Yonsei Medical Journal
Vol. 44, No. 5, pp. 883 - 891, 2003

Fall Prevention Exercise Program for Fall Risk Factor Reduction of the Community-Dwelling Elderly in Korea

Kyeong-Yae Sohng[1], Jung-Soon Moon[1], Hae-Hiang Song[2], Kwang-Soo Lee[3], and Young-Sook Kim[4]

[1]College of Nursing, The Catholic University of Nursing, Seoul, Korea;
Departments of [2]Biostatistics and [3]Neurology, College of Medicine, The Catholic University of Korea, Seoul, Korea;
[4]Department of Social Work, Sahm Yook University, Seoul, Korea.

A randomized comparison of pre-and post-experimental design was used to examine the effects of a fall prevention exercise program (FPEP) on muscle strength, ankle flexibility, balance, instrumental activities of daily living (IADLs), and depression for the community-dwelling elderly in Korea. Twenty-two subjects were assigned to an experimental group and twenty-three to a control group. The experimental group participated in a 4-day-per week FPEP of 8 weeks duration, twice a week by direct instruction and twice a week with videotaped instruction by the program instructor at each senior center.

The eight-week FPEP turned out to be significantly effective in enhancing muscle strength, ankle flexibility and balance, and in reducing depression, after intervention among community-dwelling elderly in Korea. IADLs, however, was not changed by the intervention.

Further research with a larger sample and longer follow up period is needed to expand our understanding about the effects of FPEP. Future study is also recommended to differentiate between the effects of FPEP by direct instruction and by videotaped.

Key Words: Fall prevention exercise program, muscle strength, ankle flexibility, balance, elderly

INTRODUCTION

The absolute number and relative proportions of the elderly population in Korea has undergone a drastic increase since 1970. Over the three decades since 1970, the proportion of senior citizens (aged 65 years or older) has more than doubled from 3.1% to 7.1% of the total population. Much of this increase is mainly due to the rapid economic growth, advances of medical technology and improvements in the treatment of acute and chronic illness. Such a trend is expected to continue with the proportion reaching 13.2% of the total population by 2020.[1]

Although longevity has increased for the population at large, quality of life, particularly in the later years of life, has not necessarily improved. The elderly are highly vulnerable to a number of problems. One of the most frequent and critical problems is that of falling.[2]

Community survey estimates of the prevalence of falling range from 32%[3] to 42%[4] in western countries, and from 45.5%[5] to 48.2%[6] in Korea. The likelihood of falling rises when old people engage in an activity that results in a loss of muscle strength and balance, and the body mechanisms responsible for compensation or stability fail.[2] Falls represent a major source of death and disability among old people, posing a serious threat to their physical health and psychological well-being. One of the most deleterious outcomes of reduced muscle strength, bone strength, and joint mobility is the heightened susceptibility of the elderly to injury, mainly due to falls and to serious consequences resulting from falls.[7] A number of stressful life events which older persons commonly face can lead to episodes of depression. Under these circumstances the person may be at

Received February 26, 2003
Accepted July 3, 2003

This study was supported by Korea research foundation grant, KRF-2000-042-F00094.

Reprint address: requests to Kyeong-Yae Sohng, RN, Ph.D., College of Nursing, The Catholic University of Korea, 505 Banpo-dong, Socho-gu, Seoul 137-701, Korea. Tel: 82-2-590-1292, Fax: 82-2-590-1297, E-mail: sky@catholic.ac.kr

a greater fall risk. Episodes of emotional distress can by themselves lead to poor health and falls or they can contribute to a worsening of comorbid medical conditions which themselves increase risk.[2] In addition, disability is often caused by loss of confidence, fear of falling, and deteriorating function. Since most falls are avoidable, efforts by health professionals to reduce functional limitations, as well as to enhance the old people's muscle strength and balance offer an important health promotion consideration for the vulnerable elderly.

Recently, the benefits of exercise on muscle weakness, functional capacity, and balance for preventing the elderly from fall are well documented.[8-10] In advanced countries, which already have entered the aged society, there has been a proliferation of studies related to fall prevention programs. However in Korea, in contrast to advanced countries, there is a paucity of studies on this issue with exception of the fall prevention exercise program (FPEP) for institutionalized elderly.[10,11] Considering the general reluctance of the Korean elderly to do physical exercise,[12,13] and their heavy preference for community dwelling rather than institutionalized dwelling, it is worth developing and examining the effect of FPEP for them.

