Original Article

The Effects of a Multicomponent Fall Prevention Intervention on Fall Prevalence, Depression, and Balance among Nursing Home Residents

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Abstract

Background: More than 60% of fall incidents among older adults are multifactorial. **Objectives:** This study aimed to investigate the effects of a multicomponent fall prevention intervention on fall prevalence, depression, and balance among nursing home residents. **Methods:** This pretest-posttest quasiexperimental study was conducted in 2014 on 160 residents of a nursing home in Tehran, Iran. A 4-month multicomponent fall prevention intervention was implemented with a 2-month follow-up. The intervention consisted of educations for nursing home residents and staff, environmental modifications, and stretching, strengthening, and balance-improving exercises for residents. A fall frequency form, the performance-oriented mobility assessment, the timed up and go test, the geriatric depression scale, the Katz index of independence in activities of daily living, and the mini-mental state examination test were used for data collection both before and 6 months after the intervention onset. Data analysis was done using the paired-sample *t*, independent-sample *t*, Wilcoxon signed-rank, Mann–Whitney U, and Kruskal–Wallis tests as well as the one-way analysis of variance. **Results:** The mean scores of fall frequency, mobility, balance, and depression among nursing home residents significantly changed from 2.40 ± 0.93, 17.93 ± 4.69 and 20.77 ± 6.91, and 10.14 ± 6.85 at pretest to 0.20 ± 0.55, 24.53 ± 1.78 and 14.11 ± 3.74, and 8.23 ± 5.17 at posttest, respectively. **Conclusion:** Multicomponent intervention is effective in significantly reducing fall prevalence and depression and improving balance and mobility among older adults. Nurses can use such interventions to enhance older adults' mobility, improve their balance, relieve their depression, and reduce their risk of fall.

Keywords: *Balance, Depression, Fall, Nursing home, Older people, Prevention*

Introduction

Fall is a major health problem among older adults. Its prevalence in healthcare settings is 30%–66% and is estimated to be even higher in nursing homes.[1] After fall, older adults may lose their independence and confidence in doing their daily activities and may be unable to return to their pre-fall functional level.[2]

A number of studies showed that well-designed preventive programs can prevent falls in older adults living at home.[3,4] However, evidence that these programs can also prevent fall aftermaths is poor. This paucity is somewhat because a majority of the previous studies were underpowered to examine the effect of interventions on falls aftermaths. A systematic review reported that fall prevention interventions could decrease the risk of fractures.[3] Another study reported that a fall prevention program could improve the older adults' functional tests, dynamic balance, and depression, but did not affect their static

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balance.[5] Some of the studies concluded that fall is a multifactorial phenomenon caused by different variables.[6] Therefore, fall prevention interventions also should be multimodal.[2] However, despite the benefits of multimodal preventive interventions, there are controversies over the effectiveness of such intervention in preventing fall and consequent injuries among older adults.[7-9] A study also argued that the benefits of multimodal fall prevention interventions and concluded that single fall prevention interventions might be more effective among community-dwelling older people.[10]

Because, older adults who live in nursing homes, have a sever risk of falling,[11] it is essential for nurses to prevent fall among older adults by executing preventive interventions. However, given the controversy about the impact of fall prevention interventions, further studies are needed to provide conclusive evidence respecting the effects of such interventions on fall prevalence and fall injuries among nursing home residents.

Objectives

This study aimed to investigate the effects of a multicomponent fall prevention intervention on fall prevalence, depression, and balance among nursing home residents.

