MEDICAL SCIENCE MONITOR

CLINICAL RESEARCH

e-ISSN 1643-3750
© Med Sci Monit, 2014; 20: 2283-2291
DOI: 10.12659/MSM.890611

Received: 2014.03.01
Accepted: 2014.07.16
Published: 2014.11.14

Effects of a Randomized Controlled Recurrent Fall Prevention Program on Risk Factors for Falls in Frail Elderly Living at Home in Rural Communities

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 **Mi Yang Jeon**
ABCDEF 2 **HyeonCheol Jeong**
DEF 3 **Jerrold Petrofsky**
DEF 3 **Haneul Lee**
ABCDEF 4 **JongEun Yim**

1 Department of Nursing, Gyeongsang National University, Jinju, Korea
2 Department of Nursing, Sahmyook University, Seoul, Korea
3 Department of Physical Therapy, Loma Linda University, Loma Linda, CA, U.S.A.
4 Department of Physical Therapy, Sahmyook University, Seoul, Korea

Corresponding Author: Jongeun Yim, e-mail: jeyim@syu.ac.kr
Source of support: This research was supported by a Sahmyook University Research Grant

Background: Falling can lead to severe health issues in the elderly and importantly contributes to morbidity, death, immobility, hospitalization, and early entry to long-term care facilities. The aim of this study was to devise a recurrent fall prevention program for elderly women in rural areas.

Material/Methods: This study adopted an assessor-blinded, randomized, controlled trial methodology. Subjects were enrolled in a 12-week recurrent fall prevention program, which comprised strength training, balance training, and patient education. Muscle strength and endurance of the ankles and the lower extremities, static balance, dynamic balance, depression, compliance with preventive behavior related to falls, fear of falling, and fall self-efficacy at baseline and immediately after the program were assessed. Sixty-two subjects (mean age 69.2±4.3 years old) completed the program – 31 subjects in the experimental group and 31 subjects in the control group.

Results: When the results of the program in the 2 groups were compared, significant differences were found in ankle heel rise test, lower extremity heel rise test, dynamic balance, depression, compliance with fall preventative behavior, fear of falling, and fall self-efficacy ($p<0.05$), but no significant difference was found in static balance.

Conclusions: This study shows that the fall prevention program described effectively improves muscle strength and endurance, balance, and psychological aspects in elderly women with a fall history.

MeSH Keywords: **Accidental Falls • Muscle Strength • Postural Balance • Secondary Prevention**

Full-text PDF: http://www.medscimonit.com/abstract/index/idArt/890611

3476 4 3 43

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS] [Index Copernicus]

Background

Worldwide, the number of people over 60 years old is growing faster than in any other age group and is expected to grow from 688 million in 2006 to almost 2 billion by 2050 [1]. The main reason for this substantial demographic change are higher life expectances and declining birth rates [2]. This expected increase in the proportion of older adults is important from a public health perspective, as aging is generally associated with a progressive decline in physical and psychological health, increased risks of disability, dependency, and in the number of comorbidities [3–5]. This decrease in health status is primarily responsible for one of the most common and serious public health problems – falls. Thus, the prevention of falls presents a considerable public health challenge. Falls and injuries in older people are common causes of morbidity and mortality, loss of independence, and poor quality of life [6–8]. Given increases in longevity worldwide, the health burden and costs associated with falls are certain to rise [9].

The incidence of falls among older people is high; about one-third of community-dwelling elderly and as many as three-fourths of nursing home residents fall each year [6,9]. Of those who fall, 50% have recurrent falls [10,11]. Furthermore, with increasing age, the fall rate can increase to 60%. In fact, 8–10% of annual admissions to emergency departments concern fall-related trauma. In addition, falls are responsible for 56% of hospitalizations for trauma and for 6% of urgent hospitalizations in patients older than 65 years [8,12], and 5–10% of these older patients have fractures, concussions, or injuries [13,14]. About 1% of older patients that fall have a femur fracture, which has a 1-year mortality rate of 20–30% and has a substantial negative impact on functional capacity [15]. It has been reported that 17% of individuals over 65 in South Korea have experienced a fall during the previous year and that 66% fear falling [16]. In addition, it has been reported that 62% of injured patients aged over 65 and 81% of those over 85 are hospitalized due to falling [17]. The locations of fall fractures in patients older than 65 have been reported to be the femur (52.8%), the tibia (14.2%), and the radius (7.5%) [18]. Thus, a fall by an elderly individual can lead to morbidity, death, immobility, hospitalization, or early entry to long-term care [10,19]. In addition to direct physical damage, a fall can have a serious emotional effect. Elderly that have fallen may experience difficulties living an independent life due to decreased mobility caused by the fear of falling and loss of self-confidence [20]. Those that have fallen restrict their activities of daily living due to the psychological anxiety, and consequently, their functional condition deteriorate [9,21,22]. Furthermore, fall recurrence results from a shortened or an irregular stride, slow walking, and reduced static and perceived balance [6,12,20]. A study in Canada reported that 33% of elderly dwelling in a local community had experienced a fall, and that 42.4% of these had experienced more than 1 fall [23]. In South Korea, research has shown that 44.2–53.8% of the elderly who have fallen will experience more than 2 subsequent falls [24,25].

