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Original Article

Impact of Balance Training on Fear of Falling and Fall Rate in Older Women

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Abstract

Background: Fear of falling is one of the factors that threaten the quality of life in old age and increases the risk of falling by limiting physical activity. The purpose of this study was to investigate the effect of balance training on the efficacy of fear of falling and the rate of falling in older women.

Methods: In this randomized controlled trial, 70 aging women with a fear of falling were selected and randomly assigned to experimental (n=35) and control (n=35) groups. The intervention group received 10 sessions of 1-hour balance exercise, along with training in falling prevention strategies, but the control group received only routine care. Data were collected using the Falls Efficacy Scale-International questionnaire and the new elderly health services package of the Ministry of Health of Iran. Fear of falling was evaluated as the primary outcome 1 month and 3 months after balance training, and frequency of falling was assessed as a secondary outcome one year after the intervention. Data were analyzed by ANOVA, independent *t* test, and paired *t* test.

Results: The results showed that the mean score of fear of falling in the experimental group was significantly lower than in the control group 1 month ($P = 0.005$) and 3 months ($P < 0.001$) after balance training. The mean score of fear of falling in the control group represented no significant difference between the three times ($P = 0.64$). Finally, one year after the balance training, the frequency of falling in the experimental group was significantly lower in comparison to the control group ($P = 0.035$).

Conclusion: A balance training program is recommended as a preventive approach for reducing the frequency of falling in older women.

Keywords: Circuit-based exercise, Efficacy, Elderly, Accidental falls

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Introduction

According to the World Health Organization (WHO) definition, old age (elderly) is defined as 60 years and older (1). As we get older, some changes occur in the function of the musculoskeletal, vestibular, and somatosensory systems and especially the visual system as physiological systems involved in balance (2). Meanwhile, several factors have been considered to endanger the health of the elderly, decrease their quality of life, and increase maintenance costs; one of these factors is falling (fall), which has many physical, psychological, social, and economic consequences, and its probability of occurrence increases with age (3). Fall is one of the most common and serious problems of older people that is known as an aging syndrome. Falling means losing balance in a sitting or standing position or while changing the position, which results in the person being placed on the ground or at a lower level due to factors other than external forces, sudden loss of consciousness, and paralysis. The number of falls and the severity of fall injuries increase with age. Falling is associated with a decline in basic activities for the elderly. It also imposes significant financial burdens on individuals and society, including health and social care services and high costs of hospitals, occasionally the need for long-term nursing, admission to nursing homes, and the like (4). Unfortunately, there are no accurate statistics on the cost of treatment for falling in Iran, but in a country such as the United States, this number has been reported to be $17 000 per person (5). According to evidence, falls are the most common cause of injury and

hospitalization of the elderly and even death (4). One of the major concerns of the elderly is falling, which is known as an event that leads to unwanted falls. In other words, fear of falling is associated with avoiding activities that one can do and is the most common fear among the elderly. Approximately one-third of the elderly experience a fall at least once a year, and 22%-59% of the elderly have been reported to have the fear of falling, which is defined as a decrease in one's confidence in their ability to maintain balance or low confidence in their ability to prevent falls. The psychological consequences of falling can be as much as falling or even worse (6).

Elderly people may experience cognitive impairments such as fear, depression, loneliness, and loss of confidence after falling. Those with/without a history of falls have reported to have fear of falling. Women are more afraid of falling than men (7). This fear is associated with functional abilities, daily activities, and quality of life. Therefore, fear of falling and avoidance of activity due to fear of falling may result in impaired motor performance indicators associated with falling in older people (8). This fear is also related to falling, implying that people who are afraid of falling experience more falls (9). The results of Hornyak et al showed that the amount of fear is negatively and significantly associated with daily activities (5). Fear of falling can lead to the disruption of activity, inactivity, and dependence on performance (10).