Methods

This pretest-posttest quasiexperimental study was conducted from March to September 2014 in a nursing home in Tehran, Iran. Eligibility criteria for older adults were an age of sixty or more, history of fall in the last 6 months with no obvious injury, residence in nursing homes for at least 1 year, moderate-to-high levels of physical functionality (a score of 4 or more for the Katz Index of Independence in Activities of Daily Living test,[12] and moderate-to-high cognitive ability (determined by a score of 17 or more for the mini-mental state examination [MMSE]).[13] Inclusion criteria for healthcare providers (i.e., nurses and nurse assistants) were willingness to participate, care provision to older adults in nursing homes, and no previous participation in fall prevention training programs. Exclusion criteria for older adults were voluntary withdrawal from the study and absences in more than two train sessions. Exclusion criteria for healthcare providers were voluntary withdrawal from the study and absences in more than one training sessions. Due to the number of older adults in the study setting was less than limited, we used the census method to recruit all eligible older adults. Accordingly, 160 nursing home residents (i.e., 130 females and 30 males) were recruited into the study.

Intervention

The multicomponent fall prevention intervention in the present study consisted of educations for both older adults and healthcare providers, environmental modifications, and 4-month physical exercise sessions for older adults, with a 2-month follow-up.

Initially, fall prevention educations were provided by a research assistant to both older adults and healthcare providers. Educations were provided through lectures and educational booklets in weekly sessions which lasted 30–40 min. Educational materials were related to fall risk factors, mobility aids, and best stretching, strengthening, and balance-improving exercises for fall prevention [Table 1]. Older adults attended educational sessions in 25-person groups. At the end of each session, participants' questions, if any, were answered. The educational intervention for healthcare providers and older adults lasted one and 2 months, respectively.

Physical exercise sessions included light-to-heavy stretching, strengthening, and balance-improving exercises. These sessions were held by a research assistant 3-times a week between 08:00 and 10:00 for four consecutive months.[14] Older adults participated in exercise sessions in thirty-person groups. Initially, each session consisted of 5-min warm-up exercise, 20-min stretching, strengthening, and balance-improving exercises, and 5-min cool-down exercise. However, the length of the exercise sessions was gradually increased to 45–60 min. Stretching exercises focused on the neck, shoulder, thigh, knee, and elbow joints, while strengthening exercises included extension of the hip, flexion and extension of the knee, and

Table 1: The outline of the educational intervention for older adults and healthcare providers

Contents
Fall risk factors
Intrinsic risk factors: Previous history of fall, age, gender, living alone, ethnicity, medications, medical conditions, impaired mobility and gait, sedentary lifestyle, psychological status, fear of falling, nutritional deficiencies, impaired cognition, visual impairments, and foot problems
Extrinsic risk factors: Environmental dangers (poor lighting, slick floors, rough surfaces, etc.,) footwear and clothing, unsuitable walking aids or helpful devices
Exercise
Strengthening, balance-improving, and stretching exercises
Mobility aids
Using canes, walkers, and wheelchairs
Other
The knowledge related to the side effects of drugs and the necessity of medical follow-up assessments

flexion and extension of the feet from the ankle joint. Balance-improving exercises also included standing up from the sitting position, walking forward, backward, and sideways in a straight line, and a final 360° turn.[15] A research assistant and a physician-supervised the exercise sessions.

For environmental modification, the main researcher (MJ) assessed the nursing home environment for the environmental risk factors of fall using an environmental risk assessment tool.[16] Then, environmental modifications [Table 2] were made with the collaboration of nursing home authorities. Moreover, the MJ and a physician assessed all nursing home residents for their medications to determine their medication adherence and also possible medication-related problems.

Data collection

Main data collection instruments were a demographic and illness-related characteristics questionnaire, a fall frequency form, the performance-oriented mobility assessment (POMA), the timed up and go (TUG) test, and the geriatric depression scale (GDS). Moreover, the Katz index of independence in activities of daily living and the MMSE were used to assess participants for eligibility. The demographic and illness-related characteristics questionnaire contained items on age, gender, history of injury, education level, years of nursing home residence, family support, history of cigarette smoking, affliction by osteoporosis, affliction by chronic illnesses, and polypharmacy, i.e., taking more than five medications a day.[17]

POMA examines problems associated with balance and walking. It contains 26 items, thirteen for balance assessment and thirteen for gait assessment. Some items are scored as 0 or 1 and some others are scored from 0 to 2. The score "0" indicates the highest level of impairment and "2" the individuals independence.

