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An Occupational Therapy Fall Reduction Home Visit Program for Community-Dwelling Older Adults in Hong Kong After an Emergency Department Visit for a Fall

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ABSTRACT

Objectives: To investigate the effects of an occupational therapy fall reduction home visit program for older adults admitted to the emergency department (ED) for a fall and discharged directly home.

Design: Single-blind, multicenter, randomized, controlled trial.

Settings: EDs in three acute care hospitals in Hong Kong.

Participants: Individuals aged 65 and older who had fallen (N=311).

Interventions: After screening for eligibility, 204 consenting individuals were randomly assigned to an intervention group (IG) and received a single home visit from an occupational therapist (OT) within 2 weeks after discharge from the hospital or a control group (CG) and received a well-wishing visit from a research assistant not trained in fall prevention.

Measurements: Both groups were followed for 12 months through telephone calls made every 2 weeks by blinded assessors with a focus on the frequency of falls. Another blinded assessor followed up on their status with telephone calls 4, 8, and 12 months after ED discharge. Prospective fall records on hospital admissions were retrieved from electronic databases; 198 individuals were followed for 1 year on an intention-to-treat basis.

Results: The percentage of fallers over 1 year was 13.7% in the IG (n = 95) and 20.4% in the CG (n = 103). There were significant differences in the number of fallers (p=.03) and the number of falls (p=.02) between the two groups over 6 months. Significant differences were found in survival analysis for first fall at 6 months (log-rank test 5.052, p=.02) but not 9 or 12 months.

Conclusion: One OT visit after a fall was more effective than a well-wishing visit at reducing future falls at 6 months. A booster OT visit at 6 months is suggested.

Key words: falls reduction, emergency department, occupational therapy, older adults, home visit

The prevalence of falls in the elderly population is well documented worldwide.[1] In a prospective population-based cohort study in Hong Kong, the 1-year prevalence of falls in older adults was 16% to 19%, and the mean number of falls per faller was 1.4.[2–4] The consequences of falls can be serious. In Hong Kong, studies have shown that 9.9% of falls result in bone fractures and 31.3% in soft tissue injuries.[5]

Older adults account for approximately 8% to 10% of fall-related visits made to emergency departments (EDs).[6–7] According to one study, between one-third and half of all ED visits by older adults result in hospital admission, a hospitalization rate 2.5 to 4.6 times as high as that for younger individuals.[8] Various interventions, including multifactorial assessments, have been shown to reduce falls; safety assessment and modification interventions are effective in reducing the rate of falls (relative risk (RR)=0.81, 95% CI=0.68–0.97), especially in people at higher risk of falling and when performed by occupational therapists (OTs).[9] The Prevention of Falls in the Elderly Trial demonstrated that a group of fallers who visited the ED and then received an interdisciplinary approach including a medical assessment and a single OT home visit had a lower risk of falling (odds ratio=0.39, 95% confidence interval (CI)=0.23–0.66).[7] A randomized controlled study reported a 36% reduction in falls in discharged inpatients with a history of falls from selected hospital wards after a single OT home visit intervention.[10]

OTs are employed in EDs in Britain and Australia to determine whether individuals—most of whom are older adults who experience falls but sustain no major injury—are safe to return home and to inform inpatient hospital admission decisions.[11–13] The provision of OTs in the EDs of various hospitals in Britain has been found to be cost effective because it reduces the number of unnecessary and costly hospital admissions from EDs.[14] One of the roles of OTs in EDs is to make

home visits and provide home environmental interventions. According to updated guidelines from the Panel on Prevention of Falls in Older Persons from the American Geriatrics Society and British Geriatrics Society, [15] evidence of the effectiveness of a home environment assessment and intervention as part of a multifactorial fall prevention program is strong. A metaanalysis has shown that delivering home environmental interventions is effective in fall risk reduction, reducing the incidence of falls by 21% across all studies (relative risk (RR)=0.79, 95% CI=0.65–0.97) and by 39% in populations at high risk of falls (RR=0.61, 95% CI=0.47–0.79).[16] A randomized trial showed that adaptation or modification of the home environment is particularly beneficial in high-risk community-dwelling frail older adults with a history of falls,[17] but there has been no thorough study of the effects of OT home visits in reducing falls in community-dwelling elderly adults who have fallen after a visit to the ED. The purpose of this study was to determine the effects of an OT fall reduction home visit program on older adults who visited the EDs of acute care hospitals in Hong Kong because of falls and were discharged directly home.

METHODS

Participants

Individuals were included if they were aged 65 and above, were community dwelling, were ambulatory with or without a walking aid, and had visited an ED primarily because of a fall. A fall is defined as an event that results in a person coming to rest inadvertently on the ground or hitting an object like a chair or stair.[18,19] Individuals who fell because of excess alcohol intake or sustained a sudden blow or loss of consciousness or sudden onset of paralysis due to stroke or an epileptic seizure were excluded. Those for whom hospital admission for further clinical management was not warranted were invited to provide written consent to participate.

Individuals with a telephone Mini-Mental State Examination (MMSE) [20] score less than 15 and those who were unable or unwilling to provide consent were excluded, as were those residing in nursing homes. Individuals who did not speak Cantonese were excluded for practical reasons.

