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Research article

The Effects of Multifactorial Fall Prevention Program on Balance, Physical Fitness, and Fear of Falling Among Community-Dwelling Older Adults

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Abstract

Background: Falls are common adverse events, causing considerable morbidity and mortality among older people. Falls are multifactorial but preventable; therefore, reducing fall events requires an effective multifactorial prevention program. This quasi-experimental study was aimed at assessing effects of the multifactorial fall prevention program on balance, physical fitness, and fear of falling (FOF) among older adults in Chonburi communities

Methods: Sixty older adults at-risk of fall were randomly allocated into either the intervention group or the control group. The intervention group received the fall prevention program for 24 weeks whereas the control group had routine care. Participants' balance, physical fitness, and fear of falling (FOF) were assessed at baseline (T0) and at the 17th week (T1) and the 25th week (T2). Data gathered were analyzed by descriptive statistics, independent samples t-test, and repeated measures ANOVA.

Results: Within the intervention group, assessing scores on balance ($F(1.82, 52.76) = 49.26$, $p < .001$) and physical fitness at T1 and T2 were significantly higher than at T0 while FOF scores at T1 and T2 were lower than at T0 ($F(2, 58) = 35.24$, $p < .001$). Comparing between two groups, the intervention group had higher scores on balance ($t = 2.19$, $p < .05$, $t = 6.03$, $p < .001$) and physical fitness but lower scores on FOF ($t = -4.84$, $p < .001$, $t = -7.55$, $p < .001$) at T1 and T2 than the control group while back-scratch ($t = 1.43$, $p > .05$, $t = 2.56$, $p < .05$) had significantly higher scores than the control group only at T2.

Conclusions: This research showed that the program could improve balance, physical fitness, but reduce FOF levels so that it could effectively promote falls prevention behaviors among older adults. Health care providers should utilize the program in promoting self-care capability for preventing falls among community-dwelling older adults.

Keywords: Exercise, Balance, Physical fitness, Fear of falling, Older adult

Introduction

Falls are the major global health problem among older adults. One in every three community-dwelling older adults aged 65 years and older experiences falling each year, and the proportion of falling is incremental according to number of age[1]. Falls can cause serious health consequences including injury, activity limitation, disability, loss of independence, fear of falling, and mortality[2,3]. Most falls among the older adults are due to multiple risk factors. Major factors attributed to risk of falls include impaired balance and gait, polypharmacy, cognitive decline especially attention and executive dysfunction, visual impairments, previous fall history, and environmental conditions[4]. Therefore, the older adults at-risk of fall require a multifactorial assessment and multifactorial fall prevention intervention[5,6]. The previous systematic review revealed that an effective multifactorial fall intervention program should be comprised of at least two activities such as health education, group exercise training, home-based exercise, medication review, improving self-efficacy, and modifying environmental conditions[7]. According to the previous studies, although multifactorial fall prevention interventions could improve functional ability, dynamic balance, depression, fear of falling, and fall self-efficacy in community-dwelling older adults with fall history in different countries[8,9], the success of preventing and managing falls among community-dwelling older adults in each country depend on different contextual factors including daily lives, cultures, and supportive health care systems. That is, the external influencing factors could affect the fall prevention programs implemented in each country[10].

In Thailand, falls are the major public health problems and major cause of death second only to road accidents. The prevalence of falls among community-dwelling older adults was nearly 20 percent during the six-month period; the prevalence showed 24.1 percent of women but only 12.1 percent of men[11]. The Division of Non-Communicable Disease[12] estimated that Thai older adults had fallen 3,030,900- 4,714,800 during the year 2017-2021, and the estimated mortality rates were three times higher than other age groups. Another study found that among the fallers being hospitalized due to injuries, the average length of stay (LOS) of those with and without fractures was 8.1 and 6.4 days. Their average medical expenses were 25,728 and 19,419.3 THB or 804 and 606.8 USD[13]. Among the falling events of Thai older adults, the fall-related factors were medication used, depression, sufficient exercise, and wearing slippery shoes[14,15]. Although many studies concluded that falls resulted from multiple factors[16] and required a multifactorial fall prevention intervention, the literature review of fall prevention programs in Thailand in studies of the previous five years (2016-2020) revealed that all studies focused only one single intervention either an exercise, Thai classical dance, or health education program[10,14,15,17]. To bridge the research gap, this study had applied multifactorial approach in the intervention program in order to reduce risks of falling. Therefore, it was aimed at examining the effects of the multifactorial fall prevention program on balance, physical fitness, and fear of falling (FOF) among community-dwelling older adults at-risk of falls in Thailand.

