

ORIGINAL ARTICLE

The Efficacy of a Multidisciplinary Falls Prevention Clinic With an Extended Step-Down Community Program

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ABSTRACT. Sze P-C, Cheung W-H, Lam P-S, Lo HS-D, Leung K-S, Chan T. The efficacy of a multidisciplinary falls prevention clinic with an extended step-down community program. *Arch Phys Med Rehabil* 2008;89:1329-34.

Objective: To investigate the efficacy of a falls prevention clinic and a community step-down program in reducing the number of falls among community-dwelling elderly at high risk of fall.

Design: Prospective cohort.

Setting: Community.

Participants: Community-dwelling elderly (N=200) were screened for risk of fall; 60 were identified as being at high risk and were referred to the intervention program.

Intervention: Twelve sessions of a once-a-week falls prevention clinic, including fall evaluation, balance training, home hazard management program, and medical referrals, were provided in the first 3 months. The community step-down program, including falls prevention education, a weekly exercise class, and 2 home visits, was provided in the following 9 months.

Main Outcome Measures: Fall rate, injurious fall, and its associated medical consultation were recorded during the intervention period and the year before intervention. Balance tests included the Berg Balance Scale (BBS), Sensory Organization Test, and limits of stability test; fear of falling, as evaluated using the Activities-specific Balance Confidence (ABC) scale, was measured at baseline and after the training in the falls prevention clinic.

Results: Significant reductions in fall rate (74%), injurious falls (43%), and fall-associated medical consultation (47%) were noted. Significant improvement in balance scores (BBS, $P<.001$; endpoint excursion in limits of stability test, $P=.004$) and fear of falling (ABC scale, $P=.001$) was shown.

Conclusions: The programs in the falls prevention clinic were effective in reducing the number of falls and injurious falls. The community step-down programs were crucial in maintaining the intervention effects of the falls prevention clinic.

Key Words: Accidental falls; Elderly; Rehabilitation.

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FALLS ARE COMMON and serious among the elderly. One fifth of elderly people fall annually, and one third of them are repeated fallers.¹ Fall-associated injuries are the third leading cause of years living with disability² and are also one of the leading causes for hospitalization in Hong Kong.³ With a global aging population, the problems of falling and its related injuries are getting more and more serious.

Many studies have investigated the effectiveness of specific strategies in fall prevention, including medication withdrawal, Tai Chi Chuan martial arts training, exercise programs, home hazard removal, or the combination of these strategies.^{4,5} Most of these strategies were beneficial, particularly those targeted to subjects with high risk for fall. A systematic review showed that the most effective strategies of falls prevention are those with targeted multifactorial interventions.⁵ This is probably because falling is a complex incidence that occurs as a result of the interaction between intrinsic (eg, lower-extremity weakness, balance disorder, visual deficit) and extrinsic (eg, polypharmacy, environmental factors such as poor lighting, loose carpets) factors and is seldom the result of a single factor.⁶

A few investigators proposed to extend the practice of multifactorial programs in a falls prevention clinic, in which high-risk subjects or patients received structured intervention programs including falls risk assessment, consultation, multidisciplinary programs, and referrals.⁷⁻⁹ Perell et al⁷ showed a 53% reduction in the occurrence of falls in subjects who had received programs in the clinic. However, as in most of these studies, subjects were usually followed up for a maximum period of 6 months only after being discharged from the clinic.^{8,9} To help the elderly build up habits such as regular exercise, which are beneficial for falls prevention in the long term, an extended community-based program for long-term sustainability is also necessary.¹⁰ Therefore, besides setting up a falls prevention clinic, a community-based step-down program was also developed to provide long-term care to elderly who were discharged from the falls prevention clinic. The outcomes including fall rate and other physiologic outcomes of these programs in the first-year follow-up were investigated in this study.

