ORIGINAL ARTICLE

The Effect of Balance Exercise Training on Balance Status, and Quality of Life in Elderly Women: A Randomized Controlled Trial

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ABSTRACT

Introduction: Balance disorder is one of the huge risk factors for falling in elderly population. Falling leads to loss of independence of their functioning and activities of daily living. Preventing falls still exists as a challenge in public health. The aim of this study was to investigate the effect of balance exercise training on balance status, and quality of life in elderly women. **Methods:** In the study, 60 elderly women with dizziness and history of falling over the past 6-12 months were randomized allocated into experimental and control group. Berg Balance Scale (BBS) and Romberg tests, Dizziness Handicap Inventory (DHI), Fall Efficacy Scale-International (FES-I), and Leiden-Padua (LEIPAD) questionnaires were performed before and after training period in experimental group and compared to control group. Experimental group attended Cawthorne-cooksey (CC) and strengthening the sensory-motor system training in two-hour sessions twice in a week for 8 weeks. The repeated measure (one way and two way) ANOVA, independent-samples t-test, Bayesian Model, and ROC curve were applied to analysis the data using SPSS v.25. **Results:** Compared with the control group, BBS test result in 97% percent of the experimental group obtained normal. Experimental group improved significantly in the mean scores ($ps<0.001$) of BBS, Romberg, DHI, FES-I and some dimensions of life quality in LEIPAD. **Conclusion:** Balance exercises training (CC & strengthening the sensory-motor system) may induce significant improvements in balance and can be used for prevention or treatment in elderly people; further research is required to assess the long-term consequences of such interventions in elderly

Keywords: Balance, Exercise training, Elderly, Life quality, Women

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INTRODUCTION

Aging experience has drastically changed in the 21st century (1). The pace of aging is on the rise due to the medical advances, reduced mortality, improved socioeconomic status, improved nutrition and increased life expectancy (2). The percentage of people aged 60 or more will increase up to 22 % by 2050. The number of older populations is growing faster in developing countries compared with developed countries (3). According to census records, the elderly population of Iran was 9.3 % in 2016, which is expected to reach 10% by 2026 (1, 4).

Addressing aging-related issues is a social necessity (5). Older people face several health challenges, particularly falling (6), which is a major health problem, the major cause of sudden death and the fifth leading cause of disability in older people worldwide (7-10). At least one third of those aged over 65 experience falling each year, a percentage which may reach 40% by the age of 80. Half of the people with a history of falling may experience this incidence for the second time (11). Out of the 17.1% injuries reported in Iran in 2007, 5.9% were related to the elderly and 11.2% were related to falling (12). Moreover, 12% of the 8,000 traumatized people (960 people) hospitalized are older people aged 60 years or more, while 70% suffer from injuries caused by falls (13). Loss of balance is one of the most menacing risk factors related to falls (14). Maintaining balance is the result of appropriate and simultaneous function of central and peripheral sensory nervous systems (visual system, auditory system and somatosensory system). Loss of balance results from the disruption in these systems, which will lead to increased risk of falling (15). Compared to normal individuals, in about one third of people aged more than 40, vestibular impairment with dizziness, and the risk of falls increases by 12 times (16). Fear of falling (FOF) has a serious effect on balance performance in the elderly. It can increase their risk of falling (17). The prevalence of FOF in the elderly population is between 29 and 77% (18). Fear of falling and its consequences can result in reduced physical and social activity and consequently lower quality of life (QOL) in the elderly (19).

Vestibular rehabilitation (VR) has been found to be effective and safe in patients with vestibular and balance disorder. The main objective of VR is to reduce vertigo and improve patient's balance and physical activity (16). Falls prevention interventions include teaching strength and balance exercises (20). Prescribing exercise to people with balance and vestibular disorders is a complicated task (21). VR is effective in reducing the likelihood of future falls, improving life quality and postural balance, and treating older patients with chronic vestibular disorders (16, 22). Most studies have focused on vertigo, presenting it as the major outcome of balance training interventions, while few studies have been conducted on improving balance and decreasing falls as intervention outcomes. Accordingly, the purpose of the present study was to investigate the effect of balance exercise training on balance status and improving balance and QOL in the elderly.