Total balance and gait score are 16 and 12, respectively with the total test score of 28. A total score of <19 indicated a high risk for fall, while scores 19–23 and 24–28 showed moderate and low fall risk, respectively.[18] An earlier study confirmed the validity and reliability of POMA with an interrater correlation coefficient of 0.93.[18]

Table 2: Environmental modifications in this study

Hazards	Recommendations
Poor lighting in some areas such as hallways	Using lamps to increase lighting Closing the curtains and opening windows daytimes to improve lighting
Uneven and slippery surfaces and some pits in the yard	Covering pits using asphalt
The use of open shoes such as slippers	Residents should wear lace-up shoes

Timed up and go test

Participants were asked to sit on a standard chair (with a seat height of 46 cm and a chair handle height of 63 cm). With examiner command, they stood, walked straightforward 3 m with their own usual gait style, turned, walked back toward the chair, and sat on it again.[19] The examiner recorded the time spent on doing this task using a chronometer. TUG is scored as follows: <10 s: Normal to high motor ability; 10–19 s: Ordinary mobility and independence in walking; 20–29 s: Sluggish mobility, impaired balance, and need for help during walking; more than 30 s: Low level of mobility and high risk for fall.[18] A study in Iran reported that TUG had acceptable validity and reliability with an interrater correlation coefficient of 0.81.[20]

Geriatric depression scale

This scale had fifteen items with a total score of 0–15. Scores 0–4 showed normal condition, while scores 5–8, 9–11, 12–15 indicated mild, moderate, and severe depression, respectively.[21] In the present study, scores five and more were considered as affliction by depression. The Persian version of GDS has acceptable validity and reliability with a Cronbach's alpha of 0.9.[22]

Katz index of independence in activities of daily living

This index assesses older adults' ability to perform activities of daily living such as bathing, dressing, toileting, moving, eating, and urinary continence using a 0 (dependence) or 1 (independence) scoring scale. Nursing home residents who obtained scores 4 or more were included in the present study. The Persian version of this scale has good validity and reliability with a Cronbach's alpha of 0.71.[23]

Mini-mental state examination

With 30 items, this questionnaire measures the severity and the progression of cognitive impairments. Maximum possible total score of MMSE can be 30. Scores are interpreted as the following: 9 or less: severe impairment; 10–18: moderate impairment; 19–23: mild impairment; and 24–30: normal condition.[24] An earlier study reported that the Persian MMSE had acceptable validity and reliability with a Cronbach's alpha of 0.77.[25]

For data collection, older adults were asked to complete the main data collection tools of the study before and 6 months after the intervention onset.

Ethical considerations

Necessary approval for conducting this study on human subjects was obtained from Tehran University of Medical Sciences (approval code: 130.2624.D.91). The study was also registered in the Iranian Registry of Clinical Trials (with the registration code of IRCT2013120115608N1). The objectives of the study were explained to participants and they were informed of their rights to voluntarily participate in or withdraw from the study without undergoing any change in their care plans. All participants signed written informed consent for participation.

Data analysis

All data analyses were conducted through the SPSS for Windows program v. 13.0 (SPSS Inc., Chicago, IL, USA). The Kolmogorov–Smirnov test was run to check the normality of the data. The results showed that the scores of POMA, GDS, and TUG did not follow normal distribution, while the frequency of fall had normal distribution. Consequently, before-after within-group comparisons regarding the frequency of fall and the mean scores of POMA, GDS, and TUG were made through the paired-sample *t* and the Wilcoxon signed-rank tests, respectively. Moreover, between-group comparisons regarding the frequency of fall were made through the independent-sample *t*-test and the one-way analysis of variance, while between-group comparisons regarding the mean scores of POMA, GDS, and TUG were made through the Mann–Whitney U and the Kruskal–Wallis tests. $P < 0.05$ were considered statistically significant.