The purpose of this study was to assess the effectiveness of FPEP that is designed to improve muscle strength, balance, ankle flexibility, and instrumental activities of daily living (IADLs), and reduce depression for the community-elderly in Korea.

MATERIALS AND METHODS

Research design

A randomized comparison group of pre- and post-test experimental design was used to examine the effects of FPEP on the physical function and emotional state of the community dwelling elderly in Korea. The independent variable was FPEP and the dependent variables were the fall risk factors: muscle strength, balance, ankle flexibility, IADLs, and depression.

Subjects

The subjects were recruited from three senior centers located in the residential area in Seoul, Korea. Subject eligibility criteria were: a) 65 years or older, b) able to ambulate independently without assistive device, c) absence of any unstable physical condition, evidence of terminal illness, or a history of acting-out or abusive behavior, d) a score of 19 or higher on the MMSE-K (Mini-Mental State Examination-Korea),[14] e) able to communicate, and f) completion of a written consent form.

Out of 52 total subjects meeting the above criteria, 26 were assigned to the control group and another 26 to the experimental group so as to satisfy Cohen's formula[15] that requires[16] subjects in each group to compensate for possible loss caused by drop out during investigation. A randomized coin tossing process was employed in allocating total subjects into the two groups. During the study period, 4 subjects from the experimental group and 3 from the control group withdrew from the study. The reasons for withdrawal in both groups (number of subjects in experimental / control groups) were family affairs (2/1), lack of motivation to remain in the study (1/0), moving (0/1), hospitalization (0/1), and oversea travel (1/0). The baseline characteristics of these two attrition groups were not different from the study participants. A total of 45 patients remained as the study subjects; 22 experimental and 23 control.

Methods

Subjects in the experimental group participated in a 4-day-per-week FPEP of 8 weeks duration, while the subjects in the control group did not receive any intervention. The FPEP of this study was developed by the investigators based on the People with Arthritis Can Exercise (PACE) program, formulated by the Arthritis Foundation (1987) for arthritis patients and community elderly. The components of the program included a range-of-motion (ROM) exercises, a seated exercises for strengthening, an endurance exercises, a weight-wearing exercises, balance and coordination exercises, breathing exercises, relaxation tech-

niques, and health education to prevent falls by incorporating self-care skills into the home bound environment.

The experimental group was designed to undergo supervised exercise 4 days a week for 8 weeks, twice a week by direct instruction and twice a week with a videotaped program by the program instructor at each senior center. After the completion of the study, subjects in the control group were provided with a videotape and participated in a thirty minute-long information session on FPEP by the investigators.

Instruments

Muscle strength

The Nicholas Manual Muscle Tester (Model 01160, Lafayette Instrument Company, Lafayette, IN, USA), a hand-held dynamometer, was used to measure extensor and flexor muscle strength of each knee and ankle. In using this device the same techniques for limb positioning were employed as in manual muscle testing. The tester moved the body part that the muscle activated through the maximum ROM. The subject was asked to hold the maximum against gravity while the tester applied opposing pressure to the muscle.[16] The hand-held dynamometer was set between the muscle of the subject and the tester's hand as the tester applied pressure. The dynamometer reading, in kilograms, was made at the time that maximum pressure was exerted by the tester or when the subject was unable to resist the tester's force. While Mills[17] reported an interrater coefficient of r =>.93, this study established an interrater coefficient of r=.90 prior to beginning this study.

Balance

In order to measure static balance, the sharpened Romberg maneuver (tandem stand) - to assess the ability to stand while placing the feet in a tandem position with eyes open and then repeated with eyes closed - was performed by the subjects. Each subject was asked to maintain the stance as long as possible, to a maximum of 10 seconds. Caution is advised assistant researchers to prevent the patient falling during the maneuver before the tandem stand is measured. To minimize the risk of falling, the investigator and two assistant researchers stood near the subject, ready to hold the subject if necessary. To avoid having the results influenced by the subject's footwear (for example, thick, sponge soles), the task was performed in bare feet.

Ankle flexibility

A goniometer was used to measure ankle flexibility. The axis of the goniometer was placed on the axis of rotation of the joint being measured. The stationary arm was placed along the longitudinal axis of the distal part of the joint.[18] The degrees of maximal motion of plantarflexion and dorsiflexion of both ankle joints were recorded. The goniometer has criterion-related validity coefficients ranging from 0.97 to 0.99,[19] and the interrater reliability was established within 5 degrees for all ankle measurements.