Sample Size

The sample size calculation was based on an average rate of 1.4±0.8 falls per faller per year from the results of a recent local study of community-dwelling elderly adults in Hong Kong.[2] Accounting for an estimated overall 30% attrition rate, it was assumed that the intervention and control groups were equivalent in size after using block randomization with a random numbers table. A sample size of 220 was needed for a two-sample t-test to detect a 30% reduction in the rate of falls in 12 months with 90% power and hypothesis testing at the .05 significance level (two-tailed).

Study Design

This was a single-blind, multicenter, randomized, controlled trial in three regional acute care hospitals in Hong Kong: Center A—Queen Mary Hospital, Center B—Princess Margaret Hospital, and Center C—Prince of Wales Hospital. Approval was obtained from the ethics committees of each of the participating hospitals before data collection (reference numbers UW 06–372 T/1397; KW/EX/07–011; CRE-2008.527), and informed written consent was obtained from each participant before enrollment.

Treating ED physicians collected baseline information on the fall history and concurrent medical disorders of participants, reviewed their medications, and performed cardiovascular and neurological examinations if indicated. At least one ED physician on each shift was designated for subject recruitment at each participating ED. To standardize recruitment and baseline screening, physicians were trained in procedures for obtaining informed consent and administering the Timed

Up and Go Test and visual acuity test. Participants were then referred to occupational therapy services.

Information on each participant was given to another researcher in the occupational therapy department to administer the telephone MMSE within 5 working days of the participant returning home. If the telephone MMSE score was 15 or greater, demographic details and additional fall history data were confirmed over the telephone. A blinded research assistant administered telephone versions of the Barthel Index-50 (MBI),[21–22] the Chinese version of the Frenchay Activities Index (FAI),[23–25] and the Chinese version of the 4-item Geriatric Depression Scale (GDS-4)[26] during the telephone interview.

Using block randomization (blocks of four), a member of the research team (MMLC) who was blinded and not involved in the screening assessments or any subsequent interventions or data collection randomized participants to an intervention group (IG) or a control group (CG). The investigators ensured that, at each participating ED, at least one OT with experience providing interventions in the home setting was designated and trained in the project in-home protocol.

Within 2 weeks of ED discharge, IG participants received one home visit from the OT. In the same time frame, CG participants received, as an attention control, a well-wishing visit from a research assistant not trained in fall prevention. IG and CG participants also received standard care that included medication and medical follow-up after ED discharge.

Participants in both groups received follow-up telephone calls every 2 weeks from research assistants blinded to randomization and intervention. Participants were asked about any subsequent falls, their dates, resultant injuries, and types of service sought after injury. ED and acute hospital services associated with falls were verified using Hong Kong's centralized electronic clinical management system. Another group of blinded research assistants obtained

information on participants' function (MBI), depression (GDS), and activity level (FAI) in telephone calls 4, 8, and 12 months after ED discharge.

Interventions

The IG home visit by the OT lasted approximately 1.5 hours, during which most of the OT Fall Reduction Home Visit Program, which was designed based on the experiences and evidence presented in previous studies (e.g.,[7,10]) was provided. The program consisted of an environmental hazards evaluation using the Hong Kong Chinese prototype of the Falls Behavioral Scale for the older person[27,28] and the Westmead Home Safety Assessment[29] to identify environmental hazards and potential fall risk in the participant's daily activities, and a daily life routine assessment—to learn the types of activities the participant engaged in on a typical day, fall risk behavior identification to identify the kinds of habitual and intentional day-to-day behaviors that could place a person at undue risk of falling, recommendations for environmental modification, prescription of assistive devices where appropriate, provision of customized fall reduction care plans to participants or caregivers, provision of on-site skills training in fall reduction to participants or caregivers, and referrals to community agencies for other services if needed. Studies have shown a close relationship between home environment and behavioral responses such as fall risk behaviors.[17, 30]

For participants living in public housing, the government funded recommended home modifications requiring additional resources, whereas participants living in private housing paid for modifications themselves. The OT made a follow-up telephone call regarding home modification and assistive devices 2 months after the home visit. A second home visit by the OT was made only if a participant required extra safety checks or advice on major home modifications.

CG participants received a single visit by a research assistant who had no professional training and no knowledge of fall prevention that lasted approximately 1.5 hours, equivalent to the duration of the home visit in the IG; the research assistants focused on showing concern for participants through conversation. The purpose of the well-wishing visit was to provide an attention control and to ensure that CG participants received the same amount of attention and social interaction as IG participants. For quality control, the investigators met on a regular basis, and respectively~~separately~~, with the IG OT interventionists and the staff implementing the CG intervention to assure consistency in implementation. All IG and CG participants were followed every 2 weeks with telephone calls focused on falls.

Measurements

Age, sex, educational level, site of injury, comorbidity, visual and activity of daily living performance, number of drugs taken, activity level, mobility status, use of mobility aids, and social supports were measured at baseline, for descriptive purposes. Primary outcomes included number of fallers and repeated fallers, number of falls and recurrent falls, time until first fall, number of ED visits because of falls, and length of hospital stays primarily due to falls in the 12-month follow-up period. Secondary outcomes included measurements during follow-up calls—telephone MMSE, MBI, GDS, and FAI scores.