METHODS

Participants

Two hundred community-dwelling elderly who are members of 1 local community elderly service center in the Shatin district of Hong Kong were randomly selected and screened by the PPA.¹¹ Elderly identified with high risk for falling (mean PPA z score, <-1 —ie, 1 SD below the age-matched norm from the PPA) were

List of Abbreviations

ABC	Activities-specific Balance Confidence
BBS	Berg Balance Scale
PPA	Physiological Profile Assessment
SOT	Sensory Organization Test

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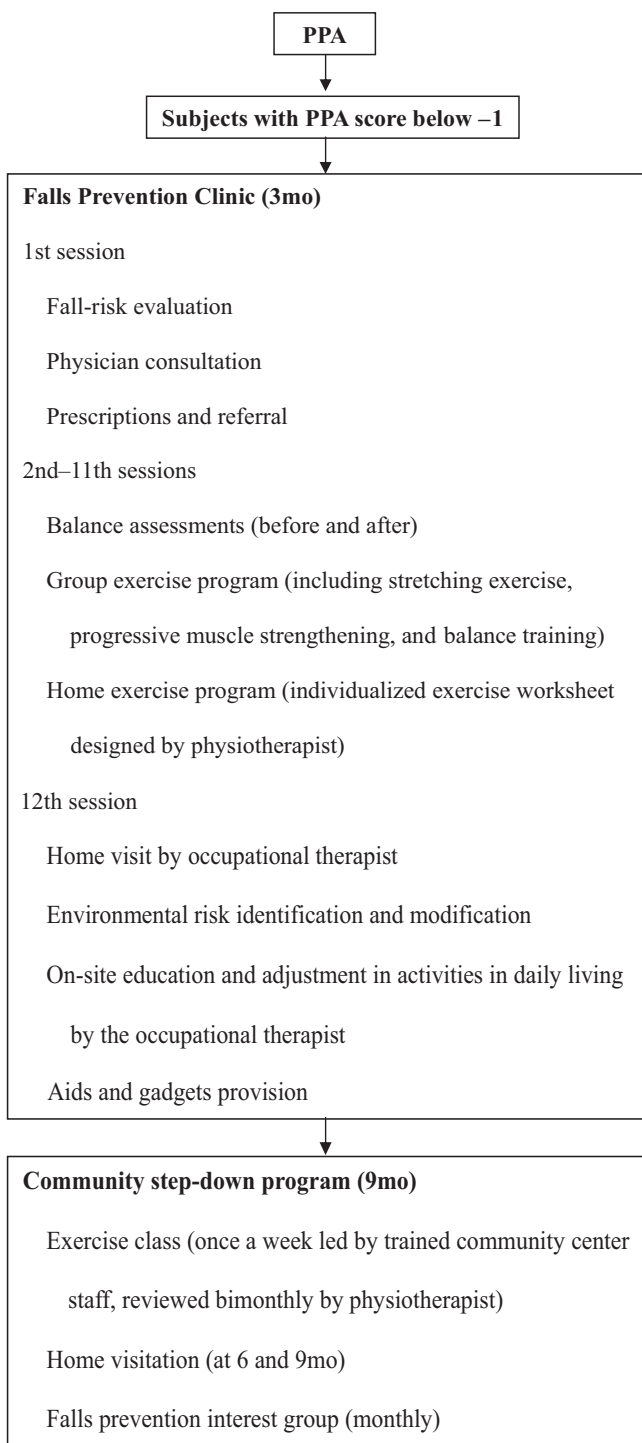


Fig 1. Intervention program in the falls prevention clinic and community step-down program.

recruited to participate in this study ($n=60$). The study protocol was approved by the Clinical Research Ethics Committee of the Chinese University of Hong Kong (CRE-2004.334).

Intervention Program

The intervention program included consultation and training in the falls prevention clinic and the step-down program in the

community (fig 1). The falls prevention clinic was established at the Chinese University of Hong Kong Jockey Club Centre for Osteoporosis Care and Control and is staffed by a physician, a physiotherapist, an occupational therapist, and other technical staff members. The step-down program was located at the Evangelical Lutheran Church Hong Kong–Shatin Multiservice Centre for the Elderly and is staffed mainly by a team of social workers and trained volunteers.