The importance of physical activity as a method for continuing older people's independence has been reported in several studies. In contrast, numerous studies have attributed the effect of 5-10% of older people's deaths to inactivity. In elderly people, fear of falling leading to reduced self-confidence and self-efficacy is an obstacle to proper physical activities (11). Regular physical activities maintain muscle mass and reduce fat mass accumulation in the muscle tissue of older people, reducing the risk of falls or falling (12). Balance is one of the most important functional abilities of humans that plays a vital role in the physical and mental health of older people. It is also essential for the stability of the movement, doing the daily activity, and participating in social activities. Therefore, preventing falls, maintaining balance, and reducing serious fall injuries for older people have been raised as important issues in most countries. Preventing falls is the best treatment, and physical activity is the easiest way to keep healthy muscles, improve neural pathways, and reduce the fear and risk of falling (13). Given the importance of falling/falls and its unfortunate consequences, any effort to improve the balance of the elderly will be valuable. Thus, this study evaluated the effect of balance training on the efficacy of fear of falling and the rate of falling in older women.

Materials and Methods

The present study was conducted based on a randomized controlled trial (identifier: IRCT20180216038754N1; https://www.irct.ir/trial/30109) on the elderly women referred to the comprehensive health services centers of Zarinshahr. According to the WHO protocol, the elderly as a vulnerable target group refer to their comprehensive health service databases for receiving primary health care, and an electronic health record is completed for them. The prevention of falling and imbalances is one of the primary health care measures in the elderly services package. In this study, 60-75-year-old elderly women, who referred to health care centers in 2018-2019 and answered yes to the question about fear of falling during care, were considered the target group of the study. Zarinshahr has 5 health centers. Four centers were quite randomly selected by drawing lots and randomly assigned to experimental and control groups. The experimental and control group samples were randomly selected from the first two selected centers and the other two selected centers, respectively. The restricted randomization was taken using the random allocation rule method. The use of a restricted randomization method in small sample clinical trials is essential. This method ensures that the number of people between the intervention and control groups is essentially equal, which maximizes the effectiveness of clinical trials because it reduces the standard error of estimating the effect of treatment and has a great reward for validity and scientific accuracy (14). The sample number was obtained at least 35 individuals in each group, and the statistical population consisted of elderly women with a fear of falling. First, a list of eligible women was prepared using the SIB software system (Integrated Health System) at the selected centers (the elderly who answered yes to *Are you afraid of falling?*). Then, according to the specifications of the electronic health record, the exclusion criteria were investigated for the subjects, and finally, individuals were contacted using the final list. If the elderly did not intend to participate in the study, the next one was replaced in the list until the experimental and control sample numbers were completed according to the sample size. After sampling, the method and purpose of the study were fully explained to the elderly in the experimental group and their consent was obtained in written forms. The physical and mental health status of the studied elderly was available in the health center record, and a detailed report of their physical and psychological problems was also available in their records, which was cited by the researchers. Furthermore, each of the subjects in the experimental group was examined by a geriatric medicine trained physician in the research team, and a license for performing physical activity was issued before starting the training.

The inclusion criteria included women aged 60-75, with written consent presentation, physician approval to participate in a training program, and self-report about fear of falling during care. On the other hand, the exclusion criteria were inability to perform balance training according to the physician's opinion, people's unwillingness to participate in balance training, and lack of presence for more than 1 session during balance

training. The other exclusion criteria included attendance in training sessions out of the intervention program, hospitalization due to illness or acute injury, and a history of diabetes and severe depression. The data collection tool included the Falls Efficacy Scale-International (FES-I) questionnaire and the new older person's health services package (fall and imbalance section) of the Ministry of Health of Iran that contained three questions about the history of falls in the past year, fear of falling, and feeling of instability and imbalance while walking. The other demographic information was designed and collected at the beginning of the questionnaire.

FES-I is a 16-item instrument that has been developed by Yardley et al, who confirmed its psychometric properties (15). The validity and reliability of this questionnaire (Cronbach's alpha 0.98, intraclass correlation coefficient (ICC) : 0.98, r: 0.823) have also been confirmed in Iran by Khajavi (16). The items in this questionnaire have four options: "I'm not worried at all" to "I'm worried", and each subject's score will be his total point of 16 questions (between 16 and 64). A higher score means more fear of falling or lower self-efficacy. The experimental group then participated in 1-hour exercise sessions for 5 weeks and 2 sessions per week (10 sessions in total) including 10 minutes of warm-up, 40 minutes of balance training, and 10 minutes of cooling down. The number of experimental groups decreased to 34 during training (1 person was removed due to respiratory problems according to the opinion of a specialist physician). During the training sessions, the physical education trainer pointed out the necessary training on the importance of balance exercises, balance exercises durability in mind, and how to do these exercises at home according to a comprehensive balance and movement program to prevent falls in older persons. At the end of several sessions, the subject of fall prevention was reviewed by an elderly expert for 15 minutes. The education and exercise sessions of the intervention group were conducted according to data in Table 1. Elderly people in the control group received their usual care (Iranian new elderly health service package including the assessment and classification of fall problem and imbalance, referral to a physician of the relevant center for further examinations and the classification of the probability of falling, as well as receiving calcium and vitamin D supplementation and training fall prevention in different parts of the home). The assessment was performed before the last training session and 1 month and 3 months after the last training session for fear of falling and one year later for a fall report (fall experience).

