypertension	14	48.28	13	43.3	
	Diabetes mellitus	10	34.48	12	40	
	Other illnesses	3	10.34	2	6.7	

^a The results of the chi-square test; ^b The results of the Fisher's exact test.

Table 2. Between- and within-group comparisons concerning the mean score of GS

Group	Time		Test results ^b	Pretest-posttest mean difference	Test results ^a
	Pretest	Posttest			
Intervention	1.34±0.351	1.86±4.49	Z=3.638 P<0.001	0.517±0.574	Z=3.44
Control	1.33±0.479	1.37±0.49	Z=0.333 P=0.739	0.033±0.556	P=0.001
P value*	Z=0.233 P=0.641	Z=0.174 P=0.862			

^a The results of the Mann-Whitney U test; ^b The results of the Wilcoxon's test.

in balance, GS, and quality of life among patients with chronic stroke (44). Moreover, a study found that six-week balance training significantly improved GS and stride length among elderly women (45). A meta-analysis also confirmed that exercise is beneficial to GS, balance, and physical functioning during the activities of daily living (46). Another meta-analysis revealed that therapeutic exercises such as strength, aerobic, stretching, and endurance exercises can improve gait parameters, while inappropriate performance of these exercises can cause problems for elderly people (47). Tai chi exercise includes slow movements and muscular relaxation with regular rhythm, breathing control, mind-body coordination, and balance control and hence, can improve gait parameters

Table 3. The posttest prevalence of fall incident and its associated injuries

Variables	Groups	Levels	N (%)	Total N (%)
Fall incident	Intervention	Yes	5 (17.24)	29 (100)
		No	24 (82.76)	
	Control	Yes	8 (26.67)	30 (100)
		No	22 (33.73)	
Fall-associated injuries	Intervention	None	1 (20)	5 (100)
		Erosion	3 (60)	
		Bruising	1 (20)	
	Control	None	2 (25)	8 (100)
		Bruising	3 (37.5)	

(48,49). Appropriate bending and rotation of the knee, femur, and foot have positive effects on walking (50). An explanation for the positive effects of tai chi exercise on GS can be its positive effects on the movements, flexibility, and range of motion of the joints of the pelvis, femur, knee, and leg. Some previous studies also reported that tai chi exercise had significant positive effects even on patients (44,48). A meta-analysis also revealed that tai chi exercise has the potential to improve gait (49). However, a study reported that weekly tai chi exercise for twelve weeks had no significant effects on balance and gait among stroke survivors (51). This contradiction is attributable to the differences between the studies in terms of their participants' characteristics, sample size, tai chi exercise style and intensity, and GS measurement test.

The findings of the present study also indicated the significant positive effects of tai chi exercise on fall rate. In line with this finding, several previous studies indicated that tai chi exercise significantly reduced fall rate among both healthy and ill elderly people (17,37,48,52–56). Tai chi exercise is based on the principles of balance, weight shift, and proprioception and includes standing on one foot and transferring weight gradually from that foot to the other along with conscious attitude towards the body which can improve balance and reduce fall rate (57,58). Unlike our findings, a study revealed that a thirteen-week tai chi exercise was not effective in significantly reducing fall rate among home-dwelling elderly people (59). This contradiction is attributable to the differences between the studies in terms of their participants' characteristics. For instance, our participants aged 60–74 years and were at low to high risk for fall, while participants in that study had a mean age of 77 years, were at high risk for fall, and suffered from balance disorders, motor disorders, and dizziness, and used benzodiazepines and diuretics (59).

Our findings also showed that most fall incidents in the intervention group happened in outdoor areas and kitchen, while most fall incidents in the control group happened respectively in the bedroom, stairs, hall, kitchen, bathroom, and outdoor areas. Previous studies reported that most fall incidents happened at home (48), steep surfaces, stairs (60), and same-level surfaces (61). Fall in outdoor areas can be due to inappropriate environmental conditions and steeps which can disturb balance and result in fall. A study reported that the most common causes of fall at same-level surfaces were balance disorders, walking disorders, visual impairment, orthostatic hypotension, and inappropriate environmental conditions (60). Another study showed that most fall incidents happened in stairs and the most common cause of fall incidents was the lack of rails and grab bars (62). Moreover, a study reported bathroom as the location of most fall incidents among elderly people (63).