Falls prevention clinic. Detailed fall and fracture risks for subjects were evaluated by the physician in the first falls prevention clinic visit (table 1). The physician provided fall-risk counseling, bisphosphonate prescription, and referrals to other specialties to subjects according to the risk factors identified. Medication review and education on possible side effects regarding the interaction of the multiple drugs taken were also provided. Subjects were required to attend 10 subsequent 1-hour sessions of group balance training (once a week) and to finish the home exercise program designed by the physiotherapist (see fig 1). Occupational therapists also visited participants' homes to assess their environmental hazards and provided intervention programs including education, home modification, and provision of aids and gadgets to subjects according to the assessment results. All participants who finished the programs offered in the falls prevention clinic were referred to the community center for the step-down program.

Community step-down program. The community step-down program lasted for 9 months. The program included an exercise class (a 1-h practice session a week) led by trained staff and volunteers (who had completed the training course before this study¹⁰) in the community center. The exercise was designed by the physiotherapist in the falls prevention clinic, who visited the class bimonthly to determine if the level of exercise needed upgrading or downgrading. Participants also formed falls prevention interest groups, which were led by the staff of the community center and held monthly for falls prevention education and reminders. Subjects needed to sign an attendance sheet when they came to these programs. Two home visitations were also arranged by the trained community center staff and volunteers at approximately the sixth and ninth months to check whether the recommended modifications had been completed.

Outcome Measures

The primary outcome of this study was fall rate, which was calculated as number of falls per person per year. *Fall* was defined as "unintentionally coming to rest on the ground, floor, or other lower level."^{12(p300)} The fall rate of subjects in the year before the intervention was compared with that during the intervention period. Any fall-related injuries before and during the intervention period were also compared as secondary outcomes. In the first visit to the falls prevention clinic, subjects were asked to recall their fall histories (number of falls, any associated injuries) retrospectively in the year preceding the intervention through a face-to-face interview by the investigators. After the intervention started, any incidence of fall and its associated injuries were recorded by subjects in a fall diary provided. All subjects had to submit the diary to investigators monthly. The investigators would confirm the fall record with each subject to avoid mistakes in filling out the fall diary and would make telephone reminders to subjects who did not submit the falls diary. The assessment of fall rate and its consequences were implemented throughout the falls prevention clinic and community step-down program.

Balance and fear of falling were evaluated before and after subjects attended the falls prevention clinic. BBS was used to evaluate the functional balance of subjects.¹³ A score below 47

Table 1: Assessment in the Falls Prevention Clinic

Assessments	Descriptions
Medical history	History taking on medical conditions
Medication	Checklist of prescriptions being taken
Polypharmacy assessment	Number of prescribed and nonprescribed medications, interaction of these medications, subject's knowledge about the medication (eg, side effect, regimen)
Physical examination	BMI, presence of Dowager's hump, blood pressure
Visual assessment	Acuity test, pinhole test, and red reflex test
Cardiovascular assessment	Presence of syncope, arrhythmias, carotid bruit, and murmurs
Musculoskeletal system	Lower-limb strength and range of motion, foot problem and footwear assessment
Neurologic examination	Presence of problems related to proprioception, tremor, rigidity, and peripheral neuropathy
BMD scanning	Dual-energy x-ray absorptiometry scanning of hip and spine BMD
Balance evaluation	Functional balance (BBS) and underlying component of balance (Smart EquiTest)
Self-efficacy	ABC scale

Abbreviations: BMI, body mass index; BMD, bone mineral density.

was regarded as failing the test.¹⁴ To assess underlying balance sensation and mechanism, a series of platform tests including the SOT and limits of stability test were implemented with the Smart EquiTest.^{15,a} The SOT measures a subject's ability to organize the sensory inputs from the 3 sensory systems—namely, somatosensory, visual, and vestibular; the limits of stability test measures voluntary motor control in terms of the maximal voluntary displacement of one's center of gravity in 4 directions (forward, backward, right, left) without losing balance. The measured parameters included reaction time, movement velocity, directional control, endpoint excursion, and maximum excursion. The measurement method and definitions of terms were in accordance with our previous protocol.¹⁶ The composite score for each subject was compared with the age-matched norms developed and was regarded as failed if the score in the specific area of balance was in the lowest fifth percentile.¹⁷ The ABC scale¹⁸ was used to determine the change in each subject's confidence toward daily activities after the training. Subjects were required to rate their confidence in performing the activities without a fall from 0 to 10, with higher scores indicating higher confidence.