Falls by the elderly cause physical and psychological deterioration and impede the activities of daily living by restricting social activities, which lead to fall recurrence. Especially, the elderly who have fallen have psychological problems such as fear of falling, loss of self-confidence, and depression due to the previous experience of falling [26–28]. Therefore, it is necessary to provide not only an exercise program to increase their muscle strength and balance, but also an educational program to reduce the fear of falling and depression and improve their self-confidence for preventing fall recurrence. Furthermore, due to their insufficient social and economic environments, elderly living at home in rural communities have less access to treatment and education for their recovery of physical and psychological impairments caused by falling than those who live in urban communities or care facilities. However, there is little research available with which to develop recurrent fall prevention programs combining exercise and education in the elderly, especially those at home in rural communities. Accordingly, the aim this study was to investigate the effects of a recurrent fall prevention program of combined physical exercise and psychological education in frail elderly living at home in rural communities.

Material and Methods

Subjects

Of the 83 potential elderly female participants who were informed of the goals and overall protocol of this study and who agreed to participate, 70 elderly women that met the selection criteria were included, and were assigned randomly to either the experimental group (n=35) or the control group (n=35). They were recruited by word of mouth. The subjects were assigned to the 2 groups by having each of the subjects take out 1 card from a box containing 2 types of cards representing the 2 groups. Of the subjects in the experimental group, 4 who did not participate in the program for more than 80% of the scheduled time were excluded. Of those in the control group, 4 who did not participate in the post-test were excluded (Figure 1). The inclusion criteria applied were: age of over 65 years; residence in rural areas; at least 3 falls during the previous year; the ability to exercise; and no mental health issues, including no diagnosis of dementia or cognitive impairment, and no psychoactive medication. Of the subjects in the experimental group, 4 who did not participate in the program for more than 80% of the scheduled time were excluded. Of those in the control group, 4 who did not participate in the post-test were excluded. Thus, the size of the study cohort was 62 – experimental group (n=31) and control group

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
[ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica]
[Chemical Abstracts/CAS] [Index Copernicus]

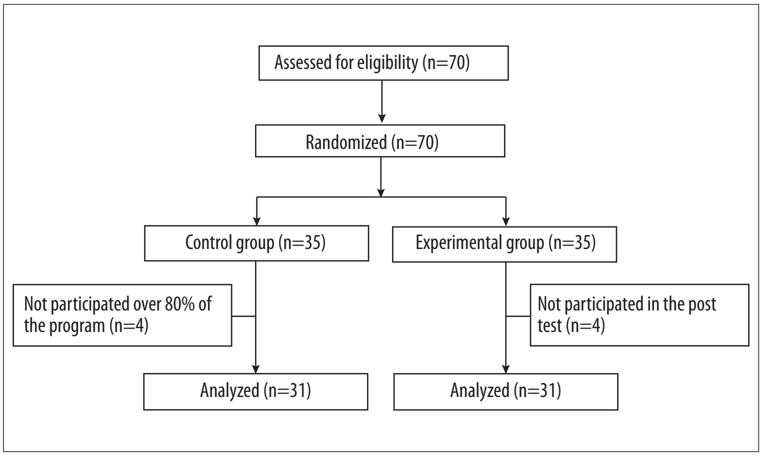

Figure 1. Flow of participants through the study.

Table 1. General characteristics of subjects.