We also found erosion as the most common fall-associated injury in the intervention group and erosion and bruising as the most common fall-associated injuries in the control group. Previous studies reported that the

most common fall-associated injuries were upper limb injuries (60), upper and lower limb injuries (61), femur joint injuries (64), and head and chest traumas (65). Moreover, our findings showed that one of the eight participants in the control group who had experienced fall needed intensive care services. Irrespective of injury type, fall incident is associated with serious complications, hospital bed occupation, and increased financial and care burden (66). Some strategies for fall prevention among elderly people are adherence to safety principles, walking in safe routes in outdoor areas, and regular performance of balance exercises. Moreover, careful elderly assessment is needed to determine elderly people who are at risk for fall, the level of fall risk, fall risk factors, and the best strategies for fall prevention. Therefore, healthcare providers should be provided with education about accurate fall risk assessment. It is noteworthy that fall risk assessment should be considered as an ongoing process and should be performed according to environmental conditions as well as the unique medical and functional conditions of each elderly person (67,68).

Limitations

One of the study limitations was that the study sample was rather small and consisted only of community-dwelling elderly people which can reduce the generalizability of the findings. Studies with larger samples of male and female elderly people from different age groups are recommended.

Conclusion

This study suggests the effectiveness of tai chi exercise in significantly increasing GS and reducing fall rate among elderly women. As tai chi exercise is a simple, mild-intensity, safe, and pleasurable exercise with positive effects on GS and fall rate, healthcare providers are suggested to train and recommend it to elderly people.

Conflict of interests

None is declared.

Ethical Approval

This study was approved by the Ethics Committee of Babol University of Medical Sciences, Babol, Iran (code: MUBABOL.HRI.REC.1396.231) and was registered in the Iranian Registry of Clinical Trials (identifier: IRCT20180426039425N1). All participants in both groups received information about the study aims, voluntariness

What does this paper contribute to the wider global clinical community?

- Tai chi exercise can improve muscular strength, muscular flexibility, reaction time, balance, and posture control among elderly people.
- Tai chi exercise can increase gait speed among elderly people.
- Tai chi exercise can reduce fall rate.

of participation, freedom to withdraw from the study, and confidential management of their data and written consent was obtained from all of them. At the end of the study, participants in the control group were provided with the opportunity to participate in two tai chi exercise sessions. Moreover, a tai chi educational CD was provided to all participants in both groups.

