




## Original Article

# Comparative Study of Balance Exercises (Frenkel) and Aerobic Exercises (Walking) on Improving Balance in the Elderly

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## ABSTRACT

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**Introduction:** Balance in the elderly is one of the important issues, and imbalance can create irreparable problems for the elderly. The aim of this study was to investigate the effect of Frenkel balance exercise and aerobic exercise (walking) on improving the balance of elderly patients in Kerman province in 2016-2017.

**Methods:** We used a randomized block design, with 4 participants in each block; 48 elderly men and women living in the nursing homes of Kerman province were randomly assigned to two groups, balance (Frenkel) exercises and aerobic exercises (walking). The two groups performed Frenkel exercises and aerobic exercises (walking) for three 10- to 15-min sessions a week for five weeks. The balance time using the Sharpened Romberg test was recorded to measure static balance and the Get Up and Go test used to measure dynamic balance before and after the exercise program. To describe the variables studied, central tendency indicators and dispersion were used. Paired t-test was used to compare the time of balance before and after intervention and independent t-test to compare changes in balance time between two groups.

**Results:** The mean static balance (with Sharpend Römberg test) was increased from 3.16 s to 6.01 s in Frenkel exercise, and from 3.33 s to 4.95 s in aerobic training group, indicating an improvement in the static balance after intervention. The mean time of dynamic balance (in the Get Up and Go test) during Frenkel exercise reduced from 17.07 s to 12.03 s, and during aerobic training from 17.08 s to 10.9 seconds, indicating an improvement in dynamic balance ( $p < 0.01$ ). However, there was no significant difference in the mean changes in the duration of dynamic and static balance before and after intervention in the two groups.

**Conclusion:** Both Frenkel exercise and walking equally improve static and dynamic balance in the elderly in different settings.

**Keywords:** Balance, Aerobic, Exercise, Walking, Elderly Balance

## Introduction

Preventing falls and maintaining the balance in the elderly and reducing its serious risks is one of

the most important issues in many countries (1). In addition, the risks of falls due to poor balance are

high and the resulting adverse effects are often irreparable. Considering that imbalance is one of the main factors for falls among the elderly in the previous research, the balance phenomenon among this age group has drawn the special attention of the researchers (2).

Although today, with the use of drug therapies, the physical and emotional frustration of aging can be partly remedied, it seems that more reliable solutions are needed to cope with this big and growing problem in human communities. In this regard, many experts of medical and sports sciences believe that the selection of an active lifestyle in which regular physical activity has a special place is one of the important solutions that can resolve the bulk of physical and mental problems of the elderly as a very suitable substitute (3).

There is some evidence that exercise is effective in improving balance in the elderly. In one study, the effect of 8 weeks of aerobic exercise on static and dynamic balance in physically inactive healthy elderly men in the nursing home of Qazvin was evaluated, and it was concluded that regular aerobic exercise improved dynamic balance in the elderly (4). In another clinical trial, the effect of balance exercises on balance in Tehran nursing homes was investigated, and the results showed that balance exercises could improve muscle strength and balance (5).

In another study, the effects of eight-week Frenkel exercises on the coordination and balance of the elderly men were examined and the results showed that Frenkel exercise program was effective in improving the coordination and balance of the elderly men. Based on that study, it was concluded that Frenkel exercises appeared to be a useful exercise technique to improve coordination and balance, and reduce the risk of falls and the cost of associated treatment (6). In a study by Marcus et al., the effect of aerobic and resistance training on balance was studied, and the results of the study showed that both types of exercises improve balance (7). In another study, the effect of a course of aerobic and balance exercises on the balance of elderly women was assessed demonstrating the significant effect of aerobic and balance exercise program on the improvement of the balance of elderly women (8). In another study, the effect of aerobic, resistance and balance exercises on adults with cognitive impairment (mild to moderate) was studied, which concluded a combination of exercise program for aerobic, resistance, and balance is beneficial for people with cognitive problems (9). While Sauvage et al. showed a statistically insignificant increase by 5 to 10 percent in the study of the effect of strength and aerobic exercises on improving the balance and walking in elderly people during 12 weeks (10). In a study of the effect of balance exercises and walking in physically disabled elderly, Shimada et al. concluded that balance

exercises led to improvement in static balance and walking in these elderly people (11). In studies on balance, Frenkel balance exercises designed specifically to improve balance have been less studied and quantitative studies carried out have suggested these exercises to be effective on static balance.