MATERIALS AND METHODS

Study Population

This randomized controlled trial study, with a pre-posttest design, was carried out in Shiraz (South-western Iran). Initially, the clients referred to two main daily care aging centers (Soroush and Jahandidegan) were randomly (via coin flipping) assigned to experimental and control groups (Soroush as experimental and Jahandidegan as control centers) .A total of 60 older adult women with dizziness (30 individuals from each center) were selected (using the goal-based approach) and assigned through block randomization (30 participants as experimental and 30 as control). The inclusion criteria were: age (60-74 years), history of falling over the past 6-12 months, positive Romberg sign, a minimum score of 24 in the mini-mental state examination (MMSE), a minimum score of 21 in Berg Balance Scale (BBS), no visual impairment, no neck disability, non-use of ambulatory assistive devices (AAD), and no orthopedic and neural impairments. The exclusion criteria were unwillingness to continue to cooperate, and musculoskeletal disorders requiring ambulatory assistive devices.

Procedure

The intervention included a balance exercise training program based on VR (CC) protocol(23)(Annex B) and exercises for strengthening the sensory-motor system (24) were taught based on two-hour sessions twice in a week for 8 weeks (16 sessions) in Soroush center (for being comfortable the elderly, the exercises were done in the center) . This intervention was used only for the experimental group and was done by a trained therapist under the supervision of one of the researchers. No other activities or interventions had received by the control group during the study period and usual care were continued. A two-month follow-up was performed after the final training session on all participants. For ethical considerations, the control group was provided with the educational materials following the completion of the research.

Outcome measurement

The BBS and Romberg tests were used for balance measurement and the eligibility of the subjects was determined through MMSE used for mental status assessment. BBS contains 14-item scales (one item for sitting and 13 items for standing positions) related to balance functions used in everyday life. The score of each item ranges from 0 to 4, and the total BBS score ranges from 0 to 56 where a low score indicates a lower level of balance (25). The results of Romberg test were reported to be normal and abnormal since the elderly balance condition was very bad prior to the intervention; in the first and second sessions, an unbalanced elderly test was conducted, where in the absence of a researcher's support, there could have been a fall, hence the lack of time to test the Romberg. MMSE has 19 items examining various cognitive functions such as orientation, registration, attention and calculation, recall, language and design; it further provides a general assessment of the subject's cognitive status. This questionnaire has 0-30 points with the following three cut-off levels employed to classify the severity of cognitive impairment: no cognitive impairment [24-30], mild cognitive impairment [18-23] and severe cognitive impairment [0-17]. In the second step of evaluation, BBS, DHI, FES-I, and LEIPAD, were used.

DHI questionnaire was developed to measure dizziness, and determine the severity of dizziness-related problems and the impact of deficits on the quality of life; it includes 25 questions with 3 response levels, namely functional (9 questions), emotional (9 questions) and physical (7 questions). Possible scores range from 0 to 100, with higher scores showing worse disabilities (26).

FES-I questionnaire evaluates the fear of falling and includes 16 questions regarding various daily activities. The scores range from 1 to 4 for each question, with the total score ranging 16-64, and higher scores indicating a higher fear of falling (27). The Persian version of FES-I was applied (28).

LEIPAD (Leiden-Padua) questionnaire was used to evaluate the QOL in seven dimensions: physical function, self-care, depression and anxiety, cognitive performance, social function, sexual function and life satisfaction. It is a questionnaire with four different choices for every question, which are scored on a numerical scale of 0 (the worst state), 1, 2, 3 (the best state) considered on a Likert scale with a maximum total score of 93(29). The standardized Persian version was applied (30).

Oculomotor assessments (random saccade, gaze and smooth pursuit) by video nystagmography (VNG) instrument (ICS Chartr 200 VNG, Madsen) were carried out in their first visit. Following the evaluation of both groups, the results of all tests were given to each individual.

The outcomes were measured prior to the intervention, immediately after the end of the intervention and two months after the intervention by one of the researchers who was blinded to the group assignments. Finally, by asking question about falling event four months after the beginning of the study, the rate of falling were registered.

Statistical Analysis
The data were entered into SPSS version 25 following data collection, and analyzed using descriptive statistics by Mean and SD, to compare within groups' results over the three times using repeated-measures (one way and two way) ANOVA and between two groups using independent samples t-test. Also, the effectiveness of intervention was extracted by using ROC curve, and the Bayesian model to estimate and predict the obtained model was used with syntax codes of new version of SPSS 25.