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References

- Jaul E, Barron J. Age-related diseases and clinical and public health implications for the 85 years old and over population. *Front Public Health*. 2017;5:335. doi: 10.3389/fpubh.2017.00335.
- Eshaghi SR, Shahsanai A, Mellat Ardakani M. Assessment of the physical activity of elderly population of Isfahan, Iran. *J Isfahan Med Sch*. 2011 Sep 19;29(147):939-46. [Persian].
- Gomeñuka NA, Oliveira HB, Silva ES, Costa RR, Kanitz AC, Liedtke GV, et al. Effects of Nordic walking training on quality of life, balance and functional mobility in elderly: a randomized clinical trial. *PLoS One*. 2019;14(1):e0211472. doi: 10.1371/journal.pone.0211472.
- United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Ageing 2019: Highlights (ST/ESA/SER.A/430)*. <https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf>.
- Selected Findings of the 2016 National Population and Housing Census Date published: First impression, Available from: URL:<https://www.amar.org.ir/accessible>. Accessed April 18, 2018.
- Guzmán JM, Pawliczko A, Beales S. Ageing in the Twenty-First Century: A Celebration and a Challenge. *United Nations Population Fund (UNFPA)*; 2018.
- Khesali Z, Mohammadi Shahboulaghi F, Khanke H, Biglarian A. Effect of "Tai Chi Chuan" on depression in elderly women. *Iranian Journal of Rehabilitation Research in Nursing*. 2016;2(2):39-46. [Persian].
- Salar A, Boryri T, Khojasteh F, Salar E, Jafari H, Karimi M. Evaluating the physical, psychological and social problems and their relation to demographic factors among the elderly in Zahedan city during 2010-2012. *Feyz Journal of Kashan University of Medical Sciences*. 2013;17(3):305-11. [Persian].
- Jessen JD, Lund HH. Study protocol: effect of playful training on functional abilities of older adults - a randomized controlled trial. *BMC Geriatr*. 2017;17(1):27. doi: 10.1186/s12877-017-0416-5.
- Vaziri E, Mohammadipour F, Sahebozamani M. Effect of pilates exercises on some gait kinematics parameters in healthy sedentary middle-aged women. *The Scientific Journal of Rehabilitation Medicine*. 2017;6(3):29-38. [Persian].
- Yousefian Molla R, Sadeghi H, Farahmand F, Azarbayjani MA. Effect of upper extremity splinting on walking speed and cadence. *The Scientific Journal of Rehabilitation Medicine*. 2020;9(1):252-8. [Persian].
- Beauchet O, Annweiler C, Lecordroch Y, Allali G, Dubost V, Herrmann FR, et al. Walking speed-related changes in stride time variability: effects of decreased speed. *J Neuroeng Rehabil*. 2009;6:32. doi: 10.1186/1743-0003-6-32.
- Rafiei H. The Effect of Selected Exercise (Equilibrium, Flexibility) on the Biomechanical Performance of Walking in Healthy Elderly Men [Thesis]. Tehran: Islamic azad university Central Tehran Branch;2011. [In Persian].
- Mohammadi B, Ilali E, Taraghi Z, Moosazadeh M. The analysis of relationship between fear of falls with depression in aged diabetic. *J Gerontol*. 2019;3(3):9-20. [Persian].
- Chen S. Effect of Tai Chi exercises on the balance, functional gait, and flexibility of elderly Filipino males. In: *Proceedings of the 2nd Symposium on Health and Education*. Vol 268. *Advances in Social Science, Education and Humanities Research (ASSEHR)*; 2019. p. 147-53.
- Bagheri Ruchi A, Mohammadi F, Mafi M, Motalebi SA. Prevalence and external factors of home falls among the elderly in Qazvin. *Journal of Inflammatory Diseases*. 2019;23(5):440-51. doi: 10.32598/jqums.23.5.440. [Persian].
- HuYN, ChungYJ, Yu HK, ChenYC, Tsai CT, Hu GC. Effect of Tai Chi exercise on fall prevention in older adults: systematic review and meta-analysis of randomized controlled trials. *Int J Gerontol*. 2016;10(3):131-6. doi: 10.1016/j.ijge.2016.06.002.
- Iranfar M, Ainy E, Soori H. Fall epidemiology in the elderly residents of care centers in Tehran-1390. *Salmand: Iranian Journal of Ageing*. 2013;8(2):30-8. [Persian].
- Sorkhe E, Jafarnezhadgero AA. Effect of a corrective exercise program on the frequency spectrum of ground reaction force during drop-landing in older adults with Genu valgum. *Salmand: Iranian Journal of Ageing*. 2020;14(4):494-509. doi: 10.32598/sija.13.10.440. [Persian].
- Pighills A, Drummond A, Crossland S, Torgerson DJ. What type of environmental assessment and modification prevents falls in community dwelling older people? *BMJ*. 2019;364:l880. doi: 10.1136/bmj.l880.
- Taheri M, Mirmoezzi M, Sabaghi M. Effects of aquatic on balance and preventing of fall among healthy elderly men. *Journal of Safety Promotion and Injury Prevention*. 2018;6(3):144-51. [Persian].
- Hartholt KA, van der Velde N, Looman CW, van Lieshout EM, Panneman MJ, van Beeck EF, et al. Trends in fall-related hospital admissions in older persons in the Netherlands. *Arch Intern Med*. 2010;170(10):905-11. doi: 10.1001/archinternmed.2010.106.
- Taghipour M, Hosseini SR, Pouraria S. The relationship between physical activity and balance control in the elderly. *Salmand: Iranian Journal of Ageing*.