Data Analysis

After checking for normality of distribution, all data for the final sample (N=198; IG=95, CG=103) were analyzed on an intention-to-treat basis with two exceptions: participants who were ineligible and thus excluded before randomization and six IG participants whose case files were lost after randomization. (Baseline information was missing, and no home visits or follow-up telephone calls were made.) Participants who dropped out or refused home visits did not receive

data collection follow-up telephone calls, so no information regarding their secondary outcomes was analyzed except their fall rates, ED visits, and hospitalization, which could be verified using Hong Kong's centralized electronic clinical management system. Pearson chi-square tests and Fisher exact tests were used for comparison of two or more groups of categorical or ordinal data, and the Student t-test was used to compare continuous data between the two groups at baseline and 12 months. Number of falls was interpreted as a cumulative frequency ratio, so the Mann-Whitney test was used to compare means of the two groups. A survival analysis was conducted based on time until first fall, for which the Kaplan-Meier method was used. For the purposes of this analysis, censored data were used, with each fall dichotomized at 0 or 1 for each faller at 6, 9, and 12 months during follow-up. Cox regression analysis was conducted by adjusting the potential confounding covariates, which were variables with significant differences ~~or those that were borderline, not significantly different~~ between the two groups (~~baseline GDS,~~ premorbid level of exercise, history of hip fracture and other diseases) (Table 1). The outcomes of the telephone MMSE, MBI, GDS, and FAI between the two groups at baseline and 4, 8, and 12 months were analyzed using repeated-measures analysis of variance (ANOVA). SPSS version 20.0 for Windows (IBM Corp., Armonk, NY) was used for the above analyses. The level of significance was set at .05.

RESULTS

Three Hong Kong EDs recruited 311 consenting participants in the ED over 2.5 years. Figure 1 shows the flow of participants through the study. On screening, 37 (11.9%) scored less than 15 on the telephone MMSE and were thus ineligible. Of the remaining 274 participants, 70 were rejected; 24 (8.8%) had communication difficulties arising from, for example, an incomprehensible dialect or a hearing deficit that precluded their participation, 21 (7.7%) declined

to participate after written consent was obtained, 16 (5.8%) could not be reached by telephone, and nine (3.3%) were admitted to nursing homes before post-ED contact. No deaths were reported before study interventions were initiated. The remaining sample of 204 participants was randomized using a random numbers table, with 101 assigned to the IG and 103 to the CG. Of the 101 participants in the IG, six did not have home visits arranged within the specified period because of missing case files and were thus eliminated. Fourteen of the remaining 95 refused the OT home visit, and 15 of the 103 CG participants refused the well-wishing home visit. Although no follow-up telephone calls for data collection were made to any who refused home visits in either group, these participants were all included in the intention-to-treat analysis.

The baseline characteristics of the subjects are outlined in Table 1. No differences were found between the groups at baseline except for premorbid level of exercise, which favored the IG, and history of hip fracture, which favored the CG. Sixty-five IG participants (68.4%) and 76 CG participants (73.8%) were female; 35 IG participants (36.8%) and 32 CG participants (31.1%) had no formal education. Approximately half of the participants (49.5% IG, 52.4% CG) had a caregiver with them for the whole day. Approximately 92% in each group were independent in activities of daily living (ADLs); 85% to 90% of each group could walk independently outdoors, and more than half did not require walking aids.

Table 2 shows further analysis of differences in baseline characteristics, final number of fallers, recurrent fallers, and number of falls at 12 months at the three trial centers. There were no significant differences in age, sex, or baseline measures for the MMSE, GDS and FAI, but significant differences were found in the MBI (p=.001) and Timed Up and Go Test (p=.01), with lower functional status scores and slower walking speed were observed in Center B participants and more fallers and higher falls rate at 12 months in Center C. There were significant differences

in final number of fallers (p=.02), recurrent fallers (p=.04), and number of falls (p=.01) at 12 months between the three centers.

Table 3 shows the results of falls at 6, 9, and 12 months and the results of telephone follow-up using the telephone MMSE, MBI, GDS, and FAI at 4, 8, and 12 months. The incidence of falls was 13.7% in the IG and 20.4% in the CG over 1 year and 3.2% in the IG and 11.7% in the CG over 6 months. There were significant differences between the two groups in number of fallers (p=.03) and number of falls (p=.02) at 6 months. Number of falls (p=.04) but not number of fallers differed significantly at 9 months. Although there was a positive trend in the IG at 12 months, none of the measured fall parameters were statistically significantly different between in the two groups. No significant differences were found between the groups in the secondary outcomes or interaction effects between groups with the variables using repeated-measures ANOVA.

Figure 2 shows survival curves at 6, 9, and 12 months. Statistically significant differences were found at 6 months (log-rank test 5.052, p=.02) but not at 9 (log-rank test 2.693, p=.10) or 12 (log-rank test 1.352, p=.24) months. Results from the Cox regression model (Enter method) showed that none of the covariates were significantly different at 6, 9, or 12 months.

Only two IG participants required a second home visit by the OT because of major home modifications. An average of 4.6 fall hazards was identified per case. Participant adherence rates to the recommendations that the OT made, recorded by telephone follow-up at 2 months, were 76.3% for advice on environmental hazards and daily life routine, 38.9% for educational advice on fall reduction care plans given to participants or caregivers, 68% for assistive device recommendations, and 44.4% for receipt of other community services.