Ethical considerations
It was approved by ethics committee of SUMS (registration number 1396.142) and registered at Iranian Registry of Clinical Trial (IRCT.ir) with number IRCT20180730040644N1. Informed consent was considered for all participants.

RESULTS

From the 65 older adult women enrolled in the study, 5 were excluded (declined to participate or other reasons) and totally 60 elderly persons were randomized into two groups (Figure 1). No participant was excluded during the study (intervention and follow up time). The mean age of participants were 65.75 ± 4.06 years old. There were no significant differences between the two groups concerning demographic characteristics (age, marital status and education level (Table I). According to the results of repeated measures (one way and two way) ANOVA and independent sample t-test, there were significant differences between the pre and post-test data in BBS, DHI, FES-I, and LEIPAD in the experimental group compared to control group indicating the positive effects of CC and balance exercises training (p <0.001) (Table II). After two-month follow-up, significance had been remained as shown in table II (p <0.001).

As mentioned before, two tests (DHI and LEIPAD) have subscales. The repeated measures (one way and two way) ANOVA and independent sample t-test on DHI

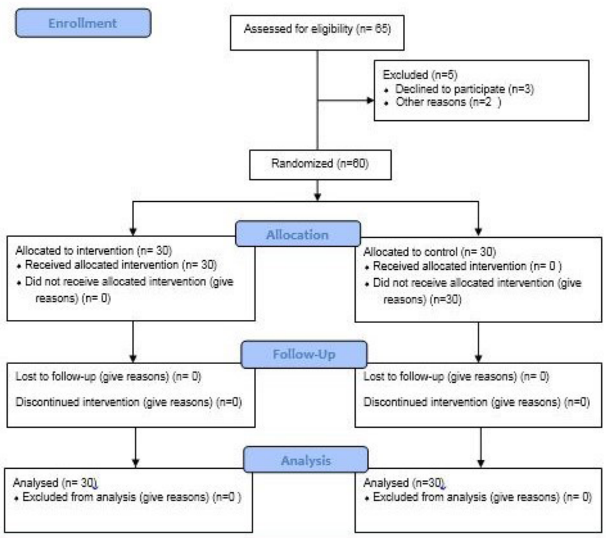

Figure 1: CONSORT flow diagram

Table I: Comparison of frequency distribution of demographic variables between Experimental and Control groups

Variables	Experimental Group (%)	Control Group (%)	P-value*
Age	66.33±4.28	67.17±3.85	0.432
Marital Status			
Married	21(70)	18(60)	
Divorce	6(20)	8(26.66)	0.719
Single	3(10)	4(13.33)	
Education Level			
Illiterate	3(10)	1(3.33)	
Primary	4(13.33)	8(26.66)	
Cycle	8(26.66)	12(40)	0.197
Diploma	10(33.33)	8(26.66)	
University	5(16.66)	1(3.33)	

P > 0.05

subscales (physical, emotional, and functional dizziness) showed significant differences between experimental and control groups even after two months follow up (p <0.001)(Table III).

The results of repeated measures (one way and two way) ANOVA and independent sample t-test showed that in the subscales of LEIPAD (physical, self-care, depression and anxiety, cognitive, social, and life satisfaction) except sexual one, there were significant differences before and after the intervention (P <0.001) in the experimental group, revealing the effectiveness of educational intervention in the life quality of the elderly even after two months follow up (Table IV).

The ROC curve estimation was used to estimate effectiveness in LEIPAD variable within the samples. Its analysis determined the effectiveness of the intervention. The area under the curve increased from 0.786 to 0.843 (Figure 2). Furthermore, by drawing Bayesian model through Rouder's method for the LEIPAD variable to estimate and predict obtained model, a mean difference of 4 were obtained (P < 0.05, DF = 58, Bayes factor= 0.002). It indicates that if the current intervention process continues, the measures of LEIPAD variable as

Table II: Comparison of the Mean of Study Constructs (BBS[a], DHI[b], FES-I[c], LEIPAD) prior to and following the intervention in the Experimental and Control groups