- 2016;10(4):60-7. [Persian].
24. Fathi Rezaei Z, Aslankhani MA, Farsi AR, Abdoli B, Zamani Sani SH. A comparison of three functional tests of balance in identifying fallers from non-fallers in elderly people. *Knowledge And Health*. 2010;4(4):21-6. [Persian].
 25. Shoaee F, Azkhosh M, Alizad V. Health status of Iranian older people: a demographical analysis. *Salmand: Iranian Journal of Ageing*. 2013;8(2):60-9. [Persian].
 26. King B, Pecanac K, Krupp A, Liebrezeit D, Mahoney J. Impact of fall prevention on nurses and care of fall risk patients. *Gerontologist*. 2018;58(2):331-40. doi: 10.1093/geront/gnw156.
 27. Shahrjerdi S, Golpayegani M, Mahmoudi F. The effect of corrective exercises on balance in elderly women with hyperkyphosis. *Feyz Journal of Kashan University of Medical Sciences*. 2015;19(4):284-92. [Persian].
 28. Kashefi M, Hemayat Talab R, Pour Azar M, Dehestani Ardakani M. The effect of two kinds of aerobic exercise on the static and dynamic balance of old men. *Salmand: Iranian Journal of Ageing*. 2014;9(2):134-41. [Persian].
 29. Tschentscher M, Niederseer D, Niebauer J. Health benefits of Nordic walking: a systematic review. *Am J Prev Med*. 2013;44(1):76-84. doi: 10.1016/j.amepre.2012.09.043.
 30. Rydwik E, Frändin K, Akner G. Effects of a physical training and nutritional intervention program in frail elderly people regarding habitual physical activity level and activities of daily living--a randomized controlled pilot study. *Arch Gerontol Geriatr*. 2010;51(3):283-9. doi: 10.1016/j.archger.2009.12.001.
 31. Koohboomi M, Norasteh AA, Samami N. Effect of Yoga training on physical fitness and balance in elderly females. *Salmand: Iranian Journal of Ageing*. 2015;10(3):26-35. [Persian].
 32. Song QH, Shen GQ, Xu RM, Zhang QH, Ma M, Guo YH, et al. Effect of Tai Chi exercise on the physical and mental health of the elder patients suffered from anxiety disorder. *Int J Physiol Pathophysiol Pharmacol*. 2014;6(1):55-60.
 33. Tanjani PT, Ainy E, Akbarpuor S, Soori H. Study of characteristics of falls among Iranian elders. *Safety Promot Inj Prev*. 2014;2(4):313-20. [Persian].
 34. Marandi SM, Rezayat F, Esfarjani F, Rezaei Z. The effect of " Tai Chi" exercise on depression, quality of sleep and some of physiological factors in elderly, living in nursing home. *Scientific Journals Management System*. 2013;11(5):51-61. [Persian].
 35. Wayne PM, Manor B, Novak V, Costa MD, Hausdorff JM, Goldberger AL, et al. A systems biology approach to studying Tai Chi, physiological complexity and healthy aging: design and rationale of a pragmatic randomized controlled trial. *Contemp Clin Trials*. 2013;34(1):21-34. doi: 10.1016/j.cct.2012.09.006.
 36. Zou L, Wang C, Tian Z, Wang H, Shu Y. Effect of Yang-style Tai Chi on gait parameters and musculoskeletal flexibility in healthy Chinese older women. *Sports (Basel)*. 2017;5(3):52. doi: 10.3390/sports5030052.
 37. Zhao Y, Wang Y. Tai Chi as an intervention to reduce falls and improve balance function in the elderly: a meta-analysis of randomized controlled trials. *Chin Nurs Res*. 2016;3(1):28-33. doi: 10.1016/j.cnre.2015.10.003.