DISCUSSION

This OT home visit program for reducing subsequent falls in older community-dwelling adults was effective 6 months after ED discharge. This result concurs with Cochrane findings,[31] which show that home safety assessment and modification interventions are effective in reducing fall rates. The results of this study show a significant reduction in the number of fallers over 6 months and in the number of falls over 6 and 9 months but not over 12 months. This was a multicenter study involving three acute care hospitals. As such, similar results are to be expected if the program is implemented in the EDs of other acute care hospitals. There were fewer participants in two of the hospitals, which might have been because of the occurrence of swine influenza and winter influenza epidemics during the study period that slowed participant recruitment. Total ED attendance in 2011 was higher in Center B (n=147,676) and Center C (n=151,112) than in Center A (n=127,405). The EDs in Centers B and C experienced higher levels of patient visits during the study period, which may have interrupted participant recruitment, because provision of clinical services took precedence over recruitment for research. It is possible—but not known from the data—that the different outcomes between the three centers in number of fallers and percentage of falls may have been because of differences in response rates or baseline functional status of participants. Falls resulting in a hospital visit would not have been underreported because all admissions to EDs and public hospitals for falls in Hong Kong are recorded automatically in the central electronic clinical management system. Older adults with a history of falls have a high risk of repeated falls and injuries due to falls.[4] It is worth considering implementation of this home visit fall reduction home visit program by an OT at other EDs to help reduce risk of repeated falls in this identifiable high-risk group. As the population ages, different ways to reduce health risks would be beneficial to enhance quality of life of elderly adults and to reduce the burden of care on families and government healthcare resources.

Not every fall prevention intervention has been shown to be successful for older adults visiting the ED after a fall. Previous studies[7, 10] showed that a structured interdisciplinary assessment involving a medical assessment and a follow-up home visit by an OT could prevent falls over 12 months of follow-up in older adults visiting the ED for a fall, although a multicenter randomized controlled trial did not find that a referral-based, nonintensive multifactorial falls prevention program was more effective than standard care in reducing recurrent falls in older adults who visited an ED after a fall.[33]

The present study shows that the OT Home Visit program was effective in reducing falls only over a 6-month follow-up period. The most likely reason is that OTs in this study provided only one home visit in the 2 weeks after discharge from an ED and the telephone follow-up on home modification items was conducted within 2 months after the home visit. This interval may be too long. Whether a booster home visit by an OT after 6 months might help further reduce the risk of a fall over the subsequent 6-month follow-up period should be explored. Participant-reported fall rates in the IG and CG in this study were low. It is also unknown whether the telephone follow-up on fall incidence for both groups raised awareness of falls of participants, thus reducing falls or reports of falls. Another possible explanation for the low fall rates in the CG is that, in previous studies, the CG did not receive any form of care, whereas in this study, for the purpose of attention control, the CG received well-wishing visits by persons not trained in fall prevention and telephone calls every other week focused on falls.

Data were obtained over the telephone 2 months after the initial home visit, and the adherence rate to OT recommendations for home modification was 76.3%. A previous study found that the level of adherence to OT recommendations for home modifications for fall prevention was 52% at a revisit after 12 months,[33] although these sets of data could not be compared directly because the

follow-up periods and methods of collection were different. It would be interesting to perform subgroup analyses to explore whether those who reported home environment and behavioral changes had fewer falls than those who did not adhere to the OT recommendations.

Limitations

The process of participant recruitment in this study lasted 2.5 years, much longer than expected. It would have been possible to recruit more participants to obtain the desired sample size if healthcare professionals' workload at the EDs had not been high because of the swine influenza and winter surge epidemics during the study period, which probably meant that many potentially eligible individuals were not recruited to participate. The resulting sample could have been nonrepresentative of fallers attending those EDs, which would affect the generalizability of the findings. Furthermore, a paper falls record was not used to aid participants' self-report of fall incidence during the telephone calls. Thus, the lower reported fall incidence may have resulted from participants' faulty memory or inaccuracy in reporting. Finally, telephone calls every 2-weeks could have reminded participant of fall prevention and focused their behavior on, although that IG and CG participants received these calls strengthens the importance of the finding of greater reduction of falls in the IG.

CONCLUSION

This study demonstrated that a 1.5-hour OT fall reduction home visit program reduced falls in older adults who had been assessed and treated at participating EDs because of falls. The benefits were observed at 6 months but not at 9 and 12 months after ED discharge. These results suggest that a booster home visit by an OT at 6 months may help reduce the risk of falls for 12 months.

CLINICAL IMPLICATIONS

The results of this study strongly suggest that the EDs in acute care hospitals should consider implementing the occupational therapy fall reduction home visit program to help reduce the risk of recurring falls in community-dwelling older adults. The findings of this study may also be useful for the planning and development of better services for elderly adults in anticipation of the needs of an aging population.

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Author Contributions: Chu, Fong, Cheng, Au, Fung, Tong: study design. Lit, Hudson, Tong: trial coordination. Chu, Cheng, Au, Fung: data collection. Chu, Fong, Fung, Wong, Tong: data analysis and interpretation. Chu, Fong, Tong: paper preparation. All authors read and approved the final manuscript.