Conceptual framework

Fall prevention programs aim to minimize the modifiable risk factors for falling, and thereby prevent falls and associated injuries. The conceptual framework of this study is comprised of both intrinsic and extrinsic risk factors including biological, psycho- behavioral, and environmental factors. The multifactorial fall prevention programs are designed reduce falls in the older people through tackling factors affecting falls, as detailed in figure 1.

Method

Research design: The quasi-experimental study was designed to assess the effects of the multifactorial fall prevention program on balance, physical fitness, and FOF among community-dwelling older adults at-risk of falls. The balance, physical fitness, and FOF of two-group participants were assessed before (T0) and after conducting the program at the 17th week (T1) and the 25th week (T2), and the result scores of two groups were compared.

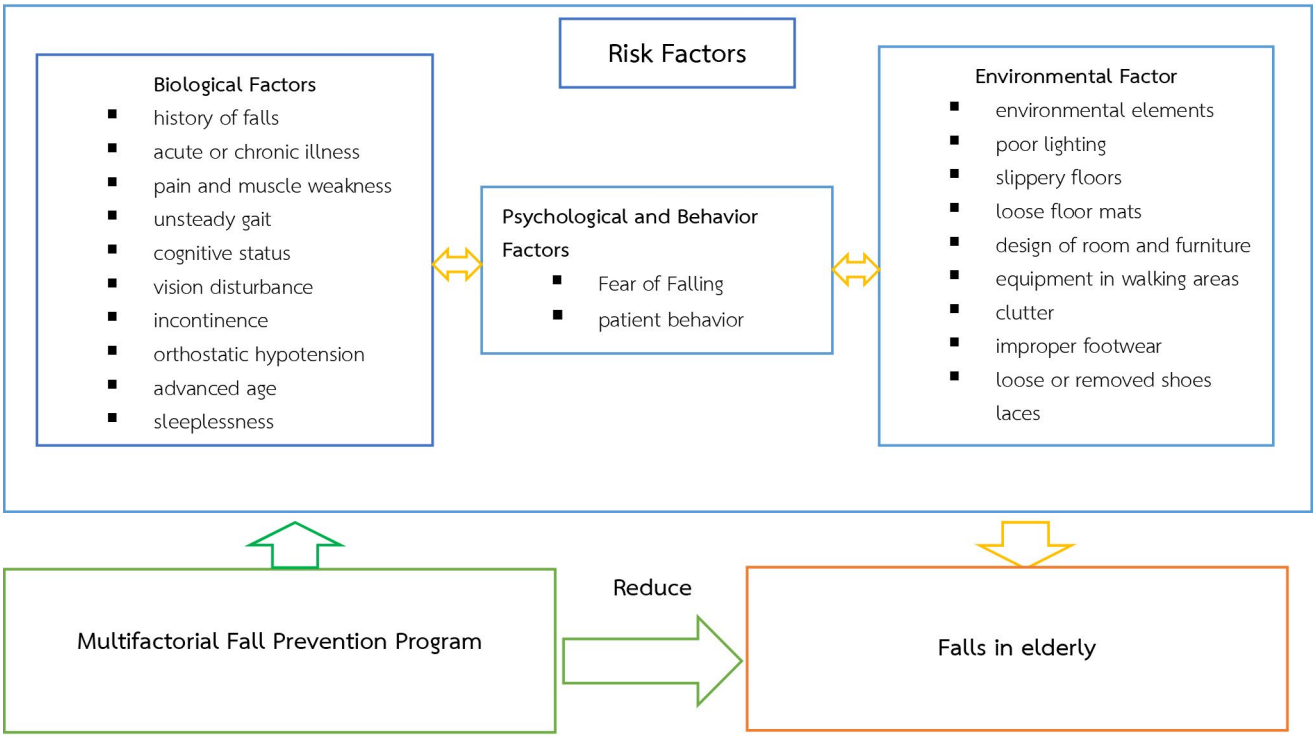

Figure 1. Conceptual framework

This study was conducted in two communities, Koh Si Chang and Mueang Municipality of Chon Buri Province, Thailand. The studied samples were the older people aged 60 and over, members of the elderly club, and living in the studied communities. The eligible samples must meet the following criteria: (i) ability to perform daily activities without an additional support; (ii) being at-risk of falls; (iii) no cognitive impairment; (iv) no serious chronic disease condition (including diabetes mellitus with severe complication, heart disease, severe hypertension), or orthopedic condition (including severe arthritis, severe joint pain, recent lower limb surgery), or major neurological disorder (including Parkinson's disease, stroke with paralysis). The exclusion criteria were applied to exclude those who were recommended by any physician for refraining from an aerobic exercise during the whole range of the program, or in any serious illness condition.

Sample size: The studied sample size was calculated by the power of 0.80, with the effect size of 0.10, and alpha of 0.05; approximately, the required total sample size for ANOVA was 30. Due to the longitudinal study, the sample size was 15 percent added up for preventing attrition. Therefore, the total participants of each group comprise 35 participants (70 participants in total). Participants at-risk of falling were recruited by the registered nurses in the Out-Patient Department of Koh Si Chang and Mueang Health Promotion hospitals. The participants of Koh Si Chang hospital were allocated through the simple random sampling into intervention group, whereas the participants of Mueang Health Promotion hospital were randomly allocated into control group. The research assistant then contacted the individual participants in both groups for providing information about the study. After each participant signed the informed consent, the researchers launched the program implementation.