Data were analyzed by SPSS software (version 22) using independent *t* test, paired *t* test, chi-square, analysis of covariance (ANCOVA), and repeated measure analysis of variance (ANOVA) analysis. The questionnaires were anonymized to keep participants' information confidential and completed by replacing the National Code.

Results

The mean age of participants in the experimental and control groups was 65±3.4 and 65.1±4.4, respectively. The mean body mass index (BMI) in the experimental and control groups was 28.4±4.4 and 29.6±5.4, respectively. The results of the independent t-test demonstrated

Table 1. Schedule of Intervention Group Training Sessions

Sessions	Objectives	A Summary of Topics and Activities	Educational Time (min)
1	Familiarity of learners with the importance of preventing falls and imbalances in the elderly	Teaching the concept of falling and imbalance and its effects; Providing balance exercises and group training	60
2	Familiarity of learners with mobility and appropriate sports in the elderly	Teaching the benefits of physical activities in the elderly, the types of appropriate exercise, and the correct steps of physical activities in the elderly; Providing balance exercises and individual training	75
3	An understanding of the importance of balance exercises in preventing falls in the elderly	Investigating the role of balance exercises in improving balance strength and muscle condition in the elderly; Providing balance exercises and group training	60
4	Familiarity with how to do balance exercises at home	Teaching the correct method of balance exercises without the presence of a coach at home and keeping it in mind; Providing balance exercises individually and collectively	60
5	Familiarity of learners with the risk factors of falling at home	Educating the factors and places of danger in the house (insufficient lighting, unsafe stairs, wearing inappropriate shoes, not installing handrails and railings on the stairs, bathroom, toilet, and yard), the importance of home security to prevent falls at home; Providing group balance training	75
6	Familiarity of learners with the risk factors of falling outside the home	Educating the factors and places of the danger of falling outdoors; Practicing the correct way to walk and observe safety tips outdoors; Providing group balance exercises	75
7	Familiarity of learners with general tips for preventing falls and imbalances	Emphasizing periodic medical care, osteoporosis prevention training (role of nutrition and supplements) ،prevention of disproportionate and arbitrary use of drugs, education to prevent dizziness and imbalance; Providing group balance exercises	75
8	Familiarity of learners with methods of controlling fear, anxiety, and stress	Doing relaxation exercises in times of fear, stress, and anxiety; Providing group balance exercises	75
9	Familiarity of learners with methods to increase self-efficacy to prevent falls	Providing self-care education to achieve maximum independence; Relying on abilities by increasing awareness of the dangers of falls and the benefits of following safety tips; Providing group balance exercises	75
10	An overview of training sessions and balance exercises	Summarizing educational topics and answering questions; Reviewing and providing group balance exercises	60

that mean age (P = 0.95) and BMI (P = 0.25) were not significantly different between the two groups. Other underlying disease characteristics of the elderly under study are provided in Table 2.

Based on the results of Fisher's exact test, there was no significant difference in the frequency of the steep slope in the residential area between the experimental and control groups (P = 0.46). Similarly, the chi-square test results revealed no significant difference in the frequency of other safety issues in the residence area (the condition of the stairs, fencing, ceramic floor of the room or kitchen, rooms at the same level) between the two groups ($P > 0.05$).