Statistical Analysis

Descriptive statistics were used for demographic data; the physician's, physiotherapist's, and occupational therapist's assessments; intervention received; and subjects' compliance with the falls prevention clinic and the step-down program. The fall rate and the rate of fall-related injuries of each subject in the intervention period, expressed in number of falls and fall-related injuries per person per year, respectively, were compared with those in the year before intervention. A paired-sample *t* test and McNemar test were used to compare the scores and the percentage of subjects who failed, respectively, in the BBS, the platform tests of the Smart EquiTest, and the

ABC scale before and after the interventions from the falls prevention clinic.

RESULTS

Demographics and Fall-Risk Evaluation

Fifty-six of 60 high-risk elderly completed the first session of the falls prevention clinic. Subjects had an age range from 63 to 88 years, and most were women (92.6%). Most subjects had regular medications (73%), which were mainly antihypertensive drugs, cardiac drugs, and hypoglycemic agents. Half of subjects had more than 3 prescribed medications (table 2). Most of these medications were prescribed with the lowest effective dose and simplest regimen. All subjects knew exactly the dosage and timing for medication. However, in the prescriptions of 34% of subjects, possible interactions of the drugs were not properly considered.

Five subjects were identified with new unattended medical problems; these subjects were successfully referred to other specialties for further treatments. Twenty-one subjects were newly identified as having osteoporosis, and bisphosphonates were prescribed to them.

Physiotherapy Assessment and Outcome

There were improvements in balance and fear of falling among subjects in general (table 3). Significant improvement in BBS score ($P < .001$) and number of falls ($P = .031$) were seen. Subjects also improved in the SOT and limits of stability test. The improvement in endpoint excursion, which indicated a better initial movement to reach the target without subsequent corrective attempts, reached statistical significance ($P = .004$). There were generally fewer subjects who failed the SOT and limits of stability test, although the reductions were not statistically significant.

Home Visitation Program

Home hazards were identified in 62.5% of subjects' homes. One third of subjects had 3 or more hazards present in their homes. The most common hazards identified were unnoticeable doorsill (44.6%), use of old cloth instead of proper antislip mat (42.9%), and obstructed pathway (32.1%). The most common falls prevention aids provided were walking aids (39.3%), handrails (35.7%), and shower chair (32.1%). Education and advice on adjustment of activities of daily living were provided to 89.3% of subjects to reduce their risk of fall. No subject required major home modifications. Most subjects (80%) were still compliant with the intervention provided at the last follow-up visit.

Falls and Fall-Related Injuries

Thirty-seven (66.7%) of 56 subjects reported falling in the year before the intervention (table 4). Among fallers, 14 (38%) of 37 were recurrent fallers. The average fall rate was 1.31 falls per person per year before the intervention. Three subjects had fractures in the previous year. There were 19 subjects who required medical consultation as a result of fall-associated injuries; 3 of them required hospitalization. Within the intervention period, the fall rate dropped to .32 falls per person per year. Only 25% of subjects experienced 1 or more falls in the intervention period. There was no fall-associated fracture observed. Ten subjects required medical consultation for associated soft-tissue injuries; none required hospitalization.

Compliance of Falls Prevention Clinic and Step Down

Fifty-six (93%) of 60 subjects attended the first session of the intervention program in the falls prevention clinic. How-

Table 2: Demographics and Assessment Outcomes

Demographics	Values
Age (y)	74.96 ± 6.10
Female sex	50 (92.6)
Education below primary level	39 (72.2)
Living alone	15 (27.8)
With >3 comorbidities	7 (12.3)
With >3 prescriptions	28 (50)
Interaction of medications not properly considered	19 (33.9)
Presence of Dowager's hump	3 (5.4)
Failed visual acuity test	21 (37.5)
Failed pinhole test	20 (35.7)
Failed red reflex test	22 (39.3)
Presence of syncope, arrhythmia, or murmur	6 (10.7)
Lower-limb weakness identified	10 (17.9)
Decreased range of motion in lower limbs	4 (7.1)
Presence of peripheral neuropathy	4 (7.1)
Presence of tremor	4 (7.1)
Outdoor mobility	
Independent without walking aids	27 (48.2)
Independent with walking aids	21 (37.5)
Supervision or assistance with walking aids	8 (14.3)