Ethical consideration: After reviewing the protocol and procedures and related document, the Research Ethics Review Committee of Burapha University granted the ethical approval of the study (No 51/2561, Project no. Sci 037/2561). The project ensured the participants' confidentialities and anonymities.

Instruments

Instrument was divided into three parts: the data collecting instruments, the screening instrument, and the intervention program

The data collecting instrument was composed of 3 instruments as follows,

1) The Berg Balance Scale (BBS), consisted of 14 items, was applied for assessing balance of the participants, and data were recorded through direct observation. The balance assessment completed in 10 to 20 minutes to measure ability of each participant for maintaining balance in static position and moving motion. Ability to perform the task was graded in each item, scored ranging from zero to four, and the overall maximum possible scores were of 56 points. The higher cumulative scores were graded the better balance would be[18]. The Berg Balance Scale has a high relative reliability with inter-rater reliability estimated at 0.97 (95% CI 0.96 to 0.98) and intra-rater reliability estimated at 0.98 (95% CI 0.97 to 0.99).

2) The Senior Fitness Test (SFT), the reliable instrument, was used for physical fitness assessment. It comprised six performance tests: included chair stand test (to assess lower-body strength), arm curl test (to measure upper body strength), two-minute step test (to assess aerobic endurance), chair-sit and reach test (to assess lower-body flexibility), back scratch test (to assess upper body flexibility), and eight-foot up and go test (to assess agility and dynamic balance)[19]. Validity estimates for each of the functional-fitness tests have been reported previously by Rikli and Jones (1999)[20].

3) The Fall Efficacy Scale International (FES-I) was used for assessing the degree of perceived self-efficacy of fall avoidance in performing basic daily activities or fear of falling. The measurement comprised 16 items including 10 original items from the FES and six new items assessing walking slippery, uneven or sloping surfaces, and visiting friends or relatives, going to a social event, or going to a crowd. Participants were asked to identify the level of concern about falling while carrying out each activity rated in four-point scale (1 = not at all concerned, 4 = very concerned). The higher score was correspondent to the higher concern about falling and less fall-related self-efficacy. Test-retest reliability of the FES-I had ranged from 0.79 to 0.96 in the older adult populations[21,22]. The pilot study of the Fall Efficacy Scale International in sample of 30 older adults whose similarity as the participants of this study identified good internal consistency; Cronbach's alpha was 0.82.