Test		Pre M±SD	Post (8 weeks) M±SD	Post (Two-month Follow-up) M±SD	One-way repeated measures ANOVA		Two-way repeated measures ANOVA	
					F test	P-value	F test	P-value
BBS	Experimental	24.87±12.77	39.24±3.09	37.60±10.53	37.71	<0.001*	35.01	<0.000*
	Control	27.29±4.41	33.78±3.04	31.43±2.81	201.1	0.946		
	P-value (independent t-test)	0.182	<0.001*	<0.001*				
DHI Total	Experimental	66.10±11.45	53.27±3.19	41.87±3.33	49.01	<0.000*	41.16	<0.000*
	Control	64.97±6.83	65.27±3.51	65.77±2.99	314.1	0.327		
	P-value (independent t-test)	0.084	<0.001*	<0.001*				
FES-I	Experimental	42±5.28	38.24±3.29	34.27±4.01	7.48	<0.000*	76.05	<0.000*
	Control	41.33±3.27	42.56±2.33	42.69±2.63	220.1	0.101		
	P-value (independent t-test)	0.884	<0.001*	<0.001*				
LEIPAD Total	Experimental	72.17±3.44	75.01±2.99	72.37±3.19	14.01	<0.002*	29.09	<0.000*
	Control	70.56±3.12	71.27±2.85	70.91±2.37	87.1	0.117		
	P-value (independent t-test)	0.712	<0.001*	<0.001*				

a. BBS: Berg Balance Scale, b. DHI: Dizziness Handicap Inventory, c. FES-I: Fall Efficacy Scale-International, P < 0.05.

Table III: Comparison of the mean and standard deviation of DHI[a] subscales before and after intervention in the experimental and control groups.

Subscales		Pre M±SD	Posttest (8 weeks) M±SD	Posttest (Two-month Follow-up) M±SD	One-way repeated measures ANOVA		Two-way repeated measures ANOVA	
					F test	P-Value	F test	P-Value
Physical	Experimental	14.50±2.67	12.11±1.16	9.23±.97	31.01	<0.000*	23.02	<0.000*
	Control	14.21±1.67	10.21±1.33	10.59±2.67	112.1	0.201		
	P-value (independent t-test)	0.981	<0.001*	<0.001*				
Emotional	Experimental	22.96±4.17	18.38±3.01	13.90±1.72	12.21	<0.001*	14.19	<0.000*
	Control	22.77±2.42	16.07±1.65	16.86±3.76	36.63	0.161		
	P-value (independent t-test)	0.994	<0.001*	<0.001*				
Function	Experimental	23.90±4.52	20.65±3.17	17.30±2.14	24.12	<0.000*	34.04	<0.000*
	Control	23.22±2.84	21.54±1.47	22.98±4.33	81.37	0.071		
	P-value (independent t-test)	.0754	<0.001*	<0.001*				

a. DHI: Dizziness Handicap Inventory , P < 0.05.

well as quality of life of older samples will increase up to four times (Figure 3).

Oculomotor tests were within normal limits in all participants (P = 0.137). The ocular motor abnormality indicates abnormal functioning of the central (not peripheral) vestibular system (31). Following the intervention, the results remained abnormal in the control group, yet normal results were observed in 97% of the subjects in the experimental group. It is noteworthy that four months after the beginning of the study, no falling was reported in the experimental group, while 7 fall events were reported in the control group (P = 0.004).

DISCUSSION

The present study corroborated the effectiveness of balance exercise education (CC and strengthening the sensory-motor system) in balance, dizziness, fall rate, and QOLin the elderly. VR training (CC) increases compensation in the central nervous system (22, 32, 33). This study demonstrated that such exercises training is effective in improving balance as well as dizziness and its concomitants (physical, functional and emotional dizziness). Bayat et al. examined the effect of CC exercises on older people with chronic vertigo and found significant improvement in DHI and VNG test after the intervention (16). Farzin et al. investigated the effect of

Table IV: **Comparison of the mean and standard deviation of subscales of LEIPAD (quality of life) in the experimental and control groups before and after intervention.**