		Experimental group Mean ±SD	Control group Mean ±SD	*p**
Age (years)		69.32±4.46	69.16±4.05	.88
Weight (kg)		56.83±8.99	55.65±9.77	.61
Height (cm)		152.48±6.54	151.12±6.00	.38
Body fat percentage (%)		29.30±5.23	31.44±4.56	.08
Blood pressure (mmHg)	Systolic pressure	139.62±18.95	142.09±21.67	.62
	Diastolic pressure	85.68±10.56	86.54±11.48	.75
Blood glucose (mg/dL)		121.46±65.05	114.88±27.87	.59

* Independent t-test, p-values for the null hypothesis that there is a no difference between the groups

(n=31). The general characteristics of the subjects are shown in Table 1. There was no significant difference in age, height, weight, or body mass index (BMI) between the 2 groups. All protocols and procedures were approved by the Institutional Review Board of Sahmyook University and all subjects signed a statement of informed consent.

Measurements

Heel rise test

We assessed the muscle strength and endurance of the ankles and the lower extremities by measuring the time taken to raise and lower the heels 10 times while sitting on a chair and standing holding a chair. Lower values indicate greater muscle strength and endurance [29,30].

Balance

Balance refers to ability to maintain the body in a state of equilibrium, and is classified as static or dynamic. The former is defined as the ability to maintain equilibrium in 1 position without movement, whereas the latter is defined as the ability to maintain certain positions while in motion. In this study, static balance was assessed by using the single-leg stance [31,32], and dynamic balance was assessed using the time achieved in the 3 meter Time Up and Go (TUG) test [33]. Accordingly, high static balance times and low dynamic balance times indicate good balance.

Depression

The Short form of the Geriatric Depression Scale (SGDS)-Korean Version was used to measure the level of depression. The SGDS-Korean scale was translated by Song (1991) from the standardized Geriatric Depression Scale: Short form, which was originally developed by Sheikh and Yesavage (cited in Song, 1991), was used to measure depression. The SGDS-Korean Version is a 15-item questionnaire with a dichotomous yes/no scale. Positive items that elicit positive or negative responses are scored as '0' or '1', respectively, and negative items that elicit positive or negative responses are scored as '1' or '0', respectively. A

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
[ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica]
[Chemical Abstracts/CAS] [Index Copernicus]

higher score indicates more severe depression. Cronbach's α for the instrument was reported to be 0.89 when first introduced, and in the present study Cronbach's α was 0.86.

Compliance with fall preventative behavior

Fall preventative behavior was scored using the instrument developed by Gu et al. [34]. This is a 14-item questionnaire, which addresses the safe wearing of shoes and socks, safe walking and daily life habits, limited consumption of alcohol, object placement, and taking medication. All items are scaled dichotomously based on responses as yes (2 points) or no (1 point). Scores range from a minimum of 14 to a maximum of 28, and a higher score indicates greater compliance. Park et al. have reported a Cronbach's α for this instrument of 0.78. In the present study, Cronbach's α was 0.79.

Fear of falling

Fear of falling was assessed using the 4-point Likert scale. Subjects' responses to the question "Do you fear falling?" were; 'Not at all' (1 point), 'A little' (2 points), 'Fairly' (3 points), and 'Very much' (4 points).

Fall self-efficacy

Fall self-efficacy was measured using the Fall Efficacy Scale (FES) adapted by Chang (2005). The FES was originally developed by Tinetti, Richman, and Powell (1990) (cited in Chang, 2005). The instrument contains 10 items that address fear of falling during activities of daily living, such as taking a bath or shower, house cleaning, walking, and performing personal care activities. The instrument is scored using a 1-10 Likert-type scale, where 10 represents maximum confidence and 1 represents minimal confidence. The total possible score ranges from 10 to 100, and a higher score indicates a higher level of fall self-efficacy. The internal consistency, Cronbach's α, for the instrument has been reported to be 0.93 (Chang, 2005) and in the present study it was 0.88.

Intervention

Development of the recurrent fall prevention program

The recurrent fall prevention program was developed for elderly women aged >65 years in rural areas. The program included education and exercises based on previous studies [34,35] and the current status of recurrent fall risk factors in elderly women in local community [36]. The program was conducted over a 12-week period with 1 education session and 3 exercise sessions per week for 80 min per session. The education session addressed topics including the definition of falling, the cause of falling, the consequences of falling, recurrent falls and the home environment, medicine, nutrition, depression, ways of preventing recurrent falls, and emergency coping strategies. The exercise sessions were developed based on Korean traditional dances and involved exercises to promote muscle strength, endurance, and balance. During the first 4 weeks, the emphasis was placed on learning the exercises. During weeks 5 and 6 (the maturity phase), the program was focused on teaching exercises to increase exercise accuracy. Finally, weeks 7 to 12 were viewed as a maintenance exercise period. The recurrent fall prevention program is described in detail in Table 2.