In the screening instrument, Timed Up and Go Test (TUG) was used for screening the risk of falling. The participants were asked to rise from the chair, walk to a marker in three meters away, turn around, walk back to the chair, and sit down. Any participants could complete the whole process equal, or more than 12 seconds would be at-risk of fall[23].

The intervention programs:

The multifactorial fall prevention program was used in the study. The program provided with the 24-week multifactorial fall prevention program. The program contained health education, home hazard evaluation/modification, medication review, and exercise intervention.

Procedure: The baseline (T0) assessment was performed for measuring balance, physical fitness, and fear of falling (FOF). The assessment measures were repeated after the intervention program given at the 17th week (T1) and the 25th week (T2). All measurements were undertaken by the sport scientists blinded to group allocation.

Intervention group: The participants received the baseline assessment to identify risk of falls and were referred to their clinicians with the risk-of-fall report. They would receive the usual care (e.g., giving advice for risk of fall prevention including exercise, wearing appropriate clothing, wearing sensible shoes, removing home hazards, light up their living space, and using assistive devices after being assessed risk of falling.) around three weeks before they were able to attend the multifactorial fall prevention program. The participants randomly allocated into the program were provided with the 24-week multifactorial fall prevention program. The program contained health education, home hazard evaluation/modification, medication review, and exercise intervention.

The health education class addressed specifically behavioral and environmental risk factors of falls, delivered by the trained profes-

sional nurses. Six sessions of health education, appropriately designed for local older people, were conducted in 60 minutes, twice a week in the local hospital classroom. Learning materials were comprised of the live model (successful aging) and video material as additional support to the verbal communication. Each class of health education contained essential topics and processes: included a brief introduction to the core topics of the day with hand-out and/or audio-visual material, group discussion identifying participants' experiences and attitudes in the topics discussed and major barriers to implementing the suggested preventive strategies. In addition, the participants discussed in group about intervention strategies, how to implement, and the benefits of the fall prevention programs from their points of view. The health education topics included fall situation in their communities, risk factors of falls, effects of falls, fall prevention strategies, benefits of exercise for fall prevention, home hazard evaluation/modification, and medication review. All participants had received fall prevention and an instruction booklet by the end of the health education class.

The exercise intervention was developed and monitored by the research team. The participants were supervised in the exercise training by sport trainer. The exercise intervention was consisted of strengthening, balance, endurance, and flexibility of the body for sixty minutes per session. Each exercise session was consisted of ten-minute warm-up exercise including neck rotation in a clockwise and counterclockwise fashion, turning shoulder exercise, trunk rotational exercise, and ankle rotational exercise. The activities included: (i) ten-minute balance training with single-leg stance, single limb stance with arm, side leg raise, heel-or-toe stand, and heel-to-toe walking, (ii) ten-minute low-extremity muscle-strengthening exercise using a resistance band, (iii) twenty-minute endurance exercise training by using the northeastern Thai folk-dance (Soeng-Isaan) exercise program, and (iv) ten-minute cool-down exercise by stretching and relaxation exercises.

Dance with the northeastern Thai folk-music was applied as the exercise intervention. The participants had practiced dancing in progressive pattern, from the simplest and least physical demanding to the most dynamic of movement. The dancing exercises were implemented in low to moderate rate of intensity (50–60% of maximum heart rate) to prevent fatigue effects. If any participants felt discomfort during exercise, they were allowed to discontinue participating in the session. All participants had participated continually in the exercise with the group at the hospital three days a week for 16 weeks.