According to the results of the independent t-test, no significant difference was found in the mean score of fear of falling before the balance training between the experimental and control groups (P = 0.23). "Adjusting the score of fear of falling before the intervention in both groups", the results of the ANCOVA test represented that the mean score of fear of falling 1 month (P = 0.005) and 3 months ($P < 0.001$) after the balance training in the experimental group was significantly lower than in the control group. The ANCOVA test results with repeated observations indicated that the mean score of fear of falling in the control group was not significantly different between the three times (P = 0.64), but a significant difference was observed between the three times in the experimental group ($P < 0.001$). The post hoc least significant difference test showed that the mean score of fear of falling in the experimental group 1 month and 3 months after the balance training was significantly lower than the situation before the balance training ($P < 0.001$); however, there was no significant difference between 1 month and 3 months after the balance training (P = 0.12, Table 3).

The repeated measure analysis demonstrated that the mean score of fear of falling in the experimental and control groups has been significantly different over time ($P < 0.001$).

Based on the investigation of the frequency of falling in the elderly one year after the intervention, the frequency of falling (fall) one year after the balance training was significantly lower (P = 0.035) in the experimental group (2.9%) in comparison with the control group (15.8%).

Discussion

Several factors are involved in the falling of older persons. In addition to demographic factors such as age and gender, risk factors for falls are divided into internal and external (environmental) categories. The most important internal causes of falling include poor mobility, cognitive

Table 2. Frequency Distribution of Different Variables in Both Experimental and Control Groups

Variable		Experimental Group		Control Group		*P* Value
		Number	Percent	Number	Percent	
History of depression		5	14.7	8	21.1	0.48
Supplementation use		31	91.2	34	89.5	0.56
History of osteoporosis		14	41.2	19	50.0	0.45
Work experience		0	0	1	2.6	0.53
Postural hypotension		4	11.8	4	10.5	0.58
Drug use		30	88.2	31	81.6	0.43
Living status	Alone	5	14.7	4	10.5	0.22
	With husband	16	47.1	10	26.3	
	With husband and children	10	29/.4	16	42.1	
	With children	3	8.8	7	18.5	
	With others	0	0	1	2.6	
Underlying diseases	Hypertension	7	20.6	6	15.8	0.24
	High blood fat	0	0	3	7.9	
	Others	8	23.5	11	28.9	
	All	17	50	14	36.9	
	None	2	5.9	4	10.5	
Level of education	Illiterate	18	52.9	21	55.3	0.84
	Primary school	15	44.2	16	42.1	
	Middle school	0	0	1	2.6	
	Diploma	1	2.9	0	0	
BMI status	Thin (<18.5)	3	8.8	2	5.3	0.56
	Normal (18.5- 24.9)	7	20.6	9	23.7	
	Overweight (25-29.9)	10	29.4	8	25	
	Obese (≥30)	14	41.2	19	50	

Note. BMI: Body mass index.

Table 3. Mean Score of Fear of Falling in Both Groups at Different Times

Time	Experimental Group	Control Group	Difference	*P* Value[a]	*P* Value[b]
	Mean ± SD	Mean ± SD			
Before the balance training	30.9 ± 11.1	27.9 ± 10.1	3.04 ± 2.5	0.23	-
One month after the balance training	23 ±7.9	27.5 ± 10.2	4.5 ± 2.1	-	0.005
Three months after the balance training	20.3 ± 6.4	28.7 ± 10.2	8.3 ± 2.02	-	<0.001
P value[c]	<0.001	0.64			
Time	871.301*	0.000**			
Group	573.047*	0.075**			
Time * group	1162.107*	0.000**			

Note. SD: Standard deviation; ANCOVA: Analysis of covariance.
[a] Independent samples *t* test; [b] ANCOVA test; [c] Repeated measures analysis.
* Mean square; ** *P* value, Repeated measures analysis.

impairment, medication use, depression, urinary incontinence, dizziness, fear of falling, visual impairment, and a history of previous falls. Moreover, the most important external factors related to homes are the risk of slipping, lack of railings or handles, worn furniture, low light, and the like, many of which are preventable (17,18).

Fear of falling is a constant concern about falling, which may eventually limit the activities of daily living and reduce a person's self-confidence in balance ability, and ultimately lead to muscle weakness and inactivity and reduced quality of life in the elderly (19,20).