On the other hand, aerobic exercises have been considered effective exercises on dynamic balance while the effectiveness of this exercise on static balance has been less studied. Therefore, the present study aimed to comparatively investigate the effect of these two types of exercises (Frenkel and aerobic) on the static and dynamic balance.

## Methods

### *Study design and participants*

In this randomized controlled trial, 48 elderly people living in the nursing homes of Kerman province (rehabilitation day care centers, under the supervision of the Welfare Organization) were enrolled from four centers (2 centers for women and 2 centers for men). Equal numbers of women and men were included to prevent gender bias.

Participants were randomly assigned to two groups of balance exercises (Frenkel) and aerobic exercises (walking). Before and after exercises, the static and dynamic balance of the elderly was measured and the data recorded.

To prevent the bias of the climate, a center for women and a center for men were selected from Kerman (provincial capital) and a feminine center and a masculine center from Bam. The inclusion criteria was age 60 years and old, general physical health such that the elderly has the ability to exercise for 30 minutes with two rest periods of 5 minutes confirmed by a physician, and ability to communicate with the researcher. Exclusion criteria, on the other hand, was refusal to participate absence in more than 2 sessions (in case of absence in more than two sessions, an opportunity was offered to the participant so that the extra exercises were performed one day after the completion of the 15 sessions by people absent in two sessions, and therefore they would not be excluded from the research); observation of general physical inactivity during exercise (vision and hearing impairment, musculoskeletal and neurological disorders, and acute and chronic diseases that did not allow the person to perform exercises). Two people in the Frenkel balance exercise group and 2 in the aerobic exercise group could not able to complete the study and were excluded from the final analysis. Finally 48 people completed the study.

### *Sample size and sampling*

Considering the mean difference of 1.73 and standard deviation of 1, the first type error of 0.05 and the second type error of 20%, and the mean difference of 0.8, the sample size was determined

40 pairs. Considering the likelihood of non-response, 48 pairs were included in the study.

After obtaining informed consent, the national IDs of eligible people in four nursing homes were recorded in a computer and a number was assigned to each person. 12 men and 12 women were selected from each of 4 nursing homes.

To assign exercises, (Frenkel F and Walking W) four-mode variable blocks were used, in which 6 compositions of four modes were first selected randomly without substitution, and the order of assignment of exercises was determined as follows: Assignment of exercise in the four centers was guided in a main center. The lottery was completely confidential.

(1): FFWW, (2): WFWF, (3): FWWF, (4): WFWF, (5): FFWW, (6): WFWF.

In the next stage, 12 blocks of four were randomly selected and their composition was written successively. Twelve people participated in exercises from each of the nursing homes, 3 blocks of 4 were selected randomly. To do this, six modes were first written on six pieces of paper placed in a container, and at each center, one of the six pieces was taken out from the container three times randomly and the composition written on it was written down, and again, the pieces was placed inside the container. Then, each letter written down was successively assigned to the numbers randomly assigned to each national ID by the computer.

#### Measure

To measure the dynamic balance, the Get Up and Go test was performed in a closed and quiet room. To do this, the subject is placed on a standard seat (with a height of 46 cm and a hand with a height of 63 cm), and after action command from the examiner, gets up and travels a 3-meter track with his/her normal movement, and then turns around, returns to the chair, and sits on the chair (12). To test the static balance, the Sharpened Romberg static balance test (with open eyes) was performed, in which the subjects stand with the naked legs so that one of the legs (dominant leg) ahead of the other leg and the arms transversely placed on the chest. The length of time during which the person is able to keep his eyes open is considered in his score. This time is calculated by stopwatch.

Both of these tests are carried out three times consecutively and the mean time of balance in the three trials is considered the duration of balance.