After the 16-week of exercise training, all participants were given an exercise booklet and video with illustrations and instructions and encouraged to continue doing similar exercises in their own home or community settings for eight-weeks, without being supported by the research team. While doing exercise at home or community, the participants were provided a home visit every two weeks by the primary investigator (PI) or the community nurse to ensure that no negative effects of the exercises or exercise-related problems occurred at home. The participants could reach the PI or the community nurse by phone if needed. Data on adherence to the exercise program were recorded by participants every week in the exercise record sheets, which could be retrieved and reviewed by the PI or the community nurse during the home visits.

Control group: The participants in the control group received no intervention but the basic routine care: advice for risk of fall prevention including exercise, wearing appropriate clothing, wearing sensible shoes, removing home hazards, light up their living space, and using assistive devices after being assessed risk of falling. The advice was delivered by the nurse or health care provider at the local hospital. The participants' performance, then, was evaluated on the outcome variables at the first week as baseline (T0), the 17th week (T1), and the 25thweek (T2) of the study program. At the end of the study, all participants in the control group received information of exercise illustrated the fall prevention and instruction booklet.

Data analysis: Descriptive statistics were applied for analyzing and describing

the demographic data of the participants. The assumptions of normal homogeneity of variance for inferential statistic variables and compound symmetry of the dependent variable data were checked for determining statistical analysis. The assumptions were met for applying, an independent t-test for testing the mean differences score of the balance, FOF, and physical fitness between treatment and control groups. Two-way repeated measure ANOVA was used to examine the mean differences between and within groups for the outcome variables.

Results

Participant characteristics: Baseline characteristics of 60 participants are shown in Table 1. The mean age ± standard deviation of the participants in the control group was 65.53 ± 2.56 and the intervention group was 65.60 ± 2.47. Participants in both groups were predominantly female. At the baseline, performance on the balance, physical fitness, and FOF test between two groups were similar on most outcome measures. In general, at the baseline, the intervention group had better health conditions than the control group. However, the intervention group had a greater number of abnormal eyesight, movement, or walking problems, and had been falling than the control group.

Intention to treat outcome analysis: In the intervention group, 30 out of 42 participants had completed the interventional activities while 30 out of the 40 participants in the control group had completed the program. Table 2. illustrated the comparison of outcome measures assessed at the baseline and post-intervention, at the 17th week and the 25th week between the intervention and control groups. For the intervention group, there were significantly higher scores on balance ($F(1.82, 52.76) = 49.26$, $p < .001$) and physical fitness scores at T1 and T2 than at T0; FOF score at T1 and T2 were significantly lower than at T0 ($F(2, 58) = 35.24$, $p < .001$). Compared between two groups, the intervention group had significantly higher scores on balance ($t = 2.19$, $p < .05$, $t = 6.03$, $p < .001$) and physical fitness, and lower scores on FOF ($t = -4.84$, $p < .001$, $t = -7.55$, $p < .001$) at T1 and T2 than control group, while back-scratch ($t = 1.43$, $p > .05$, $t = 2.56$, $p < .05$) had significantly higher scores only at T2.

Safety and compliance to the intervention: To have completed compliance of the program, the participants must do exercise three days per week. The average percentage of adherence of all participants who completed twenty weeks of the exercise program was 85.71% (30 of 35 participants). Their common reasons for limiting their exercise adherence were their moving to mainland for working, living with their relatives, and health conditions.

No injuries were associated with performing the intervention. Some participants reported bodily discomfort during the first two weeks of the exercise session. However, their symptoms were relieved after they continued doing exercises.

Discussion

This study evaluated the effectiveness of the multifactorial fall prevention program implemented through the local public health partnerships. The results showed that the program improved balance and physical fitness, but reduced FOF significantly during 24 weeks of implementation. Only back-scratch had significantly higher scores only at 17 weeks. The results of this study were relevant to the studies of[24,25] which were revealed that older adults receiving multifactorial program training improved their balance and physical fitness and reduce their FOF.