Application of the recurrent fall prevention program

The recurrent fall prevention program was performed by a principle investigator and research assistants at a public health center in B-gun, Chungcheongbuk-do. Subjects participated in the recurrent fall prevention program for 12 weeks. Control group subjects were tested at the same public health center before the program began and at 12 weeks. After the recurrent fall prevention program had been completed, it was continued for subjects in the experimental group.

Data collection

Data was collected at the public health center mentioned above from March 4 to May 31, 2012. Baseline measurements were made of the experimental and the control groups a week before the program began. The same measurements were repeated after the program was completed.

Statistical analysis

Sample size estimation

G-Power 3.1 software was used to calculate the sample size required so that a reasonable expectation would be to detect an expected effect size of 0.8 between the groups. A sample size of 52, with 26 subjects per group, and with 80% power was applied in the study. Fifty-two participants were required to show statistical significance when clinically significant differences between the groups were present. Additional subjects were recruited to provide for unanticipated attrition.

Data analysis

Data was analyzed using SPSS version 18.0. General characteristics and fall-related outcome measures were summarized using means, standard deviations (SD), frequencies, and relative frequencies. The Pearson's chi-square test of independence and the independent t-test were used to compare general characteristics. The paired t-test was used to compare outcome measures between pre- and post-intervention, and then the mean differences between pre- and post-intervention were compared between the groups using an independent t-test.

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
[ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica]
[Chemical Abstracts/CAS] [Index Copernicus]

Table 2. Contents of the fall prevention program.

Session	Components	Contents	Methods	Time
1	Knowledge related to falls	The definition of falls The cause of falls – physical factor	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle	Exercise	20 min
2	Knowledge related to falls	The cause of falls – environmental factor	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity	Exercise	30 min
3	Knowledge related to falls	The results of falls	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	40 min
4	Knowledge related to falls	The dangerousness of recurrent falls	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	50 min
5	Knowledge related to falls	Recurrent falls and exercise	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	60 min
6	Knowledge related to falls	Recurrent falls and environment	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	60 min
7	Knowledge related to falls	Recurrent falls and foot	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	60 min
8	Knowledge related to falls	Recurrent falls and medication	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	60 min
9	Knowledge related to falls	Recurrent falls and nutrition	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	60 min
10	Knowledge related to falls	Recurrent falls and depression	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	60 min
11	Knowledge related to falls	Recurrent falls prevention	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	40 min
12	Knowledge related to falls	Emergency treatment of recurrent falls	Education	20 min
	Physical functions	Muscle strengthening exercise – ankle and lower extremity Balance exercise – static and dynamic balance	Exercise	40 min

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
[ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica]
[Chemical Abstracts/CAS] [Index Copernicus]

Table 3. Baseline outcome variables measurements between the groups.

		Experimental group Mean ±SD	Control group Mean ±SD	*p**
Muscle strength endurance index (sec)	Ankle	20.90±3.68	21.35±4.86	.68
	Lower extremity	27.20±6.30	29.74±6.52	.12
Balance (sec)	Static	20.80±24.16	19.56±18.22	.82
	Dynamic	10.47±1.44	10.77±2.67	.54
Depression (score)		7.00±2.46	6.29±2.45	.26
Compliance with fall preventative behavior (score)		24.00±3.71	23.90±3.01	.86
Fear of falling (score)		2.94±0.77	2.97±0.71	.86
Fall self-efficacy (score)		61.84±15.70	63.94±10.01	.53

* Independent t-test, p-values for the null hypothesis that there is a no difference between the groups.

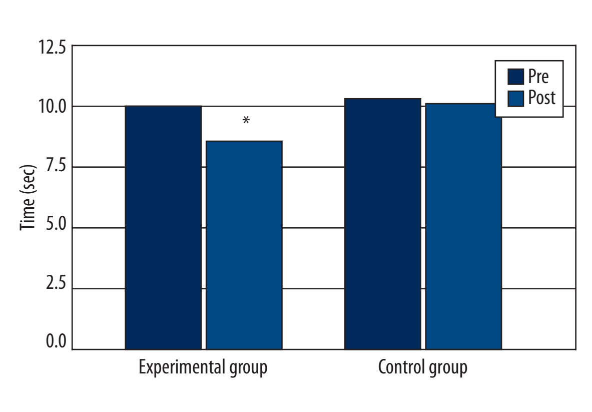

Figure 2. Mean of dynamic balance before and after the recurrent fall prevention program between the 2 groups.

