

A Study on The Effects of Aerobic and Foam Roller Exercise Programs on Body Balance in Senior Women

The purpose of this study was conducted with senior women of ages 65 in Community Center to identify effective exercise methods for preventing falling accidents by enhancing balancing skills through aerobic and foam roller exercise programs. There were 24 subjects : 11 aerobics group and 13 foam roller group. 30 minute exercise programs were conducted against both groups 12 times 6 weeks. Various tests, including Time up and go test , Forward reach test, One-leg standing with eyes open/closed and Y-Balance were conducted prior to commencing the exercise program. Wilcoxon's Signed-ranks test was executed to analyze the changes in balance of the aerobic and foam roller exercise group prior to and after the experiment, and Mann-Whitney test was executed to compare the difference between the two groups. The Y-Balance(post. medial) show statistically significant differences in the amount of change before and after exercise between the two groups, except for Timed up and go test, Forward reach test, Y-Balance(ant.), and Y-Balance(post. lateral), which did not showed statistically significant difference ($p < 0.05$). Foam roller exercises are effective methods to enhance the balancing skills in senior women to prevent falling accidents.

Key words: *Elder, Aerobic exercise, Form roller exercise, Balance*

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INTRODUCTION

In fact, the Republic of Korea is now entering the era of super-aged society with increase in the proportion of the population over 65 from 13.1% in 2015 to 19.59% by 2020. In other words, nearly one-fifth of total population is the elderly people¹⁾. As a result, the nation's population has been aging fast due to rapid increase in average life expectancy. Even though senior-friendly policies and cultural elements have substantially improved accordingly, they have still been unable to keep pace with such trends.

Falling means the touching of a body part to the ground after losing body balance during daily routine. At least 33% of the elderly aged 65 or older experiences such accident every year, and more than half undergoes it more than twice²⁾. It's been said that the recurring probability is 2-3

times higher among the aged who experience falling before²⁾. In addition, those who are physically weak because of trauma and fraction from the accident tend to suffer from severe complications, and additional dysfunctions can discourage them from rehabbing and even cause another complication which could lead them to death³⁾. Hence, falling is now perceived as a critical problem to the elderly people³⁾.

The factors causing falling are divided into internal and external factors⁴⁾. The former refers to physical elements such as age, gender, degree of disability and current illnesses while the latter means external factors including season, time and place of accident⁵⁾. Among them, it is physical factors what matter most⁴⁾. In general, compared to general adults, reduced stamina and drop in physical functions are found in the elderly. Woollacott (1990) examined the relationship between

falling and balance ability. In his study, if we fall in normal conditions, muscle contraction usually occurs according to normal muscle contraction sequence to restore body balance. Among the elderly, however, muscle contraction didn't happen in regular order.

Therefore, it's been said that decrease in muscle and sense of balance caused by physical aging can decrease gait ability and cause difficulties in daily life and falling⁷. In the aged people, furthermore, gait speed decreases with a poor sense of balance while strike width increases, and step length decreases, increasing the risk of falling⁸. The seniors who experience such accident tend to reduce their movements and activities due to fear and lack of confidence and suffer from health problems⁹. In fact, the previous studies reveal that the aged who experienced falling before are lower than the elderly who didn't in terms of lower-extremity muscle strength and dynamic reaction⁹. The most important thing in fall injury treatment is prevention. As a result, the necessity and importance of fall prevention programs have emerged.

Therefore, this study selected two exercises among fall prevention exercise programs and compared their exercise effects. The two exercises are aerobic and foam roller exercises which are most common in fall prevention exercise programs. Aerobic exercise is very efficient in drawing interest and attention from the aged by adding rhythmic exercise to music¹⁰. Since many body parts are used with a large movement range, this exercise is able to improve flexibility and strength balance at the same time¹⁰. In contrast, foam roller exercise reinforces lower-extremity muscle strength which is essential for walking, and seniors are able to learn the movements in a relatively easy and fast manner. It would be used as a tool in physical therapy and is effective in improving body balance. This exercise also relaxes fascia in soft tissues and increases a range of motion¹¹.

Many domestic and foreign studies on falling have primarily described the effects of exercise methods for the prevention of the accident. However, it's been difficult to find a study which compared the two exercises. Therefore, this study intended to investigate the effects of aerobic and foam roller exercises on body balance against senior citizens and provide effective and reliable clinical data which would be useful in preparing a balance-enhancing fall prevention exercise protocol.