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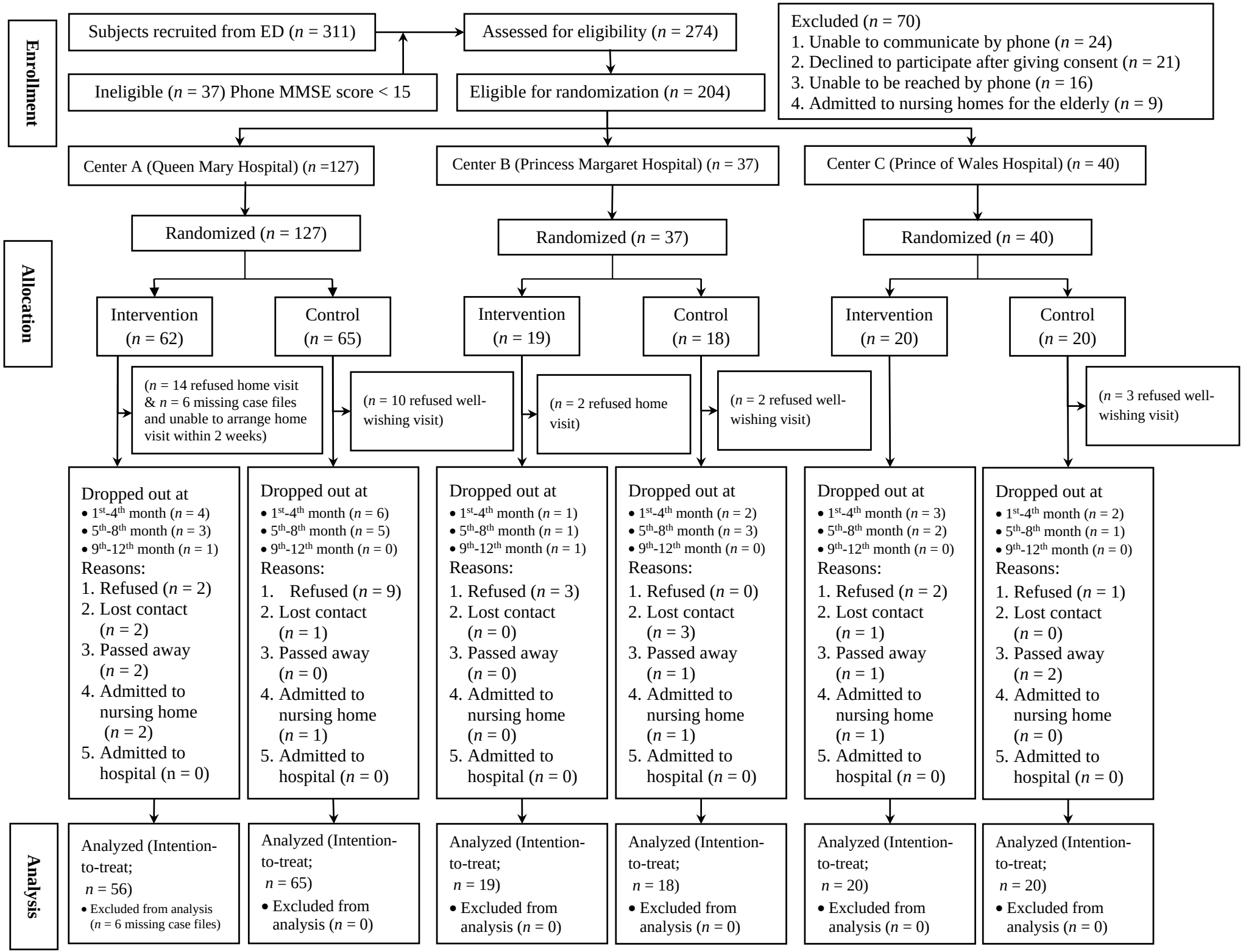
Figure 1. Flow of subjects through the study process.

Figure 2. Survival curve of first falls at 6-, 9-, and 12-month follow-ups.


Enrollment
Subjects recruited from ED (n = 311)
Assessed for eligibility (n = 274)
Excluded (n = 70)
1. Unable to communicate by phone (n = 24)
2. Declined to participate after giving consent (n = 21)
3. Unable to be reached by phone (n = 16)
4. Admitted to nursing homes for the elderly (n = 9)
Ineligible (n = 37) Phone MMSE score < 15
Eligible for randomization (n = 204)
Center A (Queen Mary Hospital) (n =127)
Center B (Princess Margaret Hospital) (n = 37)
Center C (Prince of Wales Hospital) (n = 40)
Allocation
Randomized (n = 127)
Randomized (n = 37)
Randomized (n = 40)
Intervention (n = 62)
Control (n = 65)
Intervention (n = 19)
Control (n = 18)
Intervention (n = 20)
Control (n = 20)
(n = 14 refused home visit & n = 6 missing case files and unable to arrange home visit within 2 weeks)
(n = 10 refused well-wishing visit)
(n = 2 refused home visit)
(n = 2 refused well-wishing visit)
(n = 3 refused well-wishing visit)
Dropped out at
• 1st-4th month (n = 4)
• 5th-8th month (n = 3)
• 9th-12th month (n = 1)
Reasons:
1. Refused (n = 2)
2. Lost contact (n = 2)
3. Passed away (n = 2)
4. Admitted to nursing home (n = 2)
5. Admitted to hospital (n = 0)
Dropped out at
• 1st-4th month (n = 6)
• 5th-8th month (n = 5)
• 9th-12th month (n = 0)
Reasons:
1. Refused (n = 9)
2. Lost contact (n = 1)
3. Passed away (n = 0)
4. Admitted to nursing home (n = 1)
5. Admitted to hospital (n = 0)
Dropped out at
• 1st-4th month (n = 1)
• 5th-8th month (n = 1)
• 9th-12th month (n = 1)
Reasons:
1. Refused (n = 3)
2. Lost contact (n = 0)
3. Passed away (n = 0)
4. Admitted to nursing home (n = 0)
5. Admitted to hospital (n = 0)
Dropped out at
• 1st-4th month (n = 2)
• 5th-8th month (n = 3)
• 9th-12th month (n = 0)
Reasons:
1. Refused (n = 0)
2. Lost contact (n = 3)
3. Passed away (n = 1)
4. Admitted to nursing home (n = 1)
5. Admitted to hospital (n = 0)
Dropped out at
• 1st-4th month (n = 3)
• 5th-8th month (n = 2)
• 9th-12th month (n = 0)
Reasons:
1. Refused (n = 2)
2. Lost contact (n = 1)
3. Passed away (n = 1)
4. Admitted to nursing home (n = 1)
5. Admitted to hospital (n = 0)
Dropped out at
• 1st-4th month (n = 2)
• 5th-8th month (n = 1)
• 9th-12th month (n = 0)
Reasons:
1. Refused (n = 1)
2. Lost contact (n = 0)
3. Passed away (n = 2)
4. Admitted to nursing home (n = 0)
5. Admitted to hospital (n = 0)
Analysis
Analyzed (Intention-to-treat; n = 56)
• Excluded from analysis (n = 6 missing case files)
Analyzed (Intention-to-treat; n = 65)
• Excluded from analysis (n = 0)
Analyzed (Intention-to-treat; n = 19)
• Excluded from analysis (n = 0)
Analyzed (Intention-to-treat; n = 18)
• Excluded from analysis (n = 0)
Analyzed (Intention-to-treat; n = 20)
• Excluded from analysis (n = 0)
Analyzed (Intention-to-treat; n = 20)
• Excluded from analysis (n = 0)