Depression

Depression was measured using the geriatric depression scale developed by Yesavage, et al.[20] and translated into Korean by Kee.[21] It is a 2-point rating scale, 0 or 1, (Ed- this clarification is necessary to explain the total, 0-15, that you give below) with 15 items. The total score on this scale ranges from 0 to 15, with a higher score indicating more severe depression. Cronbach's alpha reported in this study was 0.88.

Instrumental activities of daily living

IADLs (Ed- already defined above) were assessed with the IADLs scale developed by Cho[22] based on Lawton and Brody's scale.[23] The scale contains 9 items with numerical rating scales from 0 to 2, giving a score range from 0 to 18, with a higher value indicating greater functional ability to perform independent living. Cronbach's alpha for this scale was 0.88 in this study.

Procedure and data collection

The subjects invited to participate in the study were provided with both written and oral information about the purpose and procedure of the study. The participants were informed that their participation was voluntary and that they could choose to withdraw from the study anytime they

wanted without penalty. They were also informed that they would remain anonymous. Written consent was obtained from all subjects participating in the study, with approval by the Medical Research Ethics Committee of the University. All of three research assistants facilitating the study were registered nurses. Two research assistants helped the investigators by recruiting potential participants, explaining the purpose and procedure of the study, and getting their consent. MMSE-K was administered and subjects who scored 19 or higher were interviewed to collect baseline data on all variables. Subjects were randomly assigned to the two groups, experimental and control. The baseline assessment took place at the beginning of the study and post-test assessment was performed at the end of the 8-week study period.

All subjects completed a set of questionnaires that compiled demographic data, along with measurements at both baseline and the end of the study, for muscle strength, balance, ankle flexibility, IADLs, and depression. After completion of baseline data collection, the investigators and a research assistant served as FPEP instructors. The other two research assistants conducted the assessments for the study. They were blinded to whether the subject had participated in FPEP or not.

During the 8-week program, participants learn a myriad of exercises, covering a wide range of content, from a trained instructor. The specific content areas included exercises for ROM, strengthening, endurance, weight-bearing, balance and coordination, correct posture, body awareness, and breathing and relaxation, as well as educational lectures focusing on exercise and fall prevention. They started to exercise for 40 minutes per session, 4 sessions a week during the first week and the duration of each session was extended from the second to the final week. To reduce the drop out rate, about two-dollar gifts were provided at the end of each session to every subject as reward. Since each session was designed for as many as 10 to 15 persons, the 26 subjects in the experimental group were divided into two classes and received the intervention separately at different times. The total data collection period was between January and May, 2002.

Statistical analysis

Data were analyzed using SAS program. Descriptive statistics, chi-square and Fisher's exact test were performed to compare baseline characteristics in the experimental and control groups. Mean changes from the baseline in each outcome variable were compared using unpaired t-test between the two groups, and significance was judged at the 5% level. The McNemar test was conducted to identify changes by examining the number of subjects who successfully completed the task of tandem stand for assessment of maintaining balance.

RESULTS

Sample characteristics

The average age of the subjects was 75.0 years for the experimental and 76.4 years for the control group. Ages ranged from 65 to 83 years and there were only two male subjects included in each group. The MMSE-K score ranged from 23 to 30, with a mean score of 26.7 for the experimental group and 25.8 for the control group. There was no significant difference between the two groups for any of the characteristics (Table 1)

Baseline measurements

When comparing the mean baseline scores of knee and ankle muscle strength, flexibility, IADLs, depression and the number of subjects with acceptable tandem-stand balance test, initial equivalence was achieved between the two groups. The baseline measures for the total sample are summarized in Table 2.

Outcome measurements

Both Tables 3 and 4 show the effects of FPEP through the mean change scores and the number of subjects of all outcome variables for the two groups. Unpaired t-test and McNemar test revealed that there were significant differences