METHODS

Subjects

This study was performed against 30 elderly women aged 65 or older who voluntarily participated in the fall prevention exercise program launched by the welfare center for the elderly in "K"-gu, Busan. Exempt for those who withdrew from the program for personal reasons, a total of 24 (11: aerobic exercise group, 13: foam roller exercise group) participants were examined. The purpose, method, and procedure of this study, as well as information on direct/indirect discomfort or possible danger was explained to the subjects before implementing this study and "informed consent" which stated the voluntary participation of the subjects was obtained. The participants were selected in accordance with the following criteria: i) those aged 65 or older, who regularly visit the welfare center for the elderly in "K"-gu, ii) health elderly with no special disease(musculoskeletal disorders(osteoarthritis), nervous system diseases etc.) according to a pre-survey and questionnaire, iii) those who haven't had any surgical operation for the past six months, iv) those who are capable of communicating with others and following the instructions to perform the exercise program. Exclusion criteria include elderly with other clinical matters such as drugs or condition that might deter neurological instability.

Experimental procedures

In this study, aerobic and foam roller exercises were given to the elderly for the purposes of fall prevention and balance improvement. The foam roller exercise implemented a program that comprised of procedures and protocols specified in <Table 1> which was done 10 movements were repeated 5 times in 2 sets, and they were gradually increased to 8 times in 3 sets for 30 minutes. In aerobic exercise, 8 movements were performed over trot (a genre of Korean pop music recognized as the oldest form of Korean pop music) songs (e.g., Dancing Tambourine, What About My Age, Unconditional) the aged love. Specifically, tapping the floor with the tips of toes, arm extending, kicking, wall pushing, window cleaning, twist dance, PNF upper & lower-extremity patterns and standing jumping were repeated for 30 minutes. Elder individuals would need more careful exercise and measure than others to achieve their full control potential.

Table 1. Foam roller exercise program

Stage	Position	Program procedure	Time
Warm up	Standing	Breathing exercise, Range of motion exercise (Upper and Lower extremities, Trunk)	5minutes
		Stretching exercise of Thoracic muscles Stretching exercise of Latissimus dorsi muscles Stretching exercise of Neck muscles Alternate upper and lower extremities raise.	
Main Exercise	Sitting	Lifting both arms straight.	20minutes
	Kneeling	Lifting both arms diagonally abduction.	
	Supine	Perform a bridging position The straight both leg raise. Bicycle exercise Shaking anterior–posterior and left–right with a ball in both hand. Puts hands up with a ball in both hand.	
Cool down		Breathing exercise, Range of motion exercise(Upper and Lower extremities, Trunk)	5minutes

Experimental tools and Methods

Timed up and go test

The timed up and go test(TUG) is a simple test designed to quickly measure agility, speed, quickness and dynamic balance. It was used to measure the time taken for a person to get up from his chair, walk up 3 meters and return back to his chair. It was conducted twice, and the average was calculated.

Forward reach test

The forward reach test(FRT) is a method designed to measure the maximum distance participants can reach forward in balance. They were forced to extend their arms to maximum length, and the results were recorded in centimeters. The test was repeated twice, and the average was calculated.

One–leg standing with eyes open

The one–leg standing with eyes open test is designed to assess static balance. It measures how long a person can stand on one leg without any help from the outside. In this study, participants were asked to stand on one leg on the wooden floor with both arms stretched out to stay balanced. When the other leg hit the floor, a stop

watch was stopped. The test was performed twice, and the average was calculated.

One–leg standing with eyes closed

The one–leg standing with eyes closed test is a static balance test designed to measure how long a person can keep his/her balance. It is very useful as a general balance measurement test which reflects age and health conditions. For measurement, a participant was forced to stay balanced after standing on one leg with eyes closed. When his/her leg moved or hit the ground after opening his/her eyes, a stop watch was stopped. The test was performed twice, and the average was calculated.

Y–balance test

The Y–balance test is a method designed to improve the repeatability of the star excursion balance test which is commonly used to measure lower–extremity muscle strength, flexibility and proprioception. It is a dynamic balance test with high inter– and intra–rater reliability 12). Using a 1.5–inch tape, posteromedial and posterolateral direction lines were marked at 135° spots on both sides based on the anterior direction line. The distance a participant reached from the mid line was measured twice in centimeters.

Data analysis

The data collected in the present study was analyzed by using SPSS 22.0 for windows program (IBM Corp, USA), with the significant level α for statistical verification set to be 0.05. Descriptive statistics were computed for the general characteristics of the research subjects and non-parameter test was executed for the regularity in the measurement variables after having confirmed through Shapiro-Wilk analysis. Wilcoxon's Signed-ranks test was executed to analyze the changes in balance of the aerobic and foam roller exercise group prior to and after the

experiment, and Mann-Whitney test was executed to compare the difference between the two groups.

RESULTS

Subject's general characteristics

General characteristics of the subjects are listed in Table 2. We evaluate whether the means for two independent groups are associated with the equal of variances using Levene's test.

