Preplanned Studies

Effectiveness of Group-Based Interventions for Fall Prevention Among Community-Dwelling Older Adults — 7 Regions, 6 PLADs, China, 2019–2020

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Summary

What is already known about this topic?

Many of the current studies focusing on fall prevention interventions have been conducted in hospital settings within a select few urban areas in China, thus yielding limited evidence on the effectiveness of large-scale, multicenter, community-based interventions.

What is added by this report?

In comparison to the control group, participants in the intervention group exhibited a 64% reduction in fall risk. Group-based fall prevention programs have demonstrated efficacy in mitigating fall risk among the elderly population.

What are the implications for public health practice?

Group-based fall prevention interventions serve as a significant adjunctive resource for the management of elderly health within communities and offer compelling evidence to support the incorporation of fall prevention strategies into health policy frameworks in China.

In 2020, China's population aged 60 or older reached 264 million individuals, comprising 18.70% of the nation's total population (*1*). The swift increase in the aging demographic intensifies the prevalence of fall-related incidents. Falls represent the primary reason for injury-related medical consultations, the leading cause of injury-related fatalities, and the predominant cause of hip fractures among individuals aged 65 and older (*2–4*). Evidence suggests that group-based fall prevention programs that combine exercise initiatives with health education can effectively reduce the incidence of falls (*5*). Nonetheless, data on the efficacy of such interventions in preventing falls among the elderly in China remain scarce.

This investigation evaluated the efficacy of a community-based fall prevention program through a multicenter, cluster-randomized controlled trial conducted from August 2019 to December 2020 across six provincial-level administrative divisions (PLADs) in China. We enrolled 60 communities, randomly assigning them to either the intervention or the control group. Of the initially screened 954 senior adults from community health service centers (CHSCs), all met the eligibility criteria. These participants were monitored for a period of 12 months by means of telephone or in-person follow-ups. The results indicated that, in comparison to the control group, the intervention group exhibited a substantial reduction in fall risk [odds ratio (*OR*): 0.36; 95% confidence interval (*CI*): 0.24–0.52].

This cluster randomized controlled trial was carried out across 60 communities in 7 Chinese regions: Suzhou City in Jiangsu Province, Ningbo City in Zhejiang Province, Hefei City in Anhui Province, as well as Pudong and Songjiang districts in Shanghai Municipality, Shenzhen City in Guangdong Province, and Shijiazhuang City in Hebei Province. Under simple random sampling methods, communities were allocated equally into either the intervention group (30 communities) or the control group (30 communities). Eligible participants were selected following preliminary screenings conducted by CHSCs. Enrollment criteria included: age between 65 and 84, a history of at least one fall within the previous 12 months, independent ambulatory capabilities, normal communication abilities, and residency within the study area (excluding those in care facilities) for the upcoming 14 months. Exclusion criteria consisted of psychological or neurological disorders, an intolerance for exercise, or diseases affecting balance, such as vertigo or Meniere's disease. Individuals in the intervention group partook in a six-month group-based fall prevention program that included health education lectures and the cultivation of exercise skills aimed at enhancing balance, endurance, and lower limb strength. The program was facilitated by two trained physicians from the CHSCs, employing aid materials such as slides, an exercise demonstration video, and an

intervention manual. Additionally, CHSC staff conducted home-fall hazard assessments for the intervention group during the third month, providing feedback and suggestions for improvements post-assessment. Further details regarding the interventions can be found in Supplementary Table S1 (available in https://weekly.chinacdc.cn). On the contrary, participants in the control group received a total of three health education lectures that covered the same topics. Each session lasted approximately 40 minutes and was conducted monthly by trained CHSC physicians.

In this study, the primary outcome measured was the incidence of falls. Following the initial baseline survey, participants were required to maintain a monthly diary documenting any falls experienced throughout the duration of the follow-up period. A fall is characterized as an unintentional event where an individual comes to rest on the ground, floor, or another lower surface. Fall-related self-efficacy was evaluated using the Fall Efficacy Scale, which comprises 16 items. Each item is scored on a scale from 1 to 4 — where a score of 1 signifies no fear of falling, and a score of 4 indicates a high level of fear regarding potential falls. Balance function was assessed by the Short Physical Performance Battery (SPPB), which incorporates three distinct tests: the Side-by-Side Stand, the Semi-Tandem Stand, and the Tandem Stand. For the Side-by-Side Stand and Semi-Tandem Stand tests, participants received a score of 1 point if they could maintain the stance for 10 seconds and 0 points if they could not, or if the attempt was not made. The Tandem Stand was scored with 2 points for maintaining the position for 10 seconds, 1 point for holding it between 3 and 9.99 seconds, and 0 points for holding it for less than 3 seconds or if the stance was not attempted. The cumulative score, with a possible range of 0 to 4 points, represents the sum of points from all three tests.