The effectiveness of this fall prevention program resulted from both health education classes and exercise program. The health education classes, delivered by a professional nurse, were given to the older adults to understand risk factors of falls, the effects of falls, fall prevention strategies, the benefit of exercise for fall prevention, home hazards evaluation/modification, and medication review. The exercise programs, delivered by the trained instructors, could be implemented safely and effectively in local communities. Health education classes and exercise programs were accountable for the effectiveness of this fall prevention program. This result was relevant to the previous studies suggested that effects of the multifactorial risk

Table 1. Characteristics of the participants at baseline (n =60)

Characteristics and Falls risk factors	Intervention Group (30)	Control Group (30)	Statistics Value	*p*
Age, mean ± SD	65.53 ± 2.56	65.60 ± 2.47	-0.108[a]	0.915
Sex (M: F), n	2:28	3:27	-0.467[b]	0.640
Marital status (% single, married, separate and divorce)	13.3%,26.7%,60.0%	10.0%,36.7%,53.3%	0.734[c]	0.693
Working: non-working, n (%working)	10:20 (33.3%)	17:13 (56.7%)	-1.817[b]	0.069
Have medical conditions: healthy, n (%have health conditions)	26:4 (86.7%)	30:0 (100%)	-2.070[b]	0.038
Number of medical conditions, mean ± SD	1.83 ±1.23	2.00±0.91	-0.609[a]	0.545
Number of medications use, mean ± SD	1.60 ±1.25	2.16±1.31	-1.694[a]	0.096
Normal eyesight: abnormal eyesight, n (%non-normal eyesight)	22:8 (26.7%)	27:3 (10.0%)	-1.668[b]	0.095
Drinking alcohol: non-drink, n (% drinking alcohol)	3:27 (10.0%)	2:28 (6.7%)	0.467[b]	0.640
Exercise: non-exercise n (% non-exercise)	13:17(56.7%)	13:17(56.7%)	0.000[b]	1.000
Fallers: non-fallers, n (% fallers)	5:25 (16.7%)	2:28(6.7%)	1.207[b]	0.228
Movement or walking problem: normal, n (% movement or walking problem)	4:26 (13.3%)	0:30 (0.0%)	2.070[b]	0.038
Balance, mean ± SD	29.10 (±1.94)	29.03 (±3.38)	0.098[a]	0.922
Fear of Falling, mean ± SD	37.50 (±8.52)	37.60 (±8.58)	-0.045[a]	0.964
Chair stand (no. of stands), mean ± SD	12.43 (±3.01)	12.57 (±1.74)	-0.221[a]	0.826
Arm Curl (no. of reps), mean ± SD	17.10 (±4.22)	17.20 (±3.71)	-0.098[a]	0.923
2 Min Step (no. of steps), mean ± SD	99.83 (±27.72)	100.03 (±22.32)	-0.031[a]	0.976
Chair Sit-&-Reach (inches +/-), mean ± SD	-3.32 (±3.15)	-3.29 (±2.70)	-0.040[a]	0.969
Back Scratch (inches +/-), mean ± SD	-4.87 (±4.75)	-4.82 (±4.16)	-0.043[a]	0.966
8-Ft Up-&-Go (second), mean ± SD	15.53 (±3.50)	15.50 (±2.63)	0.038[a]	0.970

a = independent t-test, b = z-test for proportion difference, c = Chi-square test

Table 2. Outcome analysis

Outcome measures		Intervention Group(n=30)	Control Group(n=30)	t	*p*
Balance	Baseline	29.10±1.94	29.03±3.38	0.09	.93
	Week 17	30.83±3.02	29.17±2.88	2.19	.03
	Week 25	33.23±2.09	29.37±2.82	6.03	< .001

Table 2. Outcome analysis (Continue)