Table 1. Characteristics in the Experimental and Control Groups

Characteristics		Exp. group N (%) or M ± SD	Cont. group N (%) or M ± SD	X^2 or t	p
Age (yr)	Below 75	7 (31.8)	7 (30.4)	0.01	0.92
	Over 75	15 (68.2)	16 (69.6)		
Gender*	Male	2 (9.1)	2 (8.7)		1.000*
	Female	20 (90.9)	21 (91.3)		
MMSE-K		26.71 ± 3.82	25.78 ± 3.93	0.81	0.424
Educational level*	Uneducated	7 (31.8)	8 (34.8)		1.000*
	Under middle school	11 (50.0)	11 (48.8)		
	Above middle school	4 (18.2)	4 (17.4)		
Religion*	Yes	15 (68.2)	20 (86.9)		0.165*
	No	7 (31.8)	3 (13.1)		
Spouse*	Yes	4 (18.2)	4 (17.4)		1.000*
	No	18 (81.8)	19 (82.6)		
Living status*	Alone	2 (9.1)	4 (17.4)		0.292*
	With spouse	0 (0.0)	2 (8.7)		
	With their children	20 (90.9)	17 (73.9)		
Economic status*	High	3 (13.7)	1 (4.4)		0.221*
	Middle	14 (63.6)	20 (86.9)		
	Low	5 (22.7)	2 (8.7)		

*Fisher's exact test.
MMSE-K, Mini-Mental Status Examination-Korea.

between the two groups in the average changes for muscle strength, ankle flexibility, depression and balance, which indicates that the experimental group showed more improvement in these variables at post-intervention than the control group did.

A clear contrast was shown between the two groups as far as muscle strength was concerned. Muscle strength of the experimental group was significantly improved over all measurements, except right ankle plantarflexor, compared to the control group (Table 3).

The mean degrees in ROM of plantarflexion and dorsiflexion increased from 32.89 and 14.68 before the intervention to 36.64 and 16.89 after the intervention, respectively, while those for the control group did not show significant changes from 36.54 and 16.67 to 34.67 and 16.91, respectively (t=2.88, p=.006; t=2.01, p=.049) (Table 3).

The mean depression score for the experimental group decreased from 5.76 before the intervention to 4.55 after the intervention, whereas the control group showed an increase from 5.78 to 6.26, respectively (t=2.51, p=.016). This was a significant difference in depression score between the two groups.

In the experimental group, the number of subjects who could not complete the tandem stand test with eyes open decreased from 6 before intervention to 1 after intervention (X^2=4.247, p=.039), while there was not any statistical difference for the control group. Regarding the tandem stand with eyes closed, the number of subjects unable to complete the task decreased from 8 to 2 with intervention (X^2=4.658, p=.023), while that for the

Table 2. Baseline Characteristics in the Experimental and Control Groups

Outcome measures		Exp. group(N=22) M ± SD or N(%)	Cont. group(N=23) M ± SD or N(%)	X^2 or t	p
Muscle strength	Knee extensor				
	Lt. (Kg)	14.38 ± 2.87	13.60 ± 3.03	0.89	0.38
	Rt. (Kg)	14.48 ± 2.34	12.98 ± 3.27	1.75	0.086
	Knee flexor				
	Lt. (Kg)	12.79 ± 2.02	12.04 ± 2.46	1.1	0.276
	Rt. (Kg)	13.45 ± 1.84	12.45 ± 2.67	1.46	0.151
	Ankle plantarflexor				
	Lt. (Kg)	17.61 ± 3.78	17.27 ± 5.24	0.25	0.8
	Rt. (Kg)	18.40 ± 3.75	17.41 ± 4.46	0.81	0.423
	Ankle dorsiflexor				
	Lt. (Kg)	13.71 ± 2.50	13.09 ± 2.94	0.77	0.446
	Rt. (Kg)	14.03 ± 1.86	13.17 ± 2.70	1.23	0.224
Ankle Flexibility	ROM of Plantarflexion (°)	32.89 ± 10.14	36.54 ± 5.35	1.52	0.135
	ROM of Dorsiflexion (°)	14.68 ± 9.80	16.67 ± 6.98	1.68	0.1
IADLs		5.76 ± 3.62	5.78 ± 3.33	0.02	0.984
Depression		17.67 ± 0.73	16.96 ± 2.70	1.21	0.237
Tandem stand with eyes open	Completed	16 (72.7)	18 (78.3)	0.19	0.666
	Not-completed	6 (27.3)	5 (21.7)		
Tandem stand with eyes closed	Completed	14 (63.6)	15 (65.2)	0.3	0.585
	Not-completed	8 (36.4)	8 (34.8)		

ROM, range of motion; IADLs, instrumental activities of daily living.

control group did not show a significant change without intervention (Table 4).

However, there was no significant difference in the mean scores for IADLs between the two groups before and after the intervention.