 38. Hsu HC. Gender differences in health-related quality of life among the elderly in Taiwan. *Asian Journal of Health and Information Sciences*. 2007;1(4):366-76.
 39. Parvareshan S, Shamsalinia A, Jahanshahi M. Falling in the elderly and its relation to diabetes, a review article. *Biannual Journal of Caspian Health and Aging*. 2017;1(1):30-5. [Persian].
 40. Bakhtiyari F, Foroughan M, Fakhzadeh H, Nazari N, Najafi B, Alizadeh M, et al. Validation of the Persian version of Abbreviated Mental Test (AMT) in elderly residents of Kahrizak charity foundation. *Iranian Journal of Diabetes and Lipid Disorders*. 2014;13(6):487-94. [Persian].
 41. Taheri Tanjani P, Azadbakht M. Psychometric properties of the Persian version of the activities of daily living scale and instrumental activities of daily living scale in elderly. *J Mazandaran Univ Med Sci*. 2016;25(132):103-12. [Persian].
 42. Gómez JF, Curcio CL, Alvarado B, Zunzunegui MV, Guralnik J. Validity and reliability of the Short Physical Performance Battery (SPPB): a pilot study on mobility in the Colombian Andes. *Colomb Med (Cali)*. 2013;44(3):165-71.
 43. Scianni A. Tai Chi improves balance and prevents falls in people with Parkinson's disease. *J Physiother*. 2015;61(1):44. doi: 10.1016/j.jphys.2014.11.010.
 44. Kim H, Kim YL, Lee SM. Effects of therapeutic Tai Chi on balance, gait, and quality of life in chronic stroke patients. *Int J Rehabil Res*. 2015;38(2):156-61. doi: 10.1097/mrr.000000000000103.
 45. Farsi A, Ashayeri H, Mohammadzadeh S. The effect of six weeks balance training program on kinematic of walking in women elderly people. *Salmand: Iranian Journal of Ageing*. 2015;9(4):278-87. [Persian].
 46. Chou CH, Hwang CL, Wu YT. Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: a meta-analysis. *Arch Phys Med Rehabil*. 2012;93(2):237-44. doi: 10.1016/j.apmr.2011.08.042.
 47. Lopopolo RB, Greco M, Sullivan D, Craik RL, Mangione KK. Effect of therapeutic exercise on gait speed in community-dwelling elderly people: a meta-analysis. *Phys Ther*. 2006;86(4):520-40.
 48. Taylor-Piliae RE, Hoke TM, Hepworth JT, Latt LD, Najafi B, Coull BM. Effect of Tai Chi on physical function, fall rates and quality of life among older stroke survivors. *Arch Phys Med Rehabil*. 2014;95(5):816-24. doi: 10.1016/j.apmr.2014.01.001.
 49. Li GY, Wang W, Liu GL, Zhang Y. Effects of Tai Chi on balance and gait in stroke survivors: a systematic meta-analysis of randomized controlled trials. *J Rehabil Med*. 2018;50(7):582-8. doi: 10.2340/16501977-2346.
 50. Kwon JW, Son SM, Lee NK. Changes of kinematic parameters of lower extremities with gait speed: a 3D motion analysis study. *J Phys Ther Sci*. 2015;27(2):477-9. doi: 10.1589/jpts.27.477.
 51. Hart J, Kanner H, Gilboa-Mayo R, Haroeh-Peer O, Rozenhul-Sorokin N, Eldar R. Tai Chi Chuan practice in community-dwelling persons after stroke. *Int J Rehabil Res*. 2004;27(4):303-4. doi: 10.1097/00004356-200412000-00008.
 52. Ghasemi M. The Effect of Tai Chi Chuan Sports Program on the Risk of Falling, Fear of Falling, Self-Esteem and Social Conflict in Elderly Women Members of Tehran Retirement Broadcasting Association 2009. Tehran: University of Rehabilitation Sciences and Social Welfare; 2009.
 53. Dastmanesh S, Sahebozamani M, Karimi MT. Effect of