Subscales		Pre M±SD	Post (8 weeks) M±SD	Post (Two-month Follow-up) M±SD	One-way repeated measures ANOVA		Two-way repeated measures ANOVA_	
					F test	P-Value	F test	P-Value
Physical	Experimental	8.93±4.87	10.28±2.41	10.40±1.49	36.12	<0.001*		
	Control	8.98±1.97	8.94±1.28	8.36±1.45	111.7	0.112	71.01	<0.000*
	P-value (independent t-test)	0.877	<0.001*	<0.001*				
Self-care	Experimental	14.26±1.77	15.54±1.21	16.86±1.38	64.01	<0.000*		
	Control	14.08±1.32	14.27±2.17	14.10±1.45	87.06	0.098	23.12	<0.000*
	P-value (independent t-test)	0.123	<0.001*	<0.001*				
Depression and anxiety	Experimental	8.70±1.91	7.11±0.8	6.93±1.85	11.02	<0.000*		
	Control	8.65±1.24	9.11±1.11	8.97±1.43	81.07	0.411	34.03	<0.000*
	P-value (independent t-test)	0.897	<0.001*	<0.001*				
Cognitive	Experimental	11.13±1.79	12.02±1.74	9.40±1.73	44.00	<0.000*		
	Control	11.06±1.81	11.24±1.29	11.13±1.10	102.7	0.301	41.15	<0.000*
	P-value (independent t-test)	0.895	<0.001*	<0.001*				
Social	Experimental	8.59±1.16	9.25±1.21	10.33±1.60	91.12	<0.000*		
	Control	8.25±1.25	8.23±1.27	8.79±1.74	71.07	0.101	39.01	<0.000*
	P-value (independent t-test)	0.196	<0.001*	<0.001*				
Sexual	Experimental	2.76±1.30	2.45±1.11	2.96±1.37	14.42	<0.002*		
	Control	3.20±1.06	3.04±1.11	3±1.01	308.3	0.701	44.16	<0.000*
	P-value (independent t-test)	.164	.971	.915				
Life satisfaction	Experimental	14.33±1.62	17.84±2.58	15.46±1.16	101.1	<0.002*		
	Control	14.40±1.86	14.74±1.64	14.26±1.74	312.5	0.091	51.01	<0.000*
	P-value (independent t-test)	.883	<0.001*	.003**				

P < 0.05

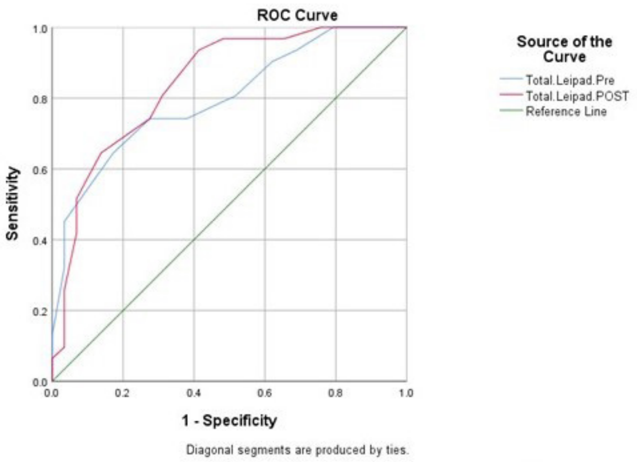

Figure 2: ROC curve for LEIPAD

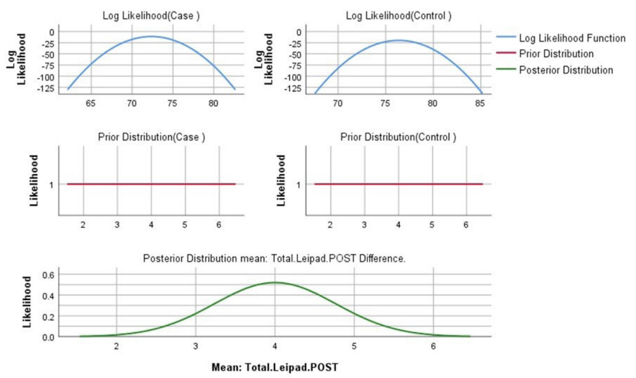

Figure 3: Bayesian model for LEIPAD

CC exercises on balance and dizziness among Multiple sclerosis (MS) patients and observed a noticeable difference between pre- and post-intervention levels of balance and dizziness (26). The normality of the results pertaining to Romberg test in the experimental group (over 97%) after the intervention indicated the positive effect of educational interventions. Corna et al. noticed that balance deficits were treated by CC exercises (34). Another finding in this study was significant reduction in FES-I as an indicator of falling after intervention that shows the positive effect of balance exercises in