Data analysis was conducted using SAS software (version 9.4; SAS Institute, Inc., Cary, NC, USA). We performed a descriptive analysis of the demographic characteristics, disease status, balance function, and other related factors of the study participants. To compare baseline characteristics between the two groups, we employed the *t*-test or Mann-Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. We used logistic regression models to evaluate the impact of the intervention on the occurrence of falls, calculating the *OR*s with 95% *CI* accordingly. The inclusion criteria

for the analysis stipulated that participants in the intervention group must have engaged in the intervention activities at least twice. Similarly, subjects in the control group who did not attend any educational lectures were excluded from the analysis. We considered a two-tailed *P*-value less than 0.05 as statistically significant. The Ethical Review Committee of the National Center for Chronic and Noncommunicable Disease Control and Prevention, part of the China CDC, has approved this study under the protocol (201907).

Participant flowchart showing 488 participants in the intervention group and 487 in the control group with a total of 21 dropouts, including withdrawn consents (*n*=18) and deaths (*n*=3), leaving 954 participants for the final analysis with 477 from each group (Figure 1). Baseline characteristics of the 954 individuals analyzed, comprising 698 (73.17%) females with an average age of 71.71±4.50 years, and showing no significant differences between the intervention and control groups (Table 1).

During the 12-month follow-up, falls occurred in 53 out of 477 participants (an 11.11% fall rate) in the intervention group. In contrast, the control group saw 114 out of 477 participants experience falls, representing a 23.90% fall rate. A multivariate logistic regression analysis was conducted, employing two models. The basic Model 1 included only the independent variable, while Model 2 was adjusted for variables showing statistically significant differences, such as education level and disease status (i.e., osteoporosis, arthritis, cervical spondylopathy, lumbar herniated disc, depression, and cataract). The analysis revealed that in comparison to the control group, the intervention group had a 60% reduced risk of falling according to Model 1 (*OR*: 0.40, 95% *CI*: 0.28–0.56) and a 64% reduced risk in Model 2 (*OR*: 0.36, 95% *CI*: 0.24–0.52), (Table 2). Subgroup analyses based on gender, age group, and fall efficacy scores [with 35 points chosen as the cutoff value, informed by prior literature (6)] showed no statistically significant differences in the efficacy of the intervention strategies among the subgroups, even after adjusting for confounding factors (all *P* for interaction >0.05), (Supplementary Table S2, available in https://weekly.chinacdc.cn).

DISCUSSION

This investigation was structured as a cluster-randomized controlled trial encompassing a substantial
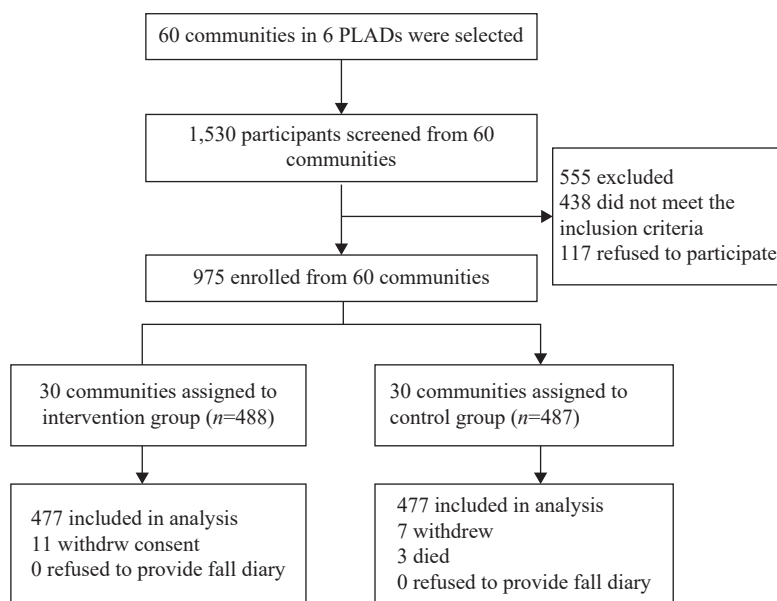
FIGURE 1. Flowchart of participants recruitment, screening, and participation — six PLADs, China, 2019–2020.
Abbreviation: PLADs=provincial-level administrative divisions.

participant cohort across six PLADs in China. The findings indicate that group-based interventions can significantly decrease the incidence of falls among community-dwelling elderly individuals when compared with the control cohort.