- Otago and Tai Chi exercise programs on balance and risk of falls in elderly men. *The Scientific Journal of Rehabilitation Medicine*. 2019; 8(1):156-64. [Persian].
54. Huang ZG, Feng YH, Li YH, Lv CS. Systematic review and meta-analysis: Tai Chi for preventing falls in older adults. *BMJ Open*. 2017;7(2):e013661. doi: 10.1136/bmjopen-2016-013661.
 55. Gao Q, Leung A, Yang Y, Wei Q, Guan M, Jia C, et al. Effects of Tai Chi on balance and fall prevention in Parkinson's disease: a randomized controlled trial. *Clin Rehabil*. 2014;28(8):748-53. doi: 10.1177/0269215514521044.
 56. Liu J, Li B, Shnyder R. Effects of Tai Chi training on improving physical function in patients with coronary heart diseases. *J Exerc Sci Fit*. 2010;8(2):78-84. doi: 10.1016/s1728-869x(10)60012-3.
 57. Gatts S. A Tai Chi Chuan training model to improve balance control in older adults. *Curr Aging Sci*. 2008;1(1):68-70. doi: 10.2174/1874609810801010068.
 58. Yu DH, Yang HX. The effect of Tai Chi intervention on balance in older males. *J Sport Health Sci*. 2012;1(1):57-60. doi: 10.1016/j.jshs.2012.03.001.
 59. Logghe IH, Zeeuwe PE, Verhagen AP, Wijnen-Sponselee RM, Willemsen SP, Bierma-Zeinstra SM, et al. Lack of effect of Tai Chi Chuan in preventing falls in elderly people living at home: a randomized clinical trial. *J Am Geriatr Soc*. 2009;57(1):70-5. doi: 10.1111/j.1532-5415.2008.02064.x.
 60. Gilasi HR, Soori H, Yazdani S, Taheri tenjani P. Fall-related injuries in older people in Kashan. *Journal of Paramedical Sciences & Rehabilitation*. 2015;4(3):74-82. doi: 10.22038/jpsr.2015.4610. [Persian].
 61. Afzal Aghaee M M, Norouzi S, Mousavi MS, Vakilzadeh AK. Traumatic injuries caused by falling in the elderly referred to the emergency department; an epidemiologic study. *Iran J Emerg Med*. 2016;3(3):109-14. [Persian].
 62. Jafarian Amiri SR, Zabihi A, Aziznejad Roshan P, Hosseini SR, Bijani A. Fall at home and its related factors among the elderly in Babol city Iran. *J Babol Univ Med Sci*. 2013;15(5):95-101. [Persian].
 63. Leclerc BS, Bégin C, Cadieux E, Goulet L, Allaire JF, Meloche J, et al. Relationship between home hazards and falling among community-dwelling seniors using home-care services. *Rev Epidemiol Sante Publique*. 2010;58(1):3-11. doi: 10.1016/j.respe.2009.10.008.
 64. Adam SH, Eid HO, Barss P, Lunsjo K, Grivna M, Torab FC, et al. Epidemiology of geriatric trauma in United Arab Emirates. *Arch Gerontol Geriatr*. 2008;47(3):377-82. doi: 10.1016/j.archger.2007.08.018.
 65. Iaria M, Surleti S, Famà F, Villari SA, Gioffré-Florio M. Epidemiology and outcome of multiple trauma in the elderly population in a tertiary care hospital in southern Italy. *BMC Geriatr*. 2009;9(1):A69. doi: 10.1186/1471-2318-9-s1-a69.
 66. Hatamabadi HR, Sum S, Tabatabaey A, Sabbaghi M. Emergency department management of falls in the elderly: A clinical audit and suggestions for improvement. *Int Emerg Nurs*. 2016;24:2-8. doi: 10.1016/j.ienj.2015.05.001.
 67. Mortazavi H, Peyrovi H, Joolae S. How do family caregivers of older people give up caregiving? *Int J Community Based Nurs Midwifery*. 2015;3(3):187-97.
 68. Hojati H, Dadgari A, Mirzaie SM. Investigation of validity and reliability of Persian version of Johns Hopkins fall risk assessment tool among the elderly. *Qom Univ Med Sci J*. 2018;12(2):45-53. [Persian].

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