NOTE. Values are mean ± SD or n (%).

ever, only 28 (50%) of subjects completed the 10 sessions of physiotherapy training, giving an attendance rate of at least 70%. The major reasons for not attending the training sessions were lack of companionship and problems in accessibility (eg, transportation). However, the mean attendance rate of the step-down program increased back to 80% (weekly exercise class, 82%; monthly falls prevention interest group, 75%).

DISCUSSION

We report the preliminary outcomes of a falls prevention clinic with a community step-down program. A 75% reduction in fall rate and a 47% reduction in fall-associated medical consultations was achieved for subjects who attended our program. Significant improvements in functional outcomes and balance scores were also observed after subjects completed the training sessions in the falls prevention clinic, which might contribute to the decreased number of falls and fall-associated injury rates.

In the present study, subjects attended a weekly program at the community elderly center after discharge from the falls prevention clinic. As shown by a large randomized controlled trial,¹⁹ such maintenance programs with multifactorial interventions are effective in reducing the number of fall incidences in the long term. Such community-based programs were also effective in maintaining the awareness of falls prevention in the elderly, which has a positive effect on their attitudes toward these falls prevention programs.^{10,20} The high compliance rate (82%) also indicated that subjects readily accepted this program.

Environmental hazards were commonly present in the living area of subjects. The environmental risk profile found in the present study was similar to that of our previous study¹⁰ on general community-dwelling elderly. Environmental modification was an important component in the falls prevention program.⁶ Particularly for the high-risk group, the interaction of environmental hazards with the increased number of intrinsic factors would probably increase the risk of fall. A previous study²¹ stressed the importance of the professional input of an occupational therapist in reducing the number of falls through a home visitation program. However, almost half of subjects were not compliant with the intervention provided after 1 year, which might dilute the efficacy of the intervention program.²¹ The step-down program in the present study may again play an important role in maintaining a high compliance rate (80%) through regular reinforcement and education.

Similar to other studies,^{7,8,22} the attendance rate in subsequent sessions of the falls prevention clinic was low. Previous studies^{8,22} proposed that some factors including use of telephone calls, value of the programs, and length of stay in the clinic might contribute to the return rate of subjects in follow-up visits. However, Perell et al⁷ failed to show a significant difference in the return rate between subjects who were satisfied with care provided and those who were not. In the present study, the major obstacle for subjects to attend the training session was problems with transportation and lack of companionship. Provision of an escort service or allocating the training programs to the community center from the falls prevention clinic might be crucial for subjects to get full benefit of the program in future practice, particularly for those with generally poorer mobility and lack of companionship.

Table 3: Outcomes of Balance Training in the Falls Prevention Clinic

Test	Test Score*			No. of Subjects Failing the Test†		
	Baseline	Posttest	P	Baseline	Posttest	P
BBS	48.1 ± 6.9	51.3 ± 5.2	<.001 [§]	21 (33.9)	4 (14.8)	0.03 [‡]
SOT	56.7 ± 10.7	59.4 ± 15.6	.96	39 (69.6)	14 (51.9)	0.38
Limits of stability test						
Reaction time	1.30 ± 0.53	1.19 ± 0.4	.17	10 (17.9)	5 (18.5)	1.00
Movement velocity	2.56 ± 1.07	3.30 ± 1.2	.15	9 (16.1)	2 (7.4)	0.63
Endpoint excursion	49.5 ± 14.0	56.6 ± 12.6	.004 [§]	25 (44.6)	7 (25.9)	0.69
Maximum point excursion	62.3 ± 14.1	70.4 ± 12.9	.46	30 (53.6)	8 (29.6)	0.23
Directional control	59.1 ± 14.7	65.6 ± 10.4	.11	27 (48.2)	8 (29.6)	0.73
ABC scale	109.3 ± 29.9	122.6 ± 20.9	.001 [§]	NA	NA	NA

NOTE. Values are mean ± SD or n (%).