The observed incidence of falls was notably lower in the intervention group (11.11%) than in the control group (23.90%) during the 12-month follow-up period. Results of the multivariate logistic regression analysis indicated a 64% reduction in the risk of falls for participants in the intervention group when compared with the control group. These findings lend support to the efficacy of group-based fall prevention interventions in diminishing the risk of falls among community-dwelling older adults. These results align with those from a similar cluster randomized controlled trial conducted in Australia, which incorporated exercise and health education as part of the intervention and found a 43% decrease in fall risk (7). Conversely, not all studies have corroborated these findings. Waterman et al. (8) evaluated the effect of home environment safety assessments and prescribed home exercises for the elderly yet discovered no significant fall risk reduction when compared with conventional care in the control group. These disparate outcomes may be attributable to variations in the nature of the interventions, characteristics of the study population, sample size, and duration of the intervention.

Exercise has been recognized as an efficacious

approach for the prevention of falls (9). The World Health Organization's latest guidelines on "Strategies for Preventing and Managing Falls Across the Life-Course" highlight exercises aimed at enhancing gait and balance as the most strongly recommended intervention to prevent falls among older adults. In the present study, participants were instructed in 14 exercise regimens designed to improve balance, as well as strength and endurance in the lower limbs, and were consistently motivated to incorporate these exercises into their daily routines following each session. Prior research has demonstrated that regular physical activity can bolster lower limb muscle strength, augment flexibility, stabilize gait, and enhance balance. These improvements can lead to faster reaction times and, consequently, a diminished risk of falls (10).

The study boasts a robust design, an ample sample size, and trustworthy findings. However, it is not without its drawbacks. First, the COVID-19 pandemic potentially influenced the outcomes, as participants were required to stay home more frequently during the follow-up. This unusual circumstance may have had unforeseen effects on the results. Secondly, the follow-up duration was relatively brief, which leaves the long-term efficacy of the interventions in question. Finally, the research focused on older individuals who were already identified as having a high risk of falls, evidenced by at least one incident in the prior year. Consequently, the applicability of the interventions to the broader population of the elderly has yet to be

TABLE 1. Baseline characteristics of participants — six PLADs, China, 2019–2020.

Characteristics	Intervention group, N (%)	Control group, N (%)	Total	P value
Age (years), ($\bar{X}$±SD)	71.74±4.40	71.69±4.60	71.71±4.50	0.869
Age group (years)				0.433
65–74	344 (72.12)	333 (69.81)	677 (70.96)	
75–84	133 (27.88)	144 (30.19)	277 (29.04)	
Gender				0.661
Male	131 (27.46)	125 (26.21)	256 (26.83)	
Female	346 (72.54)	352 (73.79)	698 (73.17)	
Education level				<0.001
Primary	217 (45.49)	279 (58.49)	496 (51.99)	
Middle school	159 (33.33)	121 (25.37)	280 (29.35)	
High school or above	101 (21.17)	77 (16.14)	178 (18.66)	
Diseases				
Hypertension	282 (59.12)	263 (55.14)	545 (57.13)	0.214
Heart disease	74 (15.51)	66 (13.84)	140 (14.68)	0.464
Diabetes	102 (21.38)	101 (21.17)	203 (21.28)	0.937
Osteoporosis	108 (22.64)	61 (12.97)	169 (17.71)	<0.001
Arthritis	87 (18.24)	49 (10.27)	136 (14.26)	<0.001
Peripheral nervous system diseases	9 (0.94)	3 (0.63)	6 (1.26)	0.315
COPD	7 (1.47)	5 (1.05)	12 (1.26)	0.561
Asthma	9 (1.89)	4 (0.84)	13 (1.36)	0.163
Osteoproliferation	84 (17.61)	64 (13.42)	148 (15.51)	0.074
Cervical spondylopathy	118 (24.74)	74 (15.51)	192 (20.13)	<0.001
Lumbar Herniated Disc	100 (20.96)	56 (11.74)	156 (16.35)	<0.001
Depression	4 (0.42)	0 (0.00)	4 (0.42)	0.045
Cataract	156 (32.70)	114 (23.90)	270 (28.30)	0.003
Glaucoma	12 (2.52)	5 (1.05)	17 (1.78)	0.087
Tympanitis	8 (1.68)	3 (0.63)	11 (1.15)	0.129
Epicophosis	13 (2.73)	19 (3.98)	32 (3.35)	0.281
Tumour	10 (2.10)	8 (1.68)	18 (1.89)	0.634
ADL disability	25 (5.24)	33 (6.92)	58 (6.08)	0.278
Fall efficacy score, ($\bar{X}$±SD)	47.60±9.11	46.69±8.30	47.15±8.72	0.106
Balance function score, ($\bar{X}$±SD)	3.84±0.50	3.82±0.51	3.83±0.50	0.666