Results

Pre-test outcome measures between groups

The heel rise test of the ankle, as determined by measuring the time taken to raise and lower the heels 10 times, was not significantly different between the experimental (20.90 s) and control groups (21.35 s). Heel rise test of the lower extremities, as determined by measuring the time taken to complete 10 chair stands, showed no significant intergroup difference (experimental group 27.20 s and control group 29.74 s). There was no significant difference in static balance, as determined by measuring time standing on 1 leg, between the 2 groups (experimental group 20.80 s and control group 19.56 s). Dynamic balance, as determined by times for the 3-m TUG test, was not significantly different between the 2 groups (experimental group 10.47 s and control group 10.77 s). The following were not significantly different between the 2 groups: depression (experimental group 7.00, control group 6.29), compliance with preventive behavior related to falls (experimental group 24.00, control group 23.90), fear of falling (experimental group 2.94 and control group 2.97), and fall self-efficacy (experimental group 61.84 and control group 63.94) (Table 3). These results show that there were no significant differences in all outcome measurements at pre-testing between the 2 groups (P>.05)

Post-test outcome measures between groups (effects of the recurrent fall prevention program)

After completing the 12-week recurrent fall prevention program, ankle heel rise test results were significantly lower in the experimental group compared to the control group (experimental group 15.94 s, control group 18.23 s; p=.02). Similarly, heel rise test results of the lower extremity also were significantly lower in the experimental group than in the control group (experimental group 22.53 s, control group 26.34 s) (p=.01). Dynamic balance was significantly different between the 2 groups (9.23 s and 10.58 s, respectively; p=.007, Figure 2, whereas static balance test results were not (experimental group 19.02 s, control group 19.45 s).

After the 12-week recurrent fall prevention program, the following variables were found to be significantly different between the 2 groups: depression (experimental group 5.10, control group 7.77; p<.001), compliance with preventive behavior related to falls (25.10 and 23.81, respectively; p=.04), fear of falling (2.71 and 3.10, respectively; p=.05), and fall self-efficacy (69.32 and 63.45, respectively; p=.04) (Table 4).

Comparing mean reduction of outcome measures between groups (effects of the recurrent fall prevention program)

Ankle heel rise test results significantly decreased between pre- and post-test in both groups (p<.001 *vs.* p=.001) and mean

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
[ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica]
[Chemical Abstracts/CAS] [Index Copernicus]

Table 4. Reduction in outcome variables measurements between the groups.

		Experimental group	Control group	p*
		Mean ±SD	Mea n±SD	
Muscle strength endurance index (sec)	Ankle	4.96±1.28	3.12±1.71	<.001
	Lower extremity	4.67±1.82	3.4±1.73	.01
Balance (sec)	Static	1.78±5.72	0.11±5.31	.24
	Dynamic	1.24±0.82	0.19±1.10	<.001
Depression (score)		1.90±0.68	1.48±0.88	.04
Compliance with fall preventative behavior (score)		1.10±1.15	0.09±0.40	<.001
Fear of falling (score)		0.23±0.13	0.13±0.14	.01
Fall self-efficacy (score)		7.48±3.48	0.49±1.08	<.001

* Independent t-test, p-values for the null hypothesis that there is a no difference between the groups.

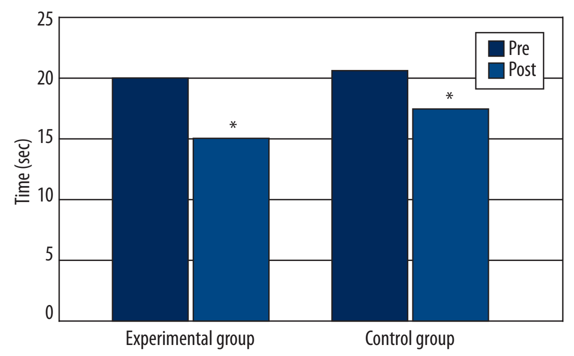

Figure 3. Mean of ankle strength endurance index before and after the intervention recurrent fall prevention program between the 2 groups.

reduction from pre- to post-test were also significantly different between the 2 groups (p<.001, Table 4). On average, a 24% decrease was shown in the experimental group versus a 15% decrease in the control group (Figure 1). Similarly, when comparing heel rise test results of the lower extremity between the pre- and post-test, the index was significantly decreased in both groups. The experimental group showed more reduction compared to the control group (18% *vs.* 11.5%, p=.002 *vs.* p=.02). Also, depression score and fear of falling showed a decrease in both groups. Dynamic balance showed a significant time reduction between pre- and post-test in the experimental group, but there was no significant change in the control group (p=.003 *vs.* p=.38) (Figure 3). However, static balance did not show any changes in either group and there was also no significant difference in mean reduction from pre- and post-test between the groups (p=.24). The depression score and fear of falling showed a decrease in both groups and there was significant difference in mean reduction between the 2 groups (Table 4). Compliance with preventive behavior related to falls and fall self-efficacy were significantly changed in the experimental group but not in the control group.