DISCUSSION

Despite the beneficial effect of exercise, only 30% of individuals over the age of 65 report exercising regularly.[24] Considering the general reluctance of the Korean elderly to do physical exercise,[13] an important consideration in conducting FPEP for them is the initiation and maintenance of regular exercise.

For enhancing the exercise adherence of the subjects in this study, the program should be safe, simple, easy to do, and enjoyable, and should fit the daily routine and promote self-efficacy. As self-efficacy is one of the most significant factors of exercise adherence,[25] the investigators needed to incorporate fall-preventing health education and self-care skills to prevent fall into FPEP. The drop out rate in this study was merely 13.5%, a lot lower than the 30% which Shin[26] experienced in an 8-week exercise study of Korean elderly.

Factors cited as having a major influence in falls

Table 3. Comparison of Muscle Strength, Flexibility, IADLs and Depression between the Experimental and Control Groups

Outcome measures	Group	Pre-test M ± SD	Post-test M ± SD	Difference M ± SD	t	*p*
Knee extensor Lt. (Kg)	Exp.	14.38 ± 2.87	16.59 ± 2.70	2.21 ± 2.26	4.6	0
	Cont.	13.60 ± 3.03	13.77 ± 3.26	-0.83 ± 2.17		
Rt. (Kg)	Exp.	14.48 ± 2.34	16.59 ± 2.48	2.11 ± 2.90	3.38	0.002
	Cont.	12.98 ± 3.27	13.68 ± 3.09	-0.30 ± 1.70		
Knee flexor Lt. (Kg)	Exp.	12.79 ± 2.02	14.90 ± 2.00	2.11 ± 14.9	5.51	0
	Cont.	12.04 ± 2.46	12.70 ± 2.69	-0.34 ± 1.50		
Rt. (Kg)	Exp.	13.45 ± 1.84	14.95 ± 1.32	1.49 ± 1.38	3.73	0
	Cont.	12.45 ± 2.67	13.30 ±2.77	0.16 ± 1.57		
Ankle plantarflexor Lt. (Kg)	Exp.	17.61 ± 3.78	21.02 ± 5.55	3.41 ± 4.25	2.69	0.011
	Cont.	17.27 ± 5.24	18.82 ± 4.67	0.55 ± 2.64		
Rt. (Kg)	Exp.	18.40 ± 3.75	21.05 ± 4.41	2.65 ± 3.37	1.99	0.054
	Cont.	17.41 ± 4.46	19.03 ± 4.15	0.63 ± 3.45		
Ankle dorsiflexor Lt. (Kg)	Exp.	13.71 ± 2.50	15.04 ± 1.90	1.32 ± 2.12	3.97	0
	Cont.	13.09 ± 2.94	13.17 ± 3.19	-0.92 ± 1.65		
Rt. (Kg)	Exp.	14.03 ± 1.86	15.44 ± 1.51	2.65 ± 3.37	4.36	0
	Cont.	13.17 ± 2.70	13.40 ± 3.15	0.63 ± 3.45		
ROM of Plantar flexion(˚)	Exp.	32.89 ± 10.14	36.64 ± 8.98	3.75 ± 6.68	2.88	0.006
	Cont.	36.54 ± 5.35	34.67 ± 7.43	-1.87 ± 5.39		
ROM of Dorsi flexion(˚)	Exp.	14.68 ± 4.80	16.89 ± 3.26	2.21 ± 4.03	2.01	0.049
	Cont.	16.67 ± 2.98	16.91 ± 2.61	0.24 ± 2.79		
IADL	Exp.	17.67 ± 0.73	17.33 ± 1.98	-0.33 ± 2.13	0.51	0.61
	Cont.	16.96 ± 2.70	17.00 ± 1.81	0.04 ± 2.67		
Depression	Exp.	5.76 ± 3.62	4.55 ± 3.05	-1.48 ± 1.97	2.51	0.016
	Cont.	5.78 ± 3.33	6.26 ± 3.33	0.48 ± 3.03		

ROM, range of motion; IADLs, instrumental activities of daily living.