This research investigated the effectiveness of a balance training course on the efficacy of fear of falling in elderly women. The results indicated the positive effect of balance training on the efficacy of fear of falling and falling frequency in the experimental group followed by a training program course attended by a physical education expert and providing education in this area. The mean score of fear of falling in the experimental group was significantly lower 1 month and 3 months after the intervention compared to the control group, and a statistically significant decrease was found in the number of falling (falls) in the intervention group. The results of this study, along with those of other studies confirm the importance of physical activities in improving balance and reducing fear of falling. In their study, Nitz and Josephson et al evaluated the impact of a strategic balance plan on increasing balance and mobility performance among the elderly living in nursing homes and reported improved balance and mobility among the elderly and a decrease in the number of falls (21). Likewise, Azadi et al found that combined intervention (staff and elderly education and environmental reform and exercise program) was effective in reducing the frequency of falls and the severity of fear of falling in the elderly living in a nursing home (22). Irez et al examined the effect of a 12-week Pilates training on elderly women. The results showed the significant effect of this training on preventing falls, increasing muscle strength, dynamic balance, and reaction time, reducing depression, and improving the quality of life in the elderly (23). Additionally, the results of a study by Aradmehr et al on the static and functional balance in elderly men using balance and Pilates training represented that static balance was significantly different in both Pilates and balance training groups compared to the control group, whereas the effectiveness of balance training, compared to Pilates training, was more in the functional balance of the elderly in the intervention group (24). In the present study, the mean score of fear of falling 1 month and 3 months after the balance training was significantly lower in the experimental group than in the control group. Based on the findings of Khajavi, this training intervention program had the highest impact on lower muscle strength, balance confidence, and static balance in the experimental group, respectively, while it had the lowest impact on flexibility, fear of falling, agility, and balance, respectively (16). In another study, Shin et al reported a significant association between daily activity and fear of falling in the elderly (25). According to the results of research by Bruce et al, older people with lower mobility had more fear of falling and greater motor restriction (26). The results of Khoramian revealed that balance training, compared with resistance training, had a significant impact only on the reaction time and the static balance of the participating elderly, and no significant change was observed in the fear of falling in any of the training groups (27).

In this study, the frequency of falling (fall) one year after the balance training was significantly lower in the experimental group than in the control group. The results of the study of Najafi and Parsa on the impact of a multidimensional intervention program on the number of falls in nursing home residents demonstrated a decrease in the number of falls (28). Salminen also showed that despite the effect of exercise on increasing muscle strength, physical training alone does not reduce the risk of falling, and other interventions are also needed in this regard (29). Moreover, the results of this study are not in line with the findings of Borhaninejad et al (30). Research methodology can be mentioned as the explanation for such a discrepancy. In studies performed by Khoramian (27) and Salminen et al(29), the performed intervention was only a type of mere exercise training, and there was no educational intervention. Although fear of falling in the elderly is a psychological and mental element and

its etiology is multifactorial, a multifaceted approach to reduce this fear of falling such as concurrent training intervention, fall prevention training, and psychological interventions can be more effective than exercise intervention alone. In the present study, the intervention group, in addition to participating in physical exercises, received fall prevention training content. Additionally, the study of Borhaninejad (30) was a correlational study conducted based on a cross-sectional design, and there was no intervention in this study.

The limitations of this study included a self-report of fear of falling in the elderly and an underreporting of information resulting from damage to social identity and credibility and the physical efficacy of falling in the elderly. This error was attempted to be partially controlled by gaining the trust of the elderly in the care process.

Conclusion

Based on the results of this research, designing educational interventions alongside balance training sessions can reduce the fear of falling and consequently the experience of falling in the elderly. Therefore, educational, cognitive, and behavioral interventions, along with balance training for the elderly enhance the quality of life in this group of individuals and prevent falls and subsequent consequences that should be addressed by health policymakers, planners, and educators.

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Authors' Contribution

RS and HA contributed to the design of the work. NA and MM collected the intervention data. AH analyzed the data, and FB interpreted the analyzed data. RS, HA, and NA prepared the initial draft of the manuscript, and FB, AH, and MM revised it critically for important intellectual contents. All authors read and approved the final version of the manuscript. In addition, all authors agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are investigated and resolved appropriately.

Conflict of Interests

The author declared that they have no competing interests.

Ethical Permissions

The study was approved by the Ethics Committee of Isfahan University of Medical Sciences with proprietary ID, IR.MUI.REC.1396.1.152. The women were aware that participation in the study was voluntary, their confidentiality would be preserved, and none of the participants would be recognized in any publications arising from the study. Informed written consent was obtained from all study participants before project initiation.

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