Discussion

In the present study, we aimed to develop a recurrent fall prevention program and to examine its effectiveness in elderly women residing in rural areas, by comparing those who participated in the recurrent fall prevention program with matched controls. We found that the devised recurrent fall prevention program was effective in terms of ankle and the lower extremity muscle strength and endurance, dynamic balance, depression, compliance with preventive behavior related to falls, fear of falling, and fall self-efficacy.

This study shows that subjects in the experimental group had significantly improved muscle strength and endurance of ankles and of the lower extremities, and in dynamic balance, as compared with the control group. These results are consistent with those of previous studies of a 4-week program composed of 2 daily exercises for 5 days per week [37]; a 12-week program composed of muscular exercise, balance exercise, and mental health education [6]; a 12-week group exercise program and an 8-week self-management exercise program [38]; a 12-week program designed to promote muscle strength, balance, and physical function [20]; and a 16-week program composed of 3 customized exercise sessions per week to prevent falls [34]. In all of the above-mentioned studies, it was reported that heel rise test and balance were significantly improved. In particular, previous studies have suggested that multifactorial fall interventions adopt a similar approach to assessing falls risk factors and devising an appropriate fall-prevention plan, and are therefore well suited to integration within

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS] [Index Copernicus]

existing and developing structures of coordinated care [39]. This study showed significant increases were achieved using a multifactorial intervention program that took into account multiple aspects, such as muscle strength and endurance, balance, and psychological perspective. During the aging process, physical activity is reduced and muscle strength and endurance is lost due to a reduction in skeletal muscle mass. Balance is also reduced due to reductions in the conduction rate of the nervous system and loss of body equilibrium. The devised program strengthens ankle, leg, and overall muscle strength and improves balance.

In terms of the influence the recurrent fall prevention program had on psychological function related to falling, this study showed the effectiveness of the devised program by presenting significant reductions in both depression and fear of falling scores and significant increases in the fall self-efficacy scores. Generally, the activity range in the elderly that have fallen is decreased due to the fear of falling, physical damage, and difficulty caused by falling. Social activities are also reduced and fear of falling and depression are increased; thus, elderly that have fallen become caught in a vicious cycle that further decreases fall self-efficacy [6,20,40]. The present study involved exercises to improve muscle strength, endurance, balance ability, and mental health education, and produced results that would reduce fall risk [6,12,21,39–41]. Furthermore, it improved fall self-efficacy by reducing the fear of a recurrent fall, increasing physical and social activities, and decreasing depression. Fear of falling and fall self-efficacy, in particular, are the significant factors of a recurrent fall. As these 2 factors were found to be positively influenced, our findings support the merits of the devised recurrent fall prevention program and suggest that recurrent fall prevention programs should be developed to address psychological challenges. We believe that depression was reduced because the program required subjects to sing familiar songs, such a, folk songs and pop songs, while performing exercises. Thus, we support the inclusion of psychological interventions based on music or laughter therapy in such programs [42].

After intervention, compliance with preventive behavior related to falls was found to be significantly higher in the experimental group than in the controls. This result is consistent with the findings of previous research in which an animated video was repeatedly shown to promote fall preventative behavior [35] and a study on the effects of 6 weeks of group education based on PowerPoint presentations at a community welfare center [43]. These previous studies reported similar results showing significant increases in compliance with preventive behavior related to falls. In the present study, subjects were taught how to prevent recurrent falls in group education sessions, and fall prevention behaviors were checked for in previous weeks on a weekly basis, which provided an opportunity to re-educate subjects on topics and encourage them to adopt these behaviors. Moreover, the program provided subjects with practical education based on video demonstrations or PowerPoint presentations. The above-mentioned observations suggest that group and individual education are required to increase compliance with preventive behavior related to repeat falls, and that compliance with preventive behaviors must be checked to facilitate re-education during recurrent fall prevention programs.