Table 2. Characteristics of subjects

(n=24)

General characteristic	Aerobic exercise group(n=11)	foam Roller exercise group(n=13)	Total(n=24)
Age(yr)	75.45±3.83	72.62±4.89	74±0.79
Height(cm)	153.55±6.67	156.02±6.67	154.15±1.08
Weight(kg)	61.30±4.63	62.40±7.39	61.43±1.12

The difference of balance before and after exercise in aerobic exercise group

The difference of balance before and after exercise in aerobic exercise group are listed in Table 3. The Timed up and go test, Forward reach test, Y-

Balance(ant.), and Y-Balance(post, medial) showed statistically significant differences before and after exercise, but the one-leg standing with eyes open/closed posture and Y-Balance(post, lateral) showed no significant results in the aerobic exercise group ($p < 0.05$) (Table 3).

Table 3. Comparison balance within aerobic exercise group

(n=24)

Variables	Pre-exercise	Post-exercise	t	p
Timed up and go test(sec)	8.19±2.46	6.93±1.10	-2.31	0.02*
Forward reach test(cm)	73.48±6.23	81.45±5.04	-2.93	0.00*
One leg standing(eyes open)(sec)	22.43±20.82	23.81±20.78	-1.33	0.18
One leg standing(eyes closed)(sec)	4.99±2.51	5.97±2.61	-0.89	0.37
Y-Balance(ant.)(cm)	87.04±12.83	94.04±13.07	-2.56	0.01*
Y-Balance(post, medial)(cm)	99.54±17.15	105.72±13.93	-5.8	0.00*
Y-Balance(post, lateral)(cm)	98.31±8.55	103.68±10.29	-2.94	0.57

* $p < 0.05$

The difference of balance before and after exercise in foam roller exercise group

The difference of balance before and after exercise in foam roller exercise group are listed in Table 4. All variables of balance measure includ-

ing the Timed up and go test, Forward reach test, one-leg standing with eyes open/closed posture, Y-Balance(ant.), Y-Balance(post. medial), and Y-Balance(post. lateral) showed statistically significant differences before and after exercise in the foam roller exercise group ($p < 0.05$) (Table 4).

Table 4. Comparison balance within foam roller exercise group (n=24)

Variables	Pre-exercise	Post-exercise	t	p
Timed up and go test(sec)	7.94±1.33	7.37±1.13	-2.69	0.00*
Forward reach test(cm)	78.91±9.00	83.66±7.97	-2.97	0.00*
One leg standing(eyes open)(sec)	22.74±19.09	30.90±24.23	-2.83	0.00*
One leg standing(eyes closed)(sec)	3.66±1.37	5.83±1.77	-2.83	0.01*
Y-Balance(ant.)(cm)	89.50±13.10	101.65±15.24	-3.18	0.00*
Y-Balance(post. medial)(cm)	101.25±15.68	106.5±16.70	-2.94	0.00*
Y-Balance(post. lateral)(cm)	96.46±15.51	106.65±14.81	-3.18	0.00*

* $p < 0.05$

The difference in the change amount of before and after the exercise between two groups

The difference in the change amount of before and after the exercise between two groups are listed in Table 5. The Y-Balance(post. medial) show

statistically significant differences in the amount of change before and after exercise between the two groups, except for Timed up and go test, Forward reach test, Y-Balance(ant.), and Y-Balance(post. lateral), which did not showed statistically significant difference ($p < 0.05$) (Table 5).

Table 5. Comparison balance difference in the amount of change before and after the exercise between two groups (n=24)

Variables	Pre-exercise	Post-exercise	t	p
Timed up and go test(sec)	-1.26±1.85	-0.57±0.60	-0.78	0.43
Forward reach test(cm)	7.97±4.48	4.75 ±3.80	-1.45	0.15
One leg standing(eyes open)(sec)	1.38±4.91	8.16±10.78	-1.68	0.09
One leg standing(eyes closed)(sec)	0.97±1.86	2.17±2.03	-1.42	0.16
Y-Balance(ant.)(cm)	7.00±6.15	12.15±5.65	-1.86	0.06
Y-Balance(post. medial)(cm)	5.36±3.64	12.15±5.65	-2.38	0.02*
Y-Balance(post. lateral)(cm)	6.18±10.81	5.25±4.23	-1.42	0.15

* $p < 0.05$

DISCUSSION

As average life expectancy increases, the aging era has come earlier than expected. As a result, welfare and medicine-related projects have more important. Therefore, this study performed balance-enhancing exercise programs against the elderly people to prevent falling, one of the biggest threats to them.