Outcome measures		Intervention Group(n=30)	Control Group(n=30)	t	*p*
Fear of Falling (FOF)	Baseline	37.50 ±8.52	37.60 ±8.58	-0.05	.95
	Week 17	28.00 ±6.63	37.53 ±8.50	-4.84	< .001
	Week 25	24.63 ±6.37	37.27 ±6.59	-7.55	< .001
Chair stand (no. Of stands)	Baseline	12.43 ±3.01	12.57 ±1.74	-0.21	.83
	Week 17	14.73±2.52	12.80±1.67	3.51	< .001
	Week 25	17.07±2.75	12.60±1.40	7.92	<.001
Arm Curl (no. of reps)	Baseline	17.10±4.22	17.20±3.71	-1.0	.92
	Week 17	23.43±5.36	17.47±3.48	5.11	<.001
	Week 25	33.37±6.42	17.27±3.05	12.40	<.001
2 Min Step (no. of steps)	Baseline	99.83±27.72	100.03±22.32	-0.31	.98
	Week 17	130.27±33.32	100.23±20.93	4.18	< .001
	Week 25	148.93±31.65	99.30±21.09	7.15	< .001
Chair Sit-&-Reach (inches +/-)	Baseline	-3.32±3.15	-3.29±2.70	-0.04	.97
	Week 17	-1.90±2.71	-3.39±2.41	2.24	.03
	Week 25	-1.22±2.19	-3.36±2.42	3.59	< .001
Back Scratch (inches +/-)	Baseline	-4.87±4.57	-4.82±4.16	-0.05	.96
	Week 17	-3.28±3.71	-4.59±3.42	1.43	.16
	Week 25	-2.40±3.42	-4.62±3.30	2.56	.01
8-Ft Up-&-Go (second)	Baseline	15.53±3.50	15.50±2.63	0.04	.98
	Week 17	12.00±2.68	15.67±2.76	0.96	< .001
	Week 25	9.37±2.24	15.33±2.47	0.33	< .001

management programs required educating patients to know about how to manage fall risk factors[24,26]. The health education classes, and exercise programs could enhance participants' self-care abilities. In addition, booklets guiding for fall prevention and instructions were also provided so that participants could learn or review the material at home. Therefore, educating the participants through formal learning class by the professional nurse and providing the fall prevention booklet for managing fall risk factors could improve effectiveness of this program.

Effectiveness of the exercise programs for the participants depended on to what extent the participants could engage themselves in exercises. Most successful exercise programs prescribed exercise three or more times per week[27], and programs should consider the participant's ability to sustain the intensity of exercise[28]. In this study, the participants attending the group exercise program at least three times per week had better performance on balance and physical fitness mobility and reducing FOF in 16-week post-intervention, compared with their own performance at baseline (T0), and with the

control group. This study results were consistent with the previous studies of the 12-week group exercise program and the eight-week self-management exercise program[9], the 12-week program composed of one education session and three exercise sessions per week[8]. The 12-week multifactorial program composed of four structured week health education classes coupled with health education brochures and eight-week exercise training once a week[24]. The above-mentioned studies showed that, it was reported that balance and physical function significantly improved.

In addition, the previous study revealed that sustaining adherence to falls prevention exercise programs could reduce risk of fall[27]. In this study, after 16 weeks of group exercise program, thirty participants in the intervention group could sustain adherence to fall prevention exercise programs at home at least three days per week for eight weeks. After 24 weeks of exercise program, they had more improvement in balance and physical fitness and reduce FOF compared to the baseline (T0), 17th-week (T1), 25th-week, post-intervention (T2), and the control group except back-scratch had significantly higher scores only at T2. Therefore, the rang of adherence and continues participation in the programs could improve program successfully.

The successful implementation of this exercise program was confirmed by outcome improvement in 17th-week and 25th-week post-intervention because activities of the exercise program were delivered in both group-based and home-based exercise in the similar pattern, 60 minutes per day, three days per week for 24 weeks. In addition, other significant factors contributing to success of the program included providing the exercise booklet and video with illustrations and instructions, and offering active reinforcement by a community nurse or PI during exercise at home could. These interventional activities could encourage the participants to continue doing exercise as program designed. This study was associated with other successful programs in the previous studies; they suggested that the successful fall prevention exercise program should combine both group-based and home-based exercise at least 30 minutes per day and three days per week[28,29]. Although the participants in this study had ability to move and travel independently, the hospital and the local government kindly provided two-way local taxi transportation to support the participants during participating in research activities at the hospital. Getting transportation support could help sustain participants' adherence to the weekly exercise sessions, which could lead the exercise program to successful implementation[30].