the elderly. Some researchers examined the impact of exercising on fear of falling in the elderly and observed decrease of fear of falling among the elderly (35, 36). Macias et al. studied the effect of VR on fall risk in the elderly, found that it will be more effective and may result in improved balance if performed immediately after falls (37). Salminen et al. investigated the effect of multi-dimensional intervention on the number of falls among the elderly and found a reduction in the number of falls after the 12 months of the intervention (38).
Akbari Kamrani et al investigated the impact of Romberg's exercise on the number of falls among the elderly, and no significant difference was seen between the control and experimental groups after a 6-month follow-up (39). Luxton et al. suggested that exercise alone is not sufficient to reduce falls in older adults although it increases muscle strength (40). It seems that using two exercise training in improving all aspects in current study were effective.
LEIPAD scores have shown improvement in the QOL in older people in this study. It is in line with Najafi et al. examined the effect of multi-dimensional fall prevention program on the incidence of falling and the QOL. Their results showed that multi-dimensional fall prevention program was able to improve the QOL and its dimensions in the elderly (41). Other studies pointed to exercise role in some subscales of QOL such as health and emotion. (42-44). This result supports that exercise can improve not only physical aspects in life, but also psychological healthy (45). Sarmadiyan et al surveyed the effect of 10 weeks aerobic exercise and resistance training on QOL among sedentary menopausal women. They proved that this training didn't improve the quality of life. It may be due to short-term exercise training (10 weeks) types of exercises applied and no follow up evaluation (46).

The following improvements were observed in the QOL: reduced risk of falling and increased self-confidence, participation in social activities, reduced dizziness, educating the eyes to obtain vision stability, effectively identifying the appropriate motor–postural strategies and improving the natural postural strategies, improved walking, especially in patients who report increased dizziness during head movements, use of alternating strategies by the somatosensory system, maintenance of the vestibular and visual function, increased mobility and walk endurance, reduced anxiety problems associated with sensory mismatches induced by abnormal signals coming from vestibular system, improved general physical conditions, and increased coordination, supporting natural and automatic motions (34, 47, 48). The present study specifically focused on long intervention period, simultaneous use of two exercise protocols (CC and strengthening of the sensory-motor system), and simultaneous use of clinical and para-clinical tests. Nonetheless, the study was limited to female participants and the results may not be generalizable to male population and was not double blinded. Furthermore, small sample size and no entry elderly with restricted mobility limited the study.
The findings of this study demonstrate a significant difference between the experimental and control groups as far as balance, dizziness, fear of fall, and QOL are concerned, as a result of vestibular rehabilitation. Given the advantages of such ilk of rehabilitation, its implementation is recommended in the integrated care program for the elderly, which is affordable, easily done at home, and available at every trainable service for the elderly.

CONCLUSION

In summary, the results of the study can provide information on planning a fall prevention program for the elderly and improving balance among the elderly residing in centers for aging services. It is also suggested that the outcomes of the study be evaluated in the long run and similar studies be conducted among different races and ethnic groups.

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REFERENCES

1. Tanjani PT, Motlagh ME, Nazar MM, Najafi F. The health status of the elderly population of Iran in 2012. Archives of Gerontology and Geriatrics. 2015;60(2):281-7.
2. Masoumi N MB, Shoujaei F, Sharafi SF. A review of postural balance and its related factors in the elderly. Crescent J Med & Biol Sci 2015;2(1):28-31.
3. Organization WH. Global age-friendly cities: A guide: World Health Organization; 2007.
4. Asadollahi A, Saberi LF, Havasi A, Kaveh M-H. Psychometric Properties of the Persian Version of the Quality of Life in Epilepsy Inventory in the Later Life. Journal of epilepsy research. 2016;6(2):61.
5. Kelachayeh SSR, Sadeghzadeh V, Shahnavaz A, Branch Z. Investigation the effect of exercise with Music on quality of life in elderly men supported by Social Security retirement center in Zanjan. Life Science Journal. 2013;10(1).
6. Joshua AM, D'Souza V, Unnikrishnan B, Mithra P, Kamath A, Acharya V, et al. Effectiveness of progressive resistance strength training versus traditional balance exercise in improving balance among the elderly-a randomised controlled trial. Journal of clinical and diagnostic research: JCDR. 2014;8(3):98.
7. Orces CH. Prevalence and determinants of fall-related injuries among older adults in Ecuador.