Table 4. Comparison of Balance between the Experimental and Control Groups

Balance (Tandem stand)		Experimental group (N=22)				Control group (N=23)			
		Pre test N (%)	Post test N (%)	X^2	*p*	Pre test N (%)	Post test N (%)	X^2	*p*
With eyes open	Completed	16 (72.7)	21 (95.5)	4.247	0.039	18 (78.3)	19 (82.6)	0.138	1
	Not-completed	6 (27.3)	1 (4.5)			5 (21.7)	4 (17.4)		
With eyes closed	Completed	14 (63.6)	20 (90.9)	4.659	0.023	16 (69.6)	17 (73.9)	0.107	1
	Not-completed	8 (36.4)	2 (9.1)			7 (30.4)	6 (26.1)		

are poor balance and decreased muscle strength in the extensors and flexors of the knees and ankles, along with markedly decreased plantar-dorsiflexion torque.[27,28] Adequate muscle strength and ROM are necessary for an individual to maintain balance when a disruption in position occurs.

Most of the outcome variables for the experimental group showed significant changes in the desired direction, except muscle strength of right ankle and IADLs, indicating FPEP is an effective means to improve muscle strength of the lower extremity, ankle joint flexibility and balance, and to reduce depression. These findings are consistent with those by other investigators who had used activity or exercise programs for the elderly.[9-11,17]

Mills[17] explained that as more subjects were right-sided dominant, it was easier for them to exercise the right leg. In Mills' study, the experimental group with low-intensity exercise for 8 weeks experienced a significant increase in right-knee, but not left knee, flexor muscle strength. That is because as other researchers, except Lee,[29] had reported only unilateral values, the investigators tried to find any differences on different sides of the lower extremities by measuring muscle strength each side of the knees and ankles; however the result of this study did not support Mills.[17]

The experimental group revealed a significant increase in strength of flexor and extensor muscle of each knee, dorsiflexor muscles of each ankle and plantarflexor muscle of left ankle. Plantarflexor muscle strength of right ankle was not significantly different. However, this result should not be considered as conclusive because of the limited sample size of this study. Therefore, it is conceivable that the desired outcome of enhancing the plantarflexor muscle strength of right ankle could be achievable with a larger sample.

After 8-week FPEP consisting of ROM exercises, subjects in the experimental group decreased ankle plantarflexor stiffness resulting from plantarflexor strengthening, while this study did not examine the functional outcome or effects of improved gait and balance. In support of this result, some of the previous community-based studies had found a significant relationship between strength training and increased lower extremity muscle strength.[7,30,31] Regular and low-intensity exercise for the elderly, such as participating in a regular program of seated exercises aimed at strengthening quadriceps muscles and improving joint flexibility, may be effective as well in improving functional capacity.[32]

With respect to balance, the tandem stand test with eyes open was a moderately difficult task for the subjects, with over 20% of all subjects not being able to complete it, and tandem stand with eyes closed was even more difficult for the subjects, with over 30% of them not being able to complete it. The number of subjects who did not complete the above two tasks decreased in the experimental group compared to that of the control group. Nevertheless, because of their difficulty, these two tests showed the greatest improvement with FPEP.

The IADLs scale employed in this study was not appropriate to differentiate the effect of FPEP. The IADLs score of each group was around 17 out of the maximum possible.[18] A possible explanation for the lack of significant changes in this study is that the 9 items of IADLs were mainly related to the function of the upper extremity, while FPEP is more effective in enhancing the function of the lower extremity.

This study has shown that the 8-week FPEP produced significantly effective improvements in enhancing muscle strength, ankle flexibility and balance, and in reducing depression, among community-dwelling elderly in Korea.

More research is needed to determine the role of self-efficacy in FPEP, especially use of a larger sample and longer follow up period, in order to understand more about the effects of FPEP. Future study is also recommended to differentiate between the effects of FPEP by direct instruction program and by videotaped.

REFERENCES

1. Ministry of Health and Welfare of Korea. Trend of population, sex ratio and population density; 2001.
2. Tideiksaar R. Falling in old age. New York: Springer Publishing Company; 2001.
3. Tinetti ME, Speechly M, Gintter SF. Risk factors for fall among elderly person living in the community. N Engl J Med 1988;319:1701-9.