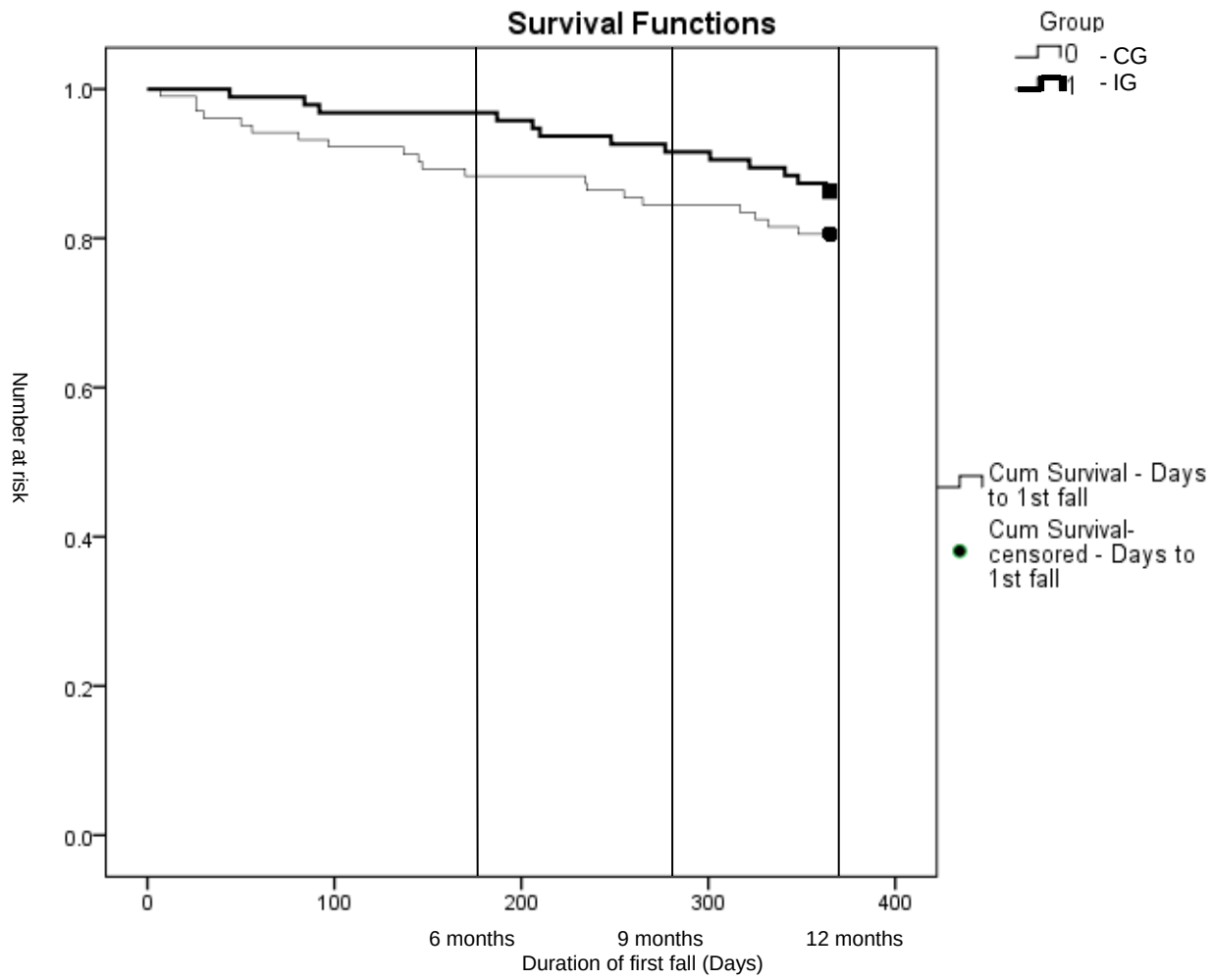

Survival Functions
Group
0 - CG
1 - IG
Number at risk
1.0
0.8
0.6
0.4
0.2
0.0
0
100
200
300
400
6 months
9 months
12 months
Duration of first fall (Days)
Cum Survival - Days to 1st fall
Cum Survival-censored - Days to 1st fall