Conclusions

This study investigated the effects of a recurrent fall prevention program on risk factors in elderly women with a fall history. Muscle strength and endurance of the ankles and the lower extremities, static balance, dynamic balance, depression, compliance with preventive behavior related to falls, fear of falling, and fall self-efficacy at baseline and immediately after the program were assessed. We showed that the recurrent fall prevention program described effectively improves muscle strength and endurance, balance, and psychological aspects in elderly women with a fall history.

Conflict of interests

The authors declare no conflicts of interest.

Reference:

1. UnitedNation: World Population Prospects: The 2004 Revision. In. New York, USA: United Nation; 2004
2. McCallum J: Ageing research directions for Australia. Australas J Ageing, 2011; 30(Suppl.2): 1–3
3. Chur-Hansen A, Todd E, Koopowitz L: Description and evaluation of an upskilling workshop for rural and remote mental health practitioners in South Australia. Australas Psychiatry, 2004; 12(3): 273–77
4. Latham NK, Anderson CS, Lee A et al: A randomized, controlled trial of quadriceps resistance exercise and vitamin D in frail older people: the Frailty Interventions Trial in Elderly Subjects (FITNESS). J Am Geriatr Soc, 2003; 51(3): 291–99
5. Muhlberg W, Sieber C: Sarcopenia and frailty in geriatric patients: implications for training and prevention. Z Gerontol Geriatr, 2004; 37(1): 2–8
6. Gschwind YJ, Kressig RW, Lacroix A et al: A best practice fall prevention exercise program to improve balance, strength/power, and psychosocial health in older adults: study protocol for a randomized controlled trial. BMC Geriatr, 2013; 13: 105
7. Cumming RG, Salkeld G, Thomas M et al: Prospective study of the impact of fear of falling on activities of daily living, SF-36 scores, and nursing home admission. J Gerontol A Biol Sci Med Sci,2000; 55(5): M299–305
8. Tinetti ME: Clinical practice. Preventing falls in elderly persons. New Engl J Med, 2003; 348(1): 42–49
9. Wu S, Keeler EB, Rubenstein LZ et al: A cost-effectiveness analysis of a proposed national falls prevention program. Clin Geriatr Med, 2010; 26(4): 751–66
10. Rubenstein LZ: Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing, 2006; 35(Suppl.2): ii37–41

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System] [ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica] [Chemical Abstracts/CAS] [Index Copernicus]