Results

Most participating older adults were female (81.2%). The means of their age and their years of nursing home residence were 67.63 ± 9.07 and 8.22 ± 6.72, respectively. While none of the participants were on polypharmacy, around 81.9% of them were using some medications in the last 6 months such as antihypertensive agents (35%), antidepressants (50%), anti-osteoporotic agents (25%), and sedative agents (48%). They received limited family support, but some of their family members visited them at weekends. Table 3 shows fall frequency and the mean scores of POMA, GDS, and TUG based on participants' demographic and illness-related characteristics. On the other hand, 85% of the participating healthcare providers were female, and 50% were staff nurses. None of them had already received fall-related educations.

The mean of fall frequency at pretest was 2.40 ± 0.93, which significantly decreased to 0.20 ± 0.55 at posttest ($P < 0.001$). Moreover, the mean score of mobility (measured using POMA) significantly increased from 17.93 ± 4.69 at pretest to 24.53 ± 1.78 at posttest ($P < 0.001$). In addition, the mean score of TUG was 20.77 ± 6.91 at pretest, which significantly decreased to 14.11 ± 3.74 at posttest ($P < 0.001$). Finally, the mean score of GDS also significantly decreased from 10.14 ± 6.85 at pretest to 8.23 ± 5.17 at posttest [$P < 0.001$; Table 4].

Discussion

Results showed the effectiveness of the intervention in significantly reducing fall prevalence and depression and improving balance and mobility. These findings are consistent with the findings of some earlier studies which reported the positive effects of multicomponent interventions on fall prevention in nursing homes.[26,27] However, a study showed that multicomponent fall prevention program had no significant effects on fall incidence among older adults.[2] The effectiveness of our intervention can be attributed to the fact that we attempted to manage all fall risk factors through improving residents' balance by physical exercise, reducing depression symptoms, providing fall-related educations to both healthcare providers and nursing home residents, and making environmental modifications. However, interventions in previous studies were mostly limited to physical exercise, dietary modifications, and education for older adults.

Our findings also showed that the multicomponent intervention significantly reduced depression among older adults. This is in line with the findings of two previous studies.[2,28] Older adults in the present study participated in the exercise program and educational sessions in groups, and hence, they had the opportunity to communicate and interact with each other. Such social interactions might have contributed to depression reduction in the present study.

Another finding of the study was the positive effects of the study intervention on older adults' balance. Some previous studies also showed that exercise can improve balance and muscle strength among older adults.[29,30] Yet, a study reported that endurance and strengthening exercises had no significant effects on older adults' gait and balance status.[31] Perhaps, due to the multifactorial nature of fall, single-component interventions are not as effective as multicomponent interventions in reducing fall incidence.[30]

We also found that some demographic characteristics were significantly correlated with fall prevalence, balance, and depression. For instance, female older adults had significantly poorer balance, greater fall prevalence, and more severe depression compared to their male counterparts. Similarly, an earlier study reported that women experienced more fall episodes than men.[32] Greater incidence of fall is associated with more depressive episodes.[33] We also found

Table 3: The mean scores of fall frequency, Performance-Oriented Mobility Assessment, Timed Up and Go, and Geriatric Depression Scale based on participants' characteristics