Abbreviation: NA, not applicable.

*Paired sample *t* test.

†McNemar test.

‡*P* < .05.

§*P* < .01.

Table 4: Falls and Related Injuries Before and After the Intervention Started

Falls and Injuries	In 12 Months Before Intervention Started	Within 12-Month Intervention Period
With ≥ 1 fall	37 (66.7)	14 (25.0)
With >1 fall	14 (25.0)	3 (5.4)
Reported fall-related injuries	25 (44.6)	14 (25.0)
Fall-associated fractures	3 (5.4)	0 (0.0)
Fall resulting in medical consultation	19 (33.9)	10 (17.9)
Fall resulting in hospitalization	3 (5.4)	0 (0.0)

NOTE. Values are n (%).

Study Limitations

Fall-risk evaluation is essential in a falls prevention program.²³ Unlike other community-based studies,^{19,21} in which paramedical professionals or nurses conducted the fall-risk assessments, the subjects in this study were assessed extensively by a physician. It is not uncommon to see that elderly have multiple medical conditions and problems related to polypharmacy, which lead to increased risk of fall.²⁴ Most subjects received medical care from different specialties, but as shown in this study, the interaction among these conditions—particularly the associated drugs, which may lead to fall—were not well addressed in 34% of subjects. Therefore, a physician's input in the falls prevention clinic is important to address these problems potentially leading to fall. Campbell et al²³ showed that input from a physician in a psychotropic medication withdrawal program could reduce 66% of fall rate.

Like similar studies,⁷⁻⁹ the outcomes of the present study were based on clinical observation of a single group of subjects rather than a randomized controlled trial design. Results regarding fall rate, fall-related injuries, and other functional outcomes need careful interpretation. Another limitation of this study is the relatively small sample size, which was due to an overestimation of the proportion of high-risk elderly. Only 30% of subjects were identified as high risk, which was far below the population of another study²⁵ in which 52% of the elderly were at high risk for fall.

When subjects were asked to recall their falls histories before enrolling in the study, recall bias might have occurred. Overreporting of falls history might have occurred, particularly when subjects were aware that they were going to participate in a falls prevention program. Such reporting bias is the major limitation of cohort studies in comparing subjects' fall rates before and after intervention.⁷⁻⁹ Because many falls among subjects were not witnessed, such self-report was, however, an essential source of data.^{19,21,23,24} Recall and reporting biases might also occur during the intervention period. To minimize recall bias, a more frequent interval was used for checking fall records (once a month) in this study compared with other studies^{7,8} (once every 3–6mo). Underreporting of falls during the intervention could also have occurred because subjects were aware of participating in a falls prevention study.¹⁹ However, such bias is unlikely to explain fully the reduction in the fall-related injuries and falls requiring medical attention, which are less susceptible to reporting bias.

Another limitation of this study was the heterogeneous nature of subjects, which might lead to difficulty in comparing with other studies. Although randomized controlled studies have more selective criteria,^{19,24} subjects of the present study ranged from healthy independent community-dwellers to frail

elderly with multiple comorbidities and had a wide age range (63–88y). These additional covariates might also add difficulties to the interpretation of these results. However, this study reflects the real situation of the falls prevention clinic, in which a heterogeneous group of clients would be expected. The results of this study may be more easily generalized to real practice in this aspect.

In addition, the increased attention of the community center staff could have biased the results toward a positive effect. A program based on education and attention might help subjects keep practicing falls prevention strategies only,¹⁰ whereas the program itself could have a very limited effect in the reduction of fall risk.⁶ An improved study design would include a randomized control group who received active staff attention.

CONCLUSIONS

This study showed that fall rate, fall-related injuries, and fall-associated medical consultations could be reduced through the introduction of a falls prevention clinic and community step-down program. We stress the importance of a multidisciplinary program, particularly for a physician's input in the prevention of falls and their associated injuries. A community-based step-down program was also emphasized to maintain a high compliance rate with the intervention and a low fall rate among the elderly. Issues of improving subject compliance with the intervention should also be considered to maximize the benefit of the program for the elderly.

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Supplier

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