Current gerontology and geriatrics research. 2014. Article ID 495468: 1-7.
8. Tiedemann A, Sherrington C, Lord SR. The role of exercise for fall prevention in older age. Motriz: Revista de Educaзго Fнsica. 2013;19(3):541-7.
9. Pi H-Y, Hu M-M, Zhang J, Peng P-P, Nie D. Circumstances of falls and fall-related injuries among frail elderly under home care in China. International journal of nursing sciences. 2015;2(3):237-42.
10. Grivna M, Eid HO, Abu-Zidan FM. Epidemiology, morbidity and mortality from fall-related injuries in the United Arab Emirates. Scandinavian journal of trauma, resuscitation and emergency medicine. 2014;22(1):51.
11. Hofmann AO. Preventing falls with occupational therapy. American Occupational Therapy Association. 2016.
12. Iranfar M, Ainy E, Soori H. Fall epidemiology in the elderly residents of care centers in Tehran–1390. Iranian Journal of Ageing. 2013;8(2):30-8.
13. Ghodsi SM, Roudsari BS, Abdollahi M, Shadman M. Fall-related injuries in the elderly in Tehran. Injury. 2003;34(11):809-14.
14. Todd C, Skelton D. What are the Main Risk Factors for Falls Amongst Older People and what are the Most Effective Interventions to Prevent These Falls?: World Health Organization; 2004.
15. Casani AP, Navari E. Dizziness and prevention of falls in the elderly. Geriatric Care. 2017;3(4).
16. Bayat A, Pourbakht A, Saki N, Zainun Z, Nikakhlagh S, Mirmomeni G. Vestibular rehabilitation outcomes in the elderly with chronic vestibular dysfunction. Iranian Red Crescent Medical Journal. 2012;14(11):705-708.
17. Young WRW, A.M. How fear of falling can increase fall-risk in older adults: Applying psychological theory to practical observations. Gait & Posture. 2015;41:7-12.
18. Hadjistavropoulos TD, K. and Fitzgerald, T.D. Reconceptualizing the role of fear of falling and balance confidence in fall risk. J Aging Health. 2011; 23(1):3-23.
19. Denkinger MD, Lukas A, Nikolaus T, Hauer K. Factors associated with fear of falling and associated activity restriction in community-dwelling older adults: a systematic review. The American Journal of Geriatric Psychiatry. 2015;23(1):72-86.
20. Pfortmueller C, Lindner G, Exadaktylos A. Reducing fall risk in the elderly: risk factors and fall prevention, a systematic review. Minerva Med. 2014;105(4):275-81.
21. Whitney SL, Alghadir AH, Anwer S. Recent evidence about the effectiveness of vestibular rehabilitation. Current treatment options in neurology. 2016;18(3):13.
22. Jung JY, Kim J-S, Chung PS, Woo SH, Rhee CK. Effect of vestibular rehabilitation on dizziness in the elderly. American journal of otolaryngology. 2009;30(5):295-9.
23. Ribeiro AdSB, Pereira JS. Balance improvement and reduction of likelihood of falls in older women after Cawthorne and Cooksey exercises. Brazilian journal of otorhinolaryngology. 2005;71(1):38-46.
24. http://www.nhs.uk/exercises-for-older-people
25. Taherzadeh J, Taheri H, Pejhan A, Seyedahmadi M, Keyvanloo F. Comparing the effects of three selected exercise patterns on the equilibrium of patients with parkinson. 2011;17:256-265 (Persian).
26. Farzin F, Golpayegani M, Faraji F, Shahrjerdi S, Ghasemi P. The Effect of Vestibular Rehabilitation on Dizzines and Balance in Patient with Multiple Sclerosis. Journal of Arak University of Medical Sciences. 2018;21(2):65-74.
27. Khajavi D, Farrokhi A, JABERI MA, Kazemnejad A. The Effect of a Training Intervention Program on Fall-Related Motor Performance in the Male Elderly without Regular Physical Activity. 2013; 12:49-65 (Persian).
28. Khajavi D. Validation and reliability of Persian version of fall efficacy scale-international (FES-I) in community-dwelling older adults. Iranian Journal of Ageing. 2013;8(2):39-47.
29. De Leo D, Diekstra RF, Lonnqvist J, Lonnqvist J, Cleiren MH, Frisoni GB, et al. LEIPAD, an internationally applicable instrument to assess quality of life in the elderly. Behavioral Medicine. 1998;24(1):17-27.
30. Hesamzadeh A MS, Mohammadi F, Fallahi Khoshknab M, Rahgozar M. . Comparison of elderlys" quality of life" living at homes and in private or public nursing homes. . Iranian journal of ageing. 2010;4(4): 66-74 (Persian).
31. Huh YE KJ. Bedside evaluation of dizzy patients. . Journal of clinical neurology (Seoul, Korea). 2013;9(4):203–13.
32. Von Brevern M, Bertholon P, Brandt T, Fife T, Imai T, Nuti D, et al. Benign paroxysmal positional vertigo: diagnostic criteria. Journal of Vestibular Research. 2015;25(3, 4):105-17.
33. Tsukamoto HF, Costa VdSP, da Silva Junior RA, Pelosi GG, de Moraes Marchiori LL, Vaz CRS, et al. Effectiveness of a vestibular rehabilitation protocol to improve the health-related quality of life and postural balance in patients with vertigo. International archives of otorhinolaryngology. 2015;19(03):238-47.
34. Corna S, Nardone A, Prestinari A, Galante M, Grasso M, Schieppati M. Comparison of Cawthorne-Cooksey exercises and sinusoidal support surface translations to improve balance in patients with unilateral vestibular deficit. Archives of physical medicine and rehabilitation. 2003;84(8):1173-84.
35. Kumar A, Delbaere K, Zijlstra G, Carpenter H, Iliffe S, Masud T, et al. Exercise for reducing fear of falling in older people living in the community: Cochrane systematic review and meta-analysis.