11. Moreland J, Richardson J, Chan D et al: Evidence-based guidelines for the secondary prevention of falls in older adults. Gerontology, 2003; 49(2): 93–116
12. Ungar A, Rafanelli M, Iacomelli I et al: Fall prevention in the elderly. Clin Cases Miner Bone Metab, 2013; 10(2): 91–95
13. Sattin RW: Falls among older persons: a public health perspective. Annu Rev Public Health, 1992; 13: 489–508
14. Sjogren H, Bjornstig U: Trauma in the elderly: the impact on the health care system. Scand J Prim Health Care, 1991; 9(3): 203–7
15. Marottoli RA, Berkman LF, Cooney LM Jr: Decline in physical function following hip fracture. J Am Geriatr Soc,1992; 40(9): 861–66
16. National Elderly Survey: The living condition and welfare needs for older adults. In. Edited by Ministry of Health WaFA. Seoul: Ministry of Health, Welfare and Family Affairs; 2009
17. Epidemiologic characteristics of injury inpatients in Korea: The results of (Korea hospital discharge survey) 2004–2005. In. Edited by Prevention KCfDC. Seoul: Korea Centers for Disease Control & Prevention; 2005
18. Jeon MY, Jeong HC, Choi MA: A Study on the Elderly Patients Hospitalized by the Fracture from the Fall. J Korean Acad Nurs, 2001; 31(3): 443–53
19. Bulat T, Castle SC, Rutledge M et al: Clinical practice algorithms: medication management to reduce fall risk in the elderly – part 2, summary algorithm. J Am Acad Nurse Pract, 2008; 20(1): 1–4
20. Hauer K, Rost B, Rutschle K et al: Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls. J Am Geriatr Soc, 2001; 49(1): 10–20
21. Faber MJ, Bosscher RJ, Chin APMJ et al: Effects of exercise programs on falls and mobility in frail and pre-frail older adults: A multicenter randomized controlled trial. Arch Phys Med Rehabil, 2006; 87(7): 885–96
22. Robertson MC, Gillespie LD: Fall prevention in community-dwelling older adults. JAMA, 2013; 309(13): 1406–7
23. Fletcher PC, Berg K, Dalby DM et al: Risk factors for falling among community-based seniors. J Patient Saf, 2009; 5(2): 61–66
24. Park HS, Chang R, Park KY: Comparative study on fall related characteristics between single and recurrent falls in community dwelling older women. Journal of Korean Academy Adult Nursing, 2008; 20(6): 905–16
25. Yoo IY: Analysis of multi-variate recurrent fall risk factors in elderly people using Residential Assessment Instrument-Home Care: comparisons between single and recurrent fallers. J Korean Acad Nurs, 2011; 41(1): 119–28
26. Todd C, Skelton D: What are the main risk factors for falls among older people and what are the most effective interventions to prevent these falls? In. Edited by Network HE. Copenhagen: WHO Regional Office for Europe; 2004
27. Tinetti ME, Speechley M, Ginter SF: Risk factors for falls among elderly persons living in the community. N Engl J Med, 1988; 319(26): 1701–7
28. Tinetti ME: Factors associated with serious injury during falls by ambulatory nursing home residents. J Am Geriatr Soc,1987; 35(7): 644–48
29. Lunsford BR, Perry J: The standing heel-rise test for ankle plantar flexion: criterion for normal. Phys Ther, 1995; 75(8): 694–98
30. Yocum A, McCoy SW, Bjornson KF et al: Reliability and validity of the standing heel-rise test. Phys Occup Ther Pediatr, 2010; 30(3): 190–204
31. Balogun JA, Ajayi LO, Alawale F: Determinants of single limb stance balance performance. Afr J Med Med Sci,1997; 26(3–4): 153–57
32. Jonsson E, Seiger A, Hirschfeld H: One-leg stance in healthy young and elderly adults: a measure of postural steadiness? Clin Biomech (Bristol, Avon), 2004; 19(7): 688–94
33. Goldberg A, Chavis M, Watkins J et al: The five-times-sit-to-stand test: validity, reliability and detectable change in older females. Aging Clin Exp Res, 2012; 24(4): 339–44
34. Gu MO, Jeon MY, Eun Y: [The development & effect of a tailored fall prevention exercise for older adults.] Taehan Kanho Hakhoe Chi, 2006; 36(2): 341–52 [in Korean]
35. Hyeon IS, Park MH, Park KM, Kim CN: The effects of a fall prevention program on the low-income elderly at risk of falls. Journal of Korean Academy of Community Health Nursing, 2010; 21(2): 200–9
36. Yun ES: Fall prediction model for community-dwelling elders based on gender. J Korean Acad Nurs, 2012; 42(6): 810–18
37. Miller KL, Magel JR, Hayes JG: The effects of a home-based exercise program on balance confidence, balance performance, and gait in debilitated, ambulatory community-dwelling older adults: a pilot study. J Geriatr Phys Ther, 2010; 33(2): 85–91
38. Kwon MS: Effects of a fall prevention program on physical fitness and psychological functions in community dwelling elders. J Korean Acad Nurs, 2011; 41(2): 165–74
39. Day LM: Fall prevention programs for community-dwelling older people should primarily target a multifactorial intervention rather than exercise as a single intervention. J Am Geriatr Soc, 2013; 61(2): 284–85; discussion 85–86
40. Lee HC, Chang KC, Tsauo JY et al: Effects of a multifactorial fall prevention program on fall incidence and physical function in community-dwelling older adults with risk of falls. Arch Phys Med Rehabil, 2013; 94(4): 606–15, 15 e1
41. El-Khoury F, Cassou B, Charles MA et al: The effect of fall prevention exercise programmes on fall induced injuries in community dwelling older adults: systematic review and meta-analysis of randomised controlled trials. BMJ, 2013; 347: f6234
42. Sakano K, Ryo K, Tamaki Y et al: Possible benefits of singing to the mental and physical condition of the elderly. Biopsychosoc Med, 2014; 8: 11
43. Shin KR, Shin SJ, Kim JS et al: [The effects of fall prevention program on knowledge, self-efficacy, and preventive activity related to fall, and depression of low-income elderly women]. Taehan Kanho Hakhoe Chi, 2005; 35(1): 104–12 [in Korean]

Indexed in: [Current Contents/Clinical Medicine] [SCI Expanded] [ISI Alerting System]
[ISI Journals Master List] [Index Medicus/MEDLINE] [EMBASE/Excerpta Medica]
[Chemical Abstracts/CAS] [Index Copernicus]