Table 1. Comparison of baseline and follow-up characteristics for the study population (*n* = 198)

Variables	IG (*n* = 95)	CG (*n* = 103)	*p*
Age (y)	78.63±6.03	78.15±6.08	.573[1]
TUG	22.39±20.77 (*n* = 72)	22.15±22.85 (*n* = 71)	.949[1]
Acuity (Right)	93.04±90.46 (*n* = 56)	96.72±99.28 (*n* = 61)	.834[1]
Acuity (Left)	110.83±99.75 (*n* = 54)	98.85±100.05 (*n* = 61)	.522[1]
MMSE at baseline	19.99±3.16	20.02±3.68	.951[1]
MBI at baseline	45.85±5.46	46.18±4.66	.647[1]
FAI at baseline	19.40±7.26	19.44±7.43	.972[1]
GDS at baseline	1.07±1.22	0.79±1.09	.084[1]
Sex			.435[3]
Male	30 (31.6)	27 (26.2)	
Female	65 (68.4)	76 (73.8)	
Site of injury			
Head	28 (29.5)	31 (30.1)	.999[3]
Trunk	10 (10.5)	10 (9.7)	.999[3]
Arm	15 (15.8)	12 (11.7)	.415[3]
Hand	15 (15.8)	18 (17.5)	.849[3]
Hip	19 (20.0)	32 (31.1)	.103[3]
Foot	7 (7.4)	9 (8.7)	.798[3]
Back	10 (10.5)	10 (9.7)	.999[3]
Comorbidity			
Circulatory Disease	41 (43.2)	49 (47.6)	.569[3]
Respiratory Disease	6 (6.3)	2 (1.9)	.156[3]
Psychiatric Illness	4 (4.2)	3 (2.9)	.712[3]
Cerebrovascular Accident	6 (6.3)	10 (9.7)	.442[3]
Parkinsonism	2 (2.1)	2 (1.9)	.999[3]
Diabetes Mellitus	16 (16.8)	21 (20.4)	.586[3]
Arthritis	5 (5.3)	7 (6.8)	.770[3]
Hip Fracture	4 (4.2)	0 (0.0)	.051[3]*
Upper Limb Fracture	2 (2.1)	2 (1.9)	.999[3]
Lower Limb Fracture	2 (2.1	1 (1.0)	.608[3]
Other Fracture	1 (1.1)	1 (1.0)	.999[3]
Back Pain	4 (4.2)	6 (5.8)	.750[3]
Visual Impairment	12 (12.6)	14 (13.6)	.999[3]
Other Diseases	15 (15.8)	6 (5.8)	.036[3]
Visual aided	4 (4.2)	10 (9.7)	.360[3]
Drugs ≥ 4			.870[2]
Yes	31 (32.6)	35 (34.0)	
No	42 (44.2)	43 (41.7)	
Educational level			.444[2]
Illiterate	35 (36.8)	32 (31.1)	
Less than 6 years education	36 (37.9)	36 (35.0)	
Primary	17 (17.9)	19 (18.4)	
Secondary	6 (6.3)	12 (11.7)	
Tertiary or above	1 (1.1)	4 (3.9)	
ADL			.999[3]
Independent	88(92.6)	95(92.2)	
Assisted	7(7.4)	8(7.8)	
Mobility			.287[2]
Outdoor walker	86(90.5)	88(85.4)	
Indoor walker	9(9.5)	15(14.6)	
Mobility aid (Indoor)	15(15.8)	14(13.6)	.692[2]
Mobility aid (Outdoor)	47(49.5)	44(42.7)	.392[2]
Activity level			.041[2*]

Daily exercise 30–60 minutes	70(73.7)	60 (58.3)	
Weekly exercise 30–60 minutes	6(6.3)	16(15.5)	
None	19(20)	27(26.2)	
Social support			.243[2]
Whole day caregiver	47 (49.5)	54(52.4)	
Day time caregiver	0 (0.0)	0 (0.0)	
Partial day time caregiver	5(5.3)	4 (3.9)	
Day time alone	14(14.7)	25 (24.3)	
Live alone	24 (25.3)	15 (14.6)	
Need to care for others	5 (5.3)	5 (4.9)	

NOTE: Values are average ± SD or *n* (%); * ≤ 0.05; [1]Student *t*-test; [2]Pearson chi-square test; [3]Fisher exact test (2-sided); TUG – Timed Up and Go test; MMSE– Phone Mini-mental State Examination, range 1-26, higher score represents better cognitive function; MBI–Phone Modified Barthel Index, range 10-50, higher score represents better functional status; FAI– Frenchay Activities Index, range 0-30, higher score represents better activity level; GDS– Geriatric Depression Scale, range 0-4, lower score represents less depression; ADL-Activities of daily living

Table 2. Comparison of baseline and follow-up characteristics in three trial centers (*n* = 198)