Age and ageing. 2016;45(3):345-52.
36. Kendrick D, Kumar A, Carpenter H, Zijlstra GR, Skelton DA, Cook JR, et al. Exercise for reducing fear of falling in older people living in the community. Cochrane Database of Systematic Reviews. 2014(11): 1-113.
37. Macias JD, Massingale S, Gerkin RD. Efficacy of vestibular rehabilitation therapy in reducing falls. Otolaryngology—Head and Neck Surgery. 2005;133(3):323-5.
38. Salminen MJ, Vahlberg TJ, Salonoja MT, Aarnio PT, Kivel∆ SL. Effect of a risk-based multifactorial fall prevention program on the incidence of falls. Journal of the American Geriatrics Society. 2009;57(4):612-9.
39. Akbari Kamrani A A, Azadi F, Akbari Kamrani M, Pezhmanfard P, Siyadat S. The Effect of Romberg Exercise on Falling Episodes of Elderlies With History of Past Fallings. . Salmand: Iranian Journal of Ageing. 2007; 2 (2):246-51.
40. Luxton T, Riglin J. Preventing falls in older people: a multi-agency approach. Nursing Older People (through 2013). 2003;15(2):18.
41. Najafi Ghezeljeh T PYZ, Mehran A, Jafari Oori M. . Effect of a Multidimensional Fall Prevention Program on Incidence of Falling and Quality of Life among Elderly. Hayat. 20. 2014;2:14-24.
42. Binder EF, Schechtman, K.B., Ehsani, A.A., Steger-May, K., Brown, M., Sinacore, D.R., Yarasheski, K.E., Holloszy, J.O. Effects of exercise training on frailty in community-dwelling older adults: results of a randomized, controlled trial. JAm Geriatr Soc 2003;50 (12):1921-8.
43. Helbostad JL, Sletvold, O., Moe, N.R. . Effects of home exercises and group training on functional abilities in home-dwelling older persons with mobility and balance problems. A randomized study. . Aging Clin Exp Res 2004a;16:113–21.
44. Helbostad JL, Sletvold, O., Moe-Nilssen, R. Home training with and without additional group training in physically frail old people living at home: effect on health-related quality of life and ambulation. . Clin Rehabil. 2004b;18: 498–508.
45. Windle G, Hughes, D., Linck, P., Russell, I., Woods, B. . Is exercise effective in promoting mental well-being in older age? A systematic review. . Aging Ment Health. 2010;14:652–69.
46. Sarmadiyan Mk, D. karimi, M. Niromand, M. Effect of 10 weeks combined training (aerobic- strength) on quality of life among untrained postmenopausal women Quarterly Journal of Geriatric Nursing. 2016;2:50-60 (persian).
47. Alghadir AH, Iqbal ZA, Whitney SL. An update on vestibular physical therapy. Journal of the Chinese Medical Association. 2013;76(1):1-8.
48. Han BI, Song HS, Kim JS. Vestibular rehabilitation therapy: review of indications, mechanisms, and key exercises. Journal of Clinical Neurology. 2011;7(4):184-96.