Demographic variables	*n* (%)	Fall frequency		POMA		TUG		GDS	
		Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*	Mean ± SD	*P*
Gender									
Male	30 (18.8)	3.06 ± 0.73	<0.001[a]	18.23 ± 5.28	<0.001[c]	20.03 ± 7.77	<0.001[c]	7.40 ± 1.32	<0.001[c]
Female	130 (81.2)	2.24 ± 0.90		17.86 ± 4.56		20.94 ± 6.71		8.46 ± 2.03	
Age (years)									
60-75	126 (78.8)	2.35 ± 0.92	<0.001[b]	17.80 ± 4.70	<0.001[b]	16.14 ± 8.45	<0.001[b]	8.33 ± 1.98	<0.001[b]
75-85	27 (16.9)	2.59 ± 0.27		18.33 ± 4.93		20.77 ± 6.76		7.92 ± 1.89	
85-95	7 (4.3)	2.42 ± 0.53		18.71 ± 4.02		21.96 ± 6.98		8.42 ± 1.81	
Injury									
No obvious	100 (62.0)	2.40 ± 0.86	0.43[d]	18.09 ± 4.69	0.08[b]	20.83 ± 6.26	0.33[b]	8.06 ± 1.81	0.48[b]
Abrasions and bruising in hands	30 (19.0)	2.40 ± 1.00		18.23 ± 4.96		20.86 ± 8.27		8.40 ± 2.22	
Ankle sprain and knee pain	10 (6.0)	2.25 ± 0.91		15.85 ± 4.42		19.50 ± 7.28		8.65 ± 2.39	
Bruising and excoriation of foot	20 (13.0)	2.70 ± 1.41		19.70 ± 3.49		22.50 ± 8.55		9.20 ± 1.39	
Education level									
Illiterate	66 (41.2)	2.24 ± 0.97	0.20[d]	16.92 ± 5.21	0.18[b]	20.03 ± 7.40	0.05[b]	8.37 ± 2.05	<0.001[b]
Primary school	78 (48.8)	2.56 ± 0.92		18.55 ± 4.08		21.92 ± 6.73		8.24 ± 1.95	
Junior high school	9 (5.6)	2.33 ± 0.50		18.77 ± 5.42		17.88 ± 3.82		7.55 ± 2.06	
Senior high school	7 (4.4)	2.16 ± 0.98		19.00 ± 4.00		19.00 ± 5.93		8.50 ± 0.83	
Marital status									
Single	68 (42.5)	2.44 ± 0.98	0.03[d]	18.91 ± 4.36	0.01[b]	19.88 ± 7.36	0.02[b]	8.27 ± 1.96	<0.001[b]
Married	46 (28.7)	2.34 ± 0.87		17.23 ± 4.51		21.93 ± 6.76		8.30 ± 1.94	
Divorced	22 (13.8)	2.27 ± 0.88		18.86 ± 4.64		19.63 ± 4.30		8.18 ± 1.65	
Widowed	24 (15.0)	2.5 ± 0.97		15.66 ± 5.19		22.15 ± 7.58		8.25 ± 2.34	
Years of residence									
1-10	123 (76.9)	2.32 ± 0.87	0.35[d]	17.62 ± 4.73	0.41[b]	21.00 ± 7.18	0.47[b]	8.28 ± 1.99	<0.001[b]
10-20	31 (19.4)	2.61 ± 1.14		18.93 ± 4.58		20.77 ± 5.72		8.51 ± 1.80	
20-30	6 (3.8)	2.83 ± 0.75		19.16 ± 4.11		16.00 ± 5.86		6.66 ± 1.36	
Smoking									
Yes	19 (11.9)	2.57 ± 1.12	0.04[a]	20.00 ± 2.94	0.02[c]	17.73 ± 6.34	0.01[c]	8.21 ± 1.81	0.14[c]
No	141 (88.1)	2.37 ± 0.90		17.65 ± 4.82		21.18 ± 6.90		8.27 ± 1.98	
Medication use									
Yes	131 (81.9)	2.61 ± 0.86	<0.001[a]	18.07 ± 4.81	<0.001[c]	20.75 ± 7.20	0.99[c]	8.15 ± 1.96	0.59[c]
No	29 (18.1)	1.41 ± 0.50		17.31 ± 4.08		20.86 ± 5.50		8.79 ± 1.87	
Osteoporosis									
Yes	96 (60.0)	1.74 ± 0.57	0.01[a]	18.30 ± 4.56	0.03[c]	18.57 ± 6.61	<0.001[c]	8.67 ± 1.91	0.42[c]
No	64 (40.0)	2.78 ± 0.88		17.72 ± 4.77		22.05 ± 6.79		8.26 ± 1.95	