#### Interventions

One group performed three 10- to 15-min sessions of Frenkel exercises per week for five weeks and the other group three 10- to 15-min sessions of walking per week for five weeks under the supervision of trained therapists. In the first week, the duration of each session was decided to be 10 minutes and then increased by 5 minutes per week so that the duration of the last session

reached 30 minutes. After 10 minutes of practice in each session, the participants were allowed 5 minute to rest. Before exercises, the exercise was demonstrated by the research team for therapists (the nurse and sports instructor of the centers) to ensure the correctness of the exercises performed by the participants.

Frenkel balance exercises is a set of exercises that are performed to improve the balance in four positions supine, sleeping, sitting, and standing, as follows:

#### A: Exercises in supine position

A person sleeps in the supine position, while the heels are on the ground, bends one of the legs from the thigh and knees (flexion and extension), and pulls off a flat line with his heel on the ground. The person does the same with the other leg. The person sleeps in the supine position and, while the heels are open on the ground and knees, moves one of the legs from the thigh to the left and right (abduction and adduction) and heels on the ground. The person does the same with the other leg.

The person sleeps in the supine position and, while the heels are on the ground, bends both legs at the same time from the thigh and knee (flexion and extension), and pulling off a flat line with heels on the ground. The person sleeps in the supine position, while the heels are on the ground, both turning away and then approaching each other (abduction and adduction of both legs at the same time).

The person lies in the supine position and, while the heels are on the ground, bends one of the legs from the thigh and knees and simultaneously straightens the front of the bicycle (the bike moves) the person repeats the exercise alternately.

The person is sleeping in a supine position, then puts one of his/her heels on the knee and lowers down on his legs. The person does the same with the other leg. The person lying in the supine position, while the heels are not on the ground, flexes the leg from the thigh and knees (flexion and extension). The person does the same with the other leg.

The person is lying in a supine position and, while the heels are on the ground, bends one of the legs from the hip and knee (flexion and extension) and make the other leg far and close (abduction and adduction).

#### B: Exercise in Sleeping Position

The person is placed in a flat state, flexes the upper leg from the knee (flexion and extension), and then does the same with the other leg.

The person sleeping on his/her side flexes the upper leg (flexion and extension) and then does the same with the other leg.

#### C: Exercises in sitting position

A person sitting on a chair raises his leg, and then by putting his/her feet on the tracks of the feet on the ground, walks on the ground.

The person sitting on the chair places the bottom of foot on the floor, and then pulls one foot on the straight line forward and backward.

As the person places his knees next to each other, he gets up from the chair and sits again.

T: Exercises in standing position

Axial turning (The person standing without moving the legs turns as far as possible to the right and left so that the bottom of the foot does not pull off the ground).

Step turning (the person standing without a turning in the body spine, turns the legs to the right and left, as the heel will not be removed from the ground).

While the distance between the legs is 14 inches, the person travels on two parallel lines.

The person goes by the side. The person walks by putting his feet on the tracks of the feet on the ground. The person puts his foot on the stairs, then places the other foot next to the first foot.

During the study, all health care was the same for both groups. All exercises were performed in the morning on the same days in all nursing homes.

#### Ethical considerations

The protocol of this study was approved at the Ethics Committee of Shahid Sadoughi University of Medical Sciences in Yazd (approval code: 1396.55IR.SSU.SPH.REC). In addition, at the beginning of the study, written consent to participate in the study was obtained from the participants. Diseases that caused imbalance in one person were referred to a specialist for treatment. Information about diseases and other information was confidential and in the beginning of the research, it was stipulated that follow up with the consent of the elderly should be made.

The research team also committed to stop the work in the event of complications during the study, registers the cases, and treats them if necessary. In addition, individual physical and motivational differences in subjects were taken into account, which sometimes caused one person's

performance of exercises to be postponed to the next session, and at the end of the exercise, an extra session was held for those who could not perform all sessions of exercises.

#### Data analysis

To describe the variables studied, central tendency and dispersion indices were used. In the statistical analysis, the paired t-test was used to compare the duration of balance before and after each exercise, and independent t-test to compare the change in balance duration between the two groups.