4. Downton JH, Andrews K. Prevalence, characteristics and factors associated with falls among the elderly living at home. Aging 1991;3:189-94.
5. Sohng KY, Moon JS, Kang SS, Choi JH. The survey of activities and fear of falling in the community dwelling elderly. J Korea Community Health Nurs Acad Soc 2001;15:324-33.
6. Hwang ON. A survey on the factors associated with falls among the elderly. J Korean Acad Soc Adul Nurs 1998;10:337-52.
7. Lord SR, Castell S. Physical activity for older persons: Effect on balance, strength, neuromuscular control, and reaction time. Arch Phys Med Rehabil 1994;75:648-52.
8. Rubenstein LZ, Josephson KR, Trueblood PR, Loy S, Harker JO, Pietruszka FM, et al. Effects of a group exercise program on strength, mobility, and falls among fall-prone elderly men. J Gerontol A Biol Sci Med Sci 2000;55:M317-21.
9. Schoenfelder DP. A fall prevention program for elderly individuals-exercise in long-term care settings. J Gerontol Nurs 2000;26:43-51.
10. Choi JH. The effects of Tai Chi exercise on physiologic, psychological functions, and fall in fall prone elderly. Doctoral dissertation. Seoul: The Catholic University of Korea; 2002.
11. Jeon MY. Effect of fall prevention program on gait, balance and muscle strength in elderly women at a nursing home. Doctoral dissertation, Seoul: Seoul National University; 2001.
12. Sohng KY, Lee SY. A survey on perceived health status and health promoting life style patterns between Korean elderly and Korean-American elderly. J Korean Acad Fund Nurs 2000;7:401-14.
13. Sohng KY, Sohng S, Yeom HA. Health-promoting behaviors of elderly Korean immigrants in the United States. Public Health Nurs 2002;19:294-300.
14. Park JH, Kwon YC. Standardization of Korean version of the Mini-Mental State Examination for use in the elderly. Part II: Diagnostic validity. J Korean Neuropsychiatr Assoc 1989;28:508-13.
15. Lee EO, Lim NY, Park HA. Statistical analysis in nursing and allied health science. Seoul: Soomoon Publishing Co.; 1996.
16. Kendall FP, McCreary EK. Muscle testing and function. Baltimore: Williams & Wilkins; 1983.
17. Mills EM. The effect of low-intensity aerobic exercise on muscle strength, flexibility, and balance among sedentary elderly persons. Nurs Res 1994;43:207-11.
18. Norkin CC, White DJ. Measurement of joint motion: A guide to goniometry. Philadelphia: Davis; 1985.
19. Gogia PP, Braatz JH, Rose SJ, Norton BJ. Reliability and validity of goniometric measurement at the knee. Phys Ther 1987;67:192-5.
20. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, et al. Development and validation of geriatric depression rating scale: a preliminary report. J Psychiatr Res 1983;17:37-49.
21. Kee BS. A preliminary study for the standardization of geriatric depression scale form-Korea version. J Korean Neuropsychiatr Assoc 1996;35:298-307.
22. Cho, JY. Functional Assessment of the elderly. J Korean Acad Fam Med 1998;19:1197-206.
23. Lawton MP, Brody EM. Assessment of older people: Self-maintaining and instrumental activities of daily living. Gerontologist 1969;9:179-85.
24. Nieman DC, Warren BJ, O'Donnell KA, Dotson RG, Butterworth DE, Henson DA. Physical activity and serum lipids and lipoproteins in elderly women. J Am Geriatr Assoc 1993;41:1339-44.
25. Bandura A. Self-efficacy: The exercise of control. New York: W. H. Freeman and Company; 1997.
26. Shin YH. The effect of walking exercise program on physical function and emotional state in elderly women. Doctoral dissertation, Seoul: Ewha Womens University; 1997.
27. Whipple RH, Wolfson LI, Amerman PM. The relationship of knee and ankle weakness to falls in nursing residents: An isokinetic study. J Am Geriatr Soc 1987; 35:13-20.
28. Ring C, Nayak USL, Issac B. Balance function in elderly people who have and who have not fallen. Arch Phys Med Rehabil 1988;69:261-4.
29. Lee YR. The effect of dance therapy on physical and psychological characteristics in the elderly. Doctoral dissertation, Seoul: The Catholic University of Korea; 1999.
30. Buchner DM, Hornbrook MC, Kutner NG, Tinetti ME, Ory MG, Mulrow CD, et al. Development of the common data base for the FICSIT trials. J Am Geriatr Soc 1993;41:297-308.
31. Heislein DM, Harris BA, Jette AM. A strength training program for postmenopausal women: A pilot study. Arch Phys Med Rehabil 1994;75:198-204.
32. McMurdo MET, Rennie LM. Improvements in quadriceps strength with regular seated exercise in the institutionalized elderly. Arch Phys Med Rehabil 1994; 75:600-3.