[a]Independent-sample *t*-test; [b]Kruskal–Wallis test; [c]Mann–Whitney U-test, [d]One-way ANOVA. POMA: Performance-Oriented Mobility Assessment, TUG: Timed Up and Go test, GDS: Geriatric Depression Scale, ANOVA: Analysis of variance, SD: Standard deviation

greater fall prevalence and poorer balance among participants with older ages. This is congruent with the findings of an earlier study.[34] People with older ages use a wide range of balance-affecting medications including psychotropic, sedative, and antihypertensive medications.[35] Moreover, our findings showed that older adults with osteoporosis had poorer balance and more falling experiences, which are in line with the findings of a previous report.[36] Although there a little difference in fall frequency among the smokers compared with non-smokers, but the smokers had fall experiences more than nonsmokers, which is consistent with a previous study that showed the smoker older adults have more fall frequency with more injuries than non-smokers.[37] Regarding the marital status, there was a small but significant difference in the number of falls, balance, mobility, and depression. The widowed and single older adults had a higher fall rate than married and divorced ones. Regarding the mobility, balance, and depression, the divorced had a better status than the others. No similar studies were accessible in this regard, however, a study reported that widowed older

Table 4: The pre- and post-test mean scores of fall frequency, Performance-Oriented Mobility Assessment, Timed Up and Go, and Geriatric Depression Scale

Variables	Before, *n* (%)	After, *n* (%)	*P*
Fall frequency			
0	0 (0.0)	138 (86.2)	
1-3	147 (91.9)	22 (13.8)	
4-5	13 (8.1)	0 (0.0)	
Mean±SD	2.4 ± 0.93	0.20 ± 0.55	<0.001[a]
POMA			
High fall risk	94 (58.8)	0 (0.0)	
Moderate fall risk	42 (26.2)	24 (15.0)	
Low fall risk	24 (15.0)	136 (85.0)	
Mean±SD	18.41 ± 3.87	24.53 ± 1.78	<0.001[b]
TUG (s)			
<10	6 (3.8)	46 (28.8)	
10-20	63 (39.4)	64 (40.0)	
20-30	54 (33.8)	41 (25.6)	
>30	37 (23.1)	9 (5.6)	
Mean±SD	20.58 ± 7.10	14.11 ± 3.74	<0.001[b]
GDS			
1-5	112 (3.8)	146 (28.8)	
6-15	48 (39.4)	14 (40.0)	
Mean±SD	10.14 ± 6.85	8.23 ± 5.17	<0.001[b]

[a]Paired-sample *t*-test; [b]Wilcoxon signed-rank test. POMA: Performance-Oriented Mobility Assessment, TUG: Timed Up and Go test, GDS: Geriatric Depression Scale, SD: Standard deviation

adults were more likely to have fall and fear of falling compared to other age groups.[38] The severity of depression in the elderly with more years of residence in the nursing home and the elderly with junior high school education was significantly low than others. Moreover, the elderly with a longer duration of residency suffer from less depression which can be attributable to the fact that they were accustomed to living in the nursing home. Finally, there was no significant difference between the type of injury and falling number, balance, mobility and depression.

This study had some limitations. The first was related to the study setting, in that most local nursing homes were not willing to collaborate and hence, the study was done in a single setting with no control group. Of course, the selected nursing home was one of the largest nursing homes in Tehran with admissions from different areas of the city. The second limitation was related to the sampling method. Due to the number of older adults in the study setting was <500, we used the census method, instead of random sampling, to include in the study the maximum number of eligible older adults. Accordingly, further studies with control group and random samples of older adults are recommended. Replication of the study among community-dwelling older adults can be another area for study.

Conclusion

This study indicates that multicomponent intervention is effective in significantly reducing fall prevalence, relieving depression, and improving balance and mobility among older adults. Healthcare providers, particularly nurses, can use such interventions to enhance older adults' mobility, improve their balance, relieve their depression, and reduce their risk for fall.

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Conflicts of interest

The authors declare no conflict of interests.

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