Abbreviation: PLADs=provincial-level administrative divisions; COPD=chronic obstructive pulmonary disease; ADL=activities of daily living; SD=standard deviation.

TABLE 2. Comparison of falls between the intervention and control groups during the follow-up — six PLADs, China, 2019–2020.

Group	N	Incidence of falls (%)	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Control	477	23.90	1.00	1.00
Intervention	477	11.11	0.40 (0.28-0.57)	0.36 (0.24-0.52)

Note: Model 1 incorporated only the independent variable. Model 2, however, was adjusted for educational level and disease status, encompassing conditions such as osteoporosis, arthritis, cervical spondylopathy, lumbar herniated discs, depression, and cataracts.
Abbreviation: PLADs=provincial-level administrative divisions; OR=odds ratio; CI=confidence interval.

established and warrants further examination.

Group-based fall prevention interventions have demonstrated efficacy in mitigating the risk of falls in older populations. The results suggest that these interventions serve as an invaluable adjunct to the management of elder health within community settings. Consequently, it is recommended that governmental authorities promote the incorporation of fall prevention strategies into the existing framework of community health services.

Conflicts of interest: No conflicts of interest.

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SUPPLEMENTARY MATERIAL

SUPPLEMENTARY TABLE S1. Frequency and contents of the intervention group.

Session	Time (week)	Main contents
Session 1	1st	1. Severity and risk factors for falls among older people 2. Exercise safety 3. Two balance exercises 4. Methods of making action plans
Session 2	2nd	1. How to solve problems in the implementation of the plan 2. Hazards in and around the home and how to reduce them 3. How to adjust and perfect action plans 4. Two balance and strength exercises
Session 3	3rd	1. Recognition of fall-hazards in the community and public places 2. Two balance and strength exercises
Session 4	4th	1. Treatment guidance of illness-related falls. 2. Two balance and strength exercises
Session 5	5th	1. Selection and use of assistive tools related to falls prevention 2. Two endurance exercise
Session 6	6th	1. Overcome fear of falls 2. Rational drug use 3. Two balance and strength exercises
Session 7	7th	1. Changing fall-related risk behaviors 2. Review knowledge and skills that have learned 3. Review exercise methods that have learned
Session 8 (home visit)	8th–13th	1. Assessment of home hazard factors related to falls 2. Guidance of home hazard modification
Session 9	14th–16th	Comprehensive review, experience sharing and encouragement
Session 10	22nd–24th	Comprehensive review, experience sharing, encouragement and graduation ceremony

SUPPLEMENTARY TABLE S2. Subgroup analysis of the effectiveness group-based interventions on falls — six PLADs, China, 2019–2020.

Subgroup	OR*	95% CI	P for interaction
Gender			0.269
Male	0.26	0.11–0.62	
Female	0.38	0.25–0.58	
Age group (years)			0.135
65–74	0.40	0.25–0.62	
75–84	0.24	0.11–0.54	
Fall efficacy score			0.563
≤35	0.42	0.14–1.25	
>35	0.35	0.23–0.52	

Abbreviation: PLADs=provincial-level administrative divisions; OR=odds ratio; CI=confidence interval.
* adjusted for education level and disease status (osteoporosis, arthritis, cervical spondylopathy, lumbar herniated disc, depression, and cataract).