For balance assessment, the findings of this study showed the positive effects of the older adults' Berg balance scale in the multifactorial fall prevention program. The reasons for the positive effects of this study were due to that this multifactorial fall prevention program was tailor-made for improving the balance among older adults at-risk of falling. This multifactorial fall prevention program was comprised of health education classes and exercise interventions for improving balance in older adults at-risk of falling. During health education class, the participants were educated to understand the risks of fall factors and how to prevent falling by applying various strategies, specifically exercise intervention.

The exercise intervention had the positive effects on reducing falls and improving muscle strength and physical function via sharing experiences from the exercise live model and media. In the training exercise session, we provided the group exercise intervention including (i) balance training with single-leg stance, single limb stance with arm, side leg raises, heel or toe stand, and heel to toe walking, (ii) low-extremity muscle strengthening exercise using a resistance band, and (iii) endurance exercise training by using the northeastern Thai folk-dance program for sixteen weeks. After that, the participants were assigned to have home exercise for eight weeks. In addition, the northeastern Thai folk-dance exercise was designed in various steps-directions synchronized with music rhythm such as forwards-and-backward, left-and-right, oblique-forwards-and-backward combined with hand movement. This kind of exercise could

be used to train proprioceptive and balancing for older adults. Moreover, we provided the exercise booklet, video with illustrations, and instructions for the participants to practice similar exercises at home. Those mentioned strategies encouraged the participants to exercise continually and sustain adherence to the program. The exercise strategies could not only improve balance but also enhance physical fitness of participants. Finally, their balance and physical fitness abilities were improved. The study findings had supported other studies[24,25] which demonstrated that the exercise could improve balance and physical fitness in the groups of older adults.

Reducing fear of falling (FOF), this multifactorial fall prevention program enhanced self-efficacy beliefs regarding falls, the sense of control over falling, and risk perception and falls outcome expectancies. To reduce FOF, this study used five strategies, including (i) promoting the positive attitude towards risks of falls and the FOF as controllable events, (ii) reducing the home hazards, (iii) changing the home environment, (iv) reviewing medication used for reducing the risk of falls, and (v) promoting exercise to increase strength, balance, and fitness by setting realistic goals based on personal capabilities. Furthermore, motivating the positive attitude of exercise by sharing experiences of the successful exercise live model in health education class, step-by-step exercise training, being supervised by the trained instructor, and encouraging the participants during exercise class had created the sense of self-efficacy in exercise. Finally, the participants could do exercise continually both as a group at hospital and as individual at home. As a result, they had improved their balance and physical fitness performance. It also resulted in reducing fear of falling. It is suggested that increasing the self-confidence in practicing exercise and perception of risks of falls as controllable factors could improve physical fitness and balance and reduce FOF[25].

Limitations: Since this study was conducted in only one province of Thai Eastern region, the findings could be plausibly transferable to other settings with similar contexts, not different ones. In addition, the study focused on the multifactorial fall prevention program implemented in the specific sample size, the results might be valid to certain group of older adults. It would be scientifically useful if the program could be applied for its effects in the larger groups of older people in various contexts.

Conclusions

This quasi-experimental study had evaluated the effects of multifactorial fall prevention intervention programs on risk factors among the older adults at-risk of falls. It was proven that the intervention program could improve balance and physical fitness and reduce FOF significantly. The key points of the intervention program could be concluded as a successful program due to the following unique components:

1) Heath education sessions that comprised of knowledge and learning process related to falls and fall prevention were well-delivered to enhance participants' capability, self-efficacy, and skills in dealing with falls.

2) Exercise programs were organized as groups and individuals and in the appropriate duration of exercise to ensure participants' adherence to the exercise program.

3) While the intervention program was being implemented, the program received good supports in term of place, facilities and transportation from both hospitals and local governments. These supports and facilities cloud encourage and motivate the older adults to participate actively in the program. As results of positive effects of the multifactorial fall prevention program, it is suggested that health care providers should utilize the program to promote self-care capability for fall prevention among community-dwelling older adults.

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