#### Results

Based on the results, the average duration of static balance before Frenkel exercises was 3.16 s and after Frenkel exercise 6.01 s, while the mean duration of dynamic balance (in the Get Up and Go test) before Frenkel exercise was 17.07 s and after Frenkel exercise 12.03 s, indicating a significant effect of Frenkel exercises on the improvement of both static balance and dynamic balance in the elderly. Similarly, the mean duration of static balance before aerobic exercise was 3.03 s and after aerobic training 4.95 s, and the mean duration of dynamic balance before aerobic exercise was 17.08 s and after aerobic exercise 10.9 seconds, indicating a positive, significant effect of this type of exercises on both static and dynamic balance (Table 1).

Comparison of the changes in dynamic and static balance between two groups of Frenkel and aerobic exercises based on independent t-test showed that there was no significant difference in dynamic and static balance between the two groups. (Table 2)

**Table 1. Mean dynamic and static balance duration before and after aerobic exercise and Frenkel exercise (n = 22)**

Group	Variable		Minimum score	Maximum score	Average	Standard deviation	dependent t-test		
							t	df	p
Frenkel exercise	Static balance	after	0	14.1	3.16	3.49	-4.7	21	< 0.001
		before	0	19.2	6.01	5.38			
	Dynamic balance	after	6.24	33.1	17.07	6.71	6.05	21	< 0.001
		before	6	20.1	12.3	4.22			
Aerobic exercise	Static balance	after	0	15.1	3.03	4.4	-	19	< 0.001
		before	0	17.1	4.95	4.53			
	Dynamic balance	after	8.2	36.6	17.08	7.54	5.2	19	< 0.001
		before	6.1	19.1	10.9	3.43			



**Table 2. Comparison of dynamic and static balance time variations in aerobic exercise and Frenkel exercise (n=22)**

Variable	Group	Average changes	S	Independent t-test		
				t	df	p
Static balance	Frenkel exercise	-4.77	3.69	1.005	40	0.32
	Aerobic exercise	-6.18	5.31			
Dynamic balance	Frenkel exercise	2.85	2.83	1.39	40	0.17
	Aerobic exercise	1.91	1.02			

## Discussion

The aim of this study was to compare the effects of balance exercises (Frenkel) and aerobic exercises (walking) on balance in the institutionalized elderly of Kerman province.

The results showed that both types of balance (static and dynamic) significantly improved in both groups, which is consistent with the results of Mehdizadeh Mollabashi (5), Ghadiri et al. and Marques et al. study and some other findings (6-9).

Both types of exercises, Frenkel balance and aerobic walking exercise, improve static and dynamic balance with no significant difference between the types of exercise, which is consistent with the results of the research by Shimada et al. (11) on the special effect of balance exercises and walking in 34 disabled elderly in the nursing home, The current body of literature provides evidence of the general benefits of exercise exercises for the elderly. Physical activity and exercises have a positive impact on improving balance due to the importance of performing physical activity in improving the ability to work and thereby increasing or maintaining individual ability to sustain activity (13).

## Conclusion

Balance (Frenkel) exercises and aerobic exercises (walking) significantly improve the static and dynamic balance of elderly people living in nursing home with no significant difference between static and dynamic balance improvement. It can be concluded that a regular walking program of three days a week and half an hour a day in nursing homes can improve balance in the elderly.

In addition, under the specialized supervision of an expert, Frenkel balance exercise can be used to improve static and dynamic balance for the elderly people who do not have adequate space in nursing homes to walk or who are disable to walk.

## Study limitations

Although this study was conducted exclusively on elderly women over 60 years of age, the results may also be applicable to sexually counterparts. Furthermore, exercises were carried out only in the morning from 9:00 to 10:00 and it was unclear whether exercises could be applied in afternoon or night considering geriatric conditions as delirium prevalent in institutionalized patients at night.

The subjects were supposedly healthier than general population of institutionalized older adults and basically these exercises may not be applicable to more complicated subjects such as bedridden subjects.

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## Conflict of interest

The authors of this article declare no conflict of interest.

## Authors' contributions

All authors contributed to the design and implementation of the study, analysis and interpretation of data, and to draft or modify the article. Data collection was carried out by Athareh Amiri. All authors have read and approved the final version of the article.

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