Variables	Center A (*n* = 121)	Center B (*n* = 40)	Center C (*n*= 37)	*p*
Age (y)	78.68±5.63	79.25±7.27	76.46±5.70	.088[1]
Sex				.964[2]
Male	34 (28.1)	12 (30.0)	11 (29.7)	
Female	87 (71.9)	28 (70.0)	26 (70.3)	
TUG	17.80±18.04 (*n* = 78)	30.97±20.60 (*n* = 33)	24.19±28.02 (*n* = 32)	.011[1*]
MMSE at baseline	19.90±3.49	19.70±3.55	20.68±3.08	.400[1]
MBI at baseline	46.12±4.66	43.90±6.77	48.03±2.86	.001[1*]
FAI at baseline	19.74±6.80	17.33±9.08	20.62±6.63	.105[1]
GDS at baseline	0.82±1.10	1.15±1.29	1.03±1.21	.247[1]
Number of fallers (1 year prevalence)	15 (12.4)	7 (17.5)	12 (32.4)	.018[2*]
Recurrent fallers (≥ 2 falls)	2 (1.65)	2 (0.05)	4 (1.08)	.044[2*]
Total falls (falls rate over 1 year)	19 (15.7)	9 (22.5)	18 (48.6)	.010[1*]

NOTE: Values are average ± SD or *n* (%); * ≤ 0.05; [1]One-way ANOVA; [2]Pearson chi-square test; [3]Mann-Whitney; TUG – Timed Up and Go test; MMSE– Phone Mini-mental State Examination, range 1-26, higher score represents better cognitive function; MBI–Phone Modified Barthel Index, range 10-50, higher score represents better functional status; FAI– Frenchay Activities Index, range 0-30, higher score represents better activity level; GDS– Geriatric Depression Scale, range 0-4, lower score represents less depression

Table 3. Comparisons of characteristics of control and intervention groups (*n* = 198)

Characteristic	IG (*n* = 95)	CG (*n* = 103)	*p*
#***MMSE***, mean (SD)			
Baseline	20.0 (3.2)	20.0 (3.7)	0.817†
4 months	19.8 (4.3)	20.0 (4.1)	
8 months	19.7 (4.1)	19.6 (3.9)	
12 months	19.6 (4.2)	20.0 (4.2)	
#***GDS***, mean (SD)			
Baseline	1.1 (1.2)	0.8 (1.1)	0.817†¶
4 months	0.8 (1.2)	0.8 (1.2)	
8 months	0.8 (1.2)	0.9 (1.1)	
12 months	1.0 (1.3)	1.0 (1.2)	
#***MBI***, mean (SD)			
Baseline	45.9 (5.5)	46.2 (4.7)	0.644†
4 months	47.1 (5.2)	47.5 (3.6)	
8 months	46.7 (5.4)	47.4 (4.1)	
12 months	47.2 (4.6)	46.9 (4.7)	
#***FAI***, mean (SD)			
Baseline	19.4 (7.3)	19.4 (7.4)	0.724†
4 months	18.9 (7.9)	19.3 (7.8)	
8 months	19.0 (8.1)	19.5 (8.2)	
12 months	19.0 (8.1)	19.5 (7.8)	
Results of 6 months follow-up, n (%)			
Number of fallers (6 months)	3 (3.2)	12 (11.7)	0.031[1]*
Total falls (falls rate over 6 months)	3 (3.8)	12 (11.7)	0.021[3]*
1 fall	3 (3.2)	10 (9.7)	0.085[1]
Recurrent fallers (≥ 2 falls)	0 (0)	2 (1.9)	0.489[1]
Emergency attendance	3 (3.1)	8 (7.7)	0.218[2]
Results of 9 months follow-up, n (%)			
Number of fallers (9 months)	7 (7.3)	15 (14.5)	0.119[1]
Total falls (falls rate over 9 months)	7 (7.3)	19 (18.4)	0.037[3]*
1 falls	7 (7.3)	16 (15.5)	0.088[1]
Recurrent fallers (≥ 2 falls)	0 (0)	3 (2.9)	0.247[1]
Results of 12 months follow-up, n (%)			
Number of fallers (1 year prevalence)	13 (13.7)	21 (20.4)	0.259[1]
Total falls (falls rate over 1 year)	16 (16.8)	30 (29.8)	0.143[3]
1 fall	11 (11.6)	16 (15.5)	0.535[1]
Recurrent fallers (≥ 2 falls)	2 (2.1)	6 (5.8)	0.282[1]
Time to fall [fallers only, mean days (SD)]	241.5 (113.3)	173.7(121.7)	0.115[3]
Emergency attendance	13 (13.7)	20 (19.4)	0.402[2]
Hospitalization	4 (4.2)	6 (6.3)	0.750[1]

Note: *p ≤ 0.05; †Between-subjects effects in univariate ANOVA; ¶ Significant group X occasion effects (F=2.870, p=0.038) in repeated measures ANOVA;[1]Fisher's Exact Test (2-sided); [2]Pearson Chi-Square; [3]Mann-Whitney; IG – Invention Group; CG – Control Group; # ITT – Intention-to-treat; MMSE– Phone Mini-mental State Examination, range 0-26, higher score represents better cognitive function; MBI–Phone Modified Barthel Index, range 10-50, higher score represents better functional status; FAI– Frenchay Activities Index, range 0-30, higher score represents better activity level; GDS– Geriatric Depression Scale, range 0-4, lower score represents less depression