In previous studies, it's been very hard to find a study which compares aerobic and foam roller exercises for the purpose of balance improvement. Based on the estimation that among the exercises which can substitute or be more effective than aerobic exercise, body alignment and foam roller exercise which reveals the improvement of muscle strength would be effective in balance improvement, this study was initiated. The aged are able to improve their quality of life by slowing down aging and decrease in flexibility, balance ability and muscle strength. Aerobic exercise can give direct help through the development and application of the customized aerobic exercise programs that seniors prefer, which meet domestic conditions. In a study by Ahn and Kim(2011), compared to a control group in which subjects participated in mat pilates, the foam roller exercise group revealed greater effects (2.90>1.87). Aerobic and foam roller exercises are very safe and easy to do so that they can be performed in a confined space. Foam roller exercise keeps a human body stable by strengthening the backbone and core muscles and helps people have a good posture. To maximize exercise effects, accurate movements should be consecutively done¹⁴. It was also insisted that the improvement of flexibility, balance ability and coordination via foam roller (pilates) would decrease fall frequency in aged women¹⁵. As such, Foam roller exercise have been used in the welfare center for the elderly as a balance to improve core stability, balance, proprioception, soft-tissue mobility and body awareness.

In a study by Park(2006), an exercise program which combined stretching rhythmic exercise was given to the elderly aged 75 or older at a local senior center 3 times a week for 13 weeks. In terms of influence on physicality and health factors for decrease in osteoarthritis pain and fall prevention, the one-leg standing test revealed significant difference between experimental and control groups. In a study by Bae(2011), to investigate the effects of fall prevention exercises on

lower-extremity muscle strength and balance among institutionalized elderly women, an exercise program which combined videos and music movements was given to them twice a week (40 minutes at a time) for 8 weeks. Then, a significant effect was found within and between the groups in one-leg standing with eyes open/closed. In this study, however, a significant result was observed in the foam roller exercise group only at the one-leg standing test. In fact, no significant result was detected between the two groups. Accordingly, it is deemed that foam roller exercise to restore alignment, instill body awareness, improve posture and flexibility, challenge neuromuscular control. Despite the aerobic exercise comprised of diverse movements, no difference was found because the greatest effect was revealed when the test was given 3 times a week (1 hour at a time) for 12 weeks according to a study¹⁸ on fall prevention exercise programs. In this study, however, there were some limitations in exercise time, period and frequency. Therefore, it appears that there would be good results if exercise time, period and frequency are increased.

In a study by Lim(2007), Korean dance-based rhythmic exercise was given to the aged 3 times a week (30-50 minutes at a time) for 12 weeks. As a result, balance improvement which refers to dynamic balance (stair ascent & descent) was found. In a study by Lee(2000), rhythmic exercise programs were applied for health improvement, and balance difference was observed between the two groups. In a study by Roh(2002), aerobic exercise was given to 19 stroke patients at home 3 times a week (35-60 minutes at a time) for 8 weeks. As a result, significant difference was detected between the two groups (6.5 seconds faster in the experimental group). In a study by Ahn and Kim(2012), in addition, aerobic exercise was given to 24 professional golfers once a week (1 hour at a time) for 8 weeks. As a result, balance improvement was found. In a study by Bae(2011), a significant effect was observed in both experimental and control groups in terms of TUG. The significant result was found between the groups as well. In this study, balance improvement was detected in Y-balance posteromedial reach (dynamic balance) only. In particular, it appears that foam roller exercise is effective in improving core & body core stability and muscle strength. It is expected that there would be further studies on foam roller exercise with improved muscle strength.

This study is conducted against elderly women only. It would be a good idea to perform further studies on the effects of balance improvement and diverse exercise programs against elderly men.

CONCLUSIONS

In this study, aerobic and foam roller exercises were given to the elderly women aged 65 or older, who visit the welfare center for the elderly in “K”-gu, Busan, twice a week (30 minutes at a time) for 6 weeks to figure out the exercise which is effective in improving balance for the purpose of fall prevention. The results found the followings: First, in the aerobic exercise group after exercise, significant effects were found in forward reach test and one-leg standing with eyes closed in terms of static balance. In terms of dynamic balance, on the contrary, significant results were observed in time up & go, Y-balance anterior and posterolateral reaches only($p < 0.05$). Second, in the foam roller exercise group after exercise, significant effects were found in forward reach test and one-leg standing with eyes open/closed in terms of static balance. In terms of dynamic balance, significant results were observed in time up & go and Y-balance test’ s all reach directions($p < 0.05$). The above results prove that even though aerobic and foam roller exercises are effective in improving body balance in elderly women, the latter revealed better results. It is hoped that diverse exercise programs are further developed and distributed.

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