The Effects of a Physical Activity Program for Fall Prevention among Thai Older Adults

Teeranut Harnirattisai, Borwarnluck Thongtawee, Parinya Raetong

Abstract : Falls are common problems among older persons, often leading to disability or death. This study examined the feasibility of a physical activity program for fall prevention and the effects of that program on fall efficacy, physical performance, and balance among older adults. The study was based on self-efficacy theory and the concept of movement and balance control appropriate for fall prevention among older adults. A quasi-experimental design was used. Forty Thai older adults in the community who met the inclusion criteria were studied. The experimental group (n=20) and control group (n=20) were randomly assigned by the villages they lived in. The experimental group received the Physical Activity Program for Fall Prevention developed by the investigators. This program consisted of self-efficacy enhancement activities, basic movements, rubber band exercise, and a nine-squared walk. Outcome measures were the Fall Efficacy Scale, the Physical Performance test, and Berg's Balance test. Data were analyzed using descriptive statistics and repeated measures ANOVA.

The results demonstrated that the experimental group significantly improved their physical performance and the Berg's Balance test compared to the control group. The program did not increase the fall efficacy score. However, the experimental group significantly improved their fall efficacy score at week 8 after receiving the program. It is feasible that this program can be one kind of strategy applied to improve balance in order to prevent falls among Thai older adults. A larger sample size and a longer period of study are suggested for further study.

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Introduction

Falls are common problems among older adults globally, including in Thailand, and they can lead to disability and death. In the United States, one of three adults 65 and older falls each year: in 2010, about 21,700 older adults died from fall injuries, and 2.3 million older adults that were injured from

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falls were treated in emergency departments and more than 662,000 of these patients were hospitalized.[1] From a health survey of Thai people, it was demonstrated that 18.5% of older adults fall each year, and females had a 1.5 time greater rate of falling than males.[2] The consequences of falls can range from injury or disability to death. In addition, following a fall, many older adults develop a fear of falling and this lead them to avoid performing physical activity.[3,4] There is strong evidence that older people that are afraid of falling and consequently avoid activities will have little confidence in performing activities, no social participation, and this will then result in physical frailty, falls, and loss of independence.[5] Fall risk assessment and intervention to prevent falls among older people are therefore necessary.

The causes of falls are multifaceted, which can be divided into intrinsic and extrinsic factors. A number of intrinsic factors play an important role in fall causation. The intrinsic factors often include alteration of balance, gait, muscle strength, visual acuity, cognition, and having a chronic disease.[6] Functional decline, the consequence of the physiological change from aging, can lead to these intrinsic factors related to falls. Increasing age is associated with visual deficit, vestibular dysfunction, and a progressive alteration of proprioception, yet the older adults seem to depend increasingly on the visual afferent to maintain their balance.[7] Moreover, aging is associated with decreased muscular strength, which affects the major postural functions, especially global balance. In order to maintain postural stability, it is necessary that there be interaction between the musculoskeletal system and the sensory system, and this interaction requires the complex integration of sensory information regarding the position of the body relative to the surroundings, and the ability to generate force to control movement[8]. Muir and his colleagues demonstrated that older adults that had balance impairment had an increased risk of falling.[9] There is also evidence that exercise and physical activity, such as Tai Chi and progressive training for quadriceps muscles, can improve muscle weakness and balance, decreasing the risk of falls.[6, 10]

Major factors for fall risk are (a) a previous fall history; (b) the limitation of movements such as weakness of the lower limbs; (c) use of many kinds of medications ; d) urinary incontinence; (e) dizziness ; and (f) cognitive impairment.[11] Many tools have been developed for fall risk assessment. For example, the Thai Fall Risk Assessment Tool (Thai FRAT) developed by Theimwong, Jitapunkul and Panyachevin [12] deals with fall risk assessment for Thai older adults consisting of various factors, such as gender, age, vision, balance and movement deficit, number of chronic illnesses, medication, fall history, and the home environment. This tool was appropriate for fall risk assessment because it included a Thai traditional house (a house with a high first floor and an open area beneath it) which is one of the local environmental factors for risk of falls in Thailand.

Self-efficacy in performing physical activities has been found to be associated with physical functions in older adults. Almost 50% of fallers admitted to the fear of falling, and 25% of these fallers acknowledged avoiding activities because of fear.[13] The fear of falling or low perceived self-efficacy in performing activities is linked to functional decline since those that have such a fear tend to avoid physical activity.[13] Thus, interventions aimed at enhancing older adults' self-efficacy in performing activities might reduce the fear of falling, depression, and enhance physical function. Self-efficacy and outcome expectation for exercise have been found to be associated with physical performance in Thai older adults.[14] In addition, an intervention designed based on self-efficacy and outcome expectation enhancement could increase physical activity participation and improve physical performance in Thai older adults. Harnirattisai and Johnson[15] examined the effects of a behavioral intervention (BCI) on self-efficacy and outcome expectations for exercise and functional activity, physical activity participation, and physical performance

of Thai older adults. The results demonstrated that the experimental group that had greater improvements in self-efficacy for exercise, outcome expectations for exercise, and functional activity, exhibited significantly more participation in exercise and walking, and also exhibited significant improvement in physical performance than did the control group. Therefore, promoting self-efficacy among older Thais in terms of performing physical activity will help them to have more confidence in performing exercise and physical activity, resulting in physical performance improvement, and this could also decrease their risk of falling.

A literature review of a fall prevention program for older adults summarized that the most effective program has to be a multifactorial intervention program.[16, 17, 18] The components of successful multifactorial intervention include exercise intervention, education to increase fall efficacy for performing activities, and modification of environmental hazards.[17, 18] For example, Zijkstra and his colleagues studied the effects of a multicomponent cognitive behavioral group intervention with community-dwelling older adults and found that at 8 months, there was a significant difference between groups in all outcomes and at 14 months a difference in the fear of falling, perceived control over falling, and recurrent fallers, but not in activity avoidance, concern about falling, daily activity or fallers. Moreover, increasing exercise and physical activity is the most significant strategy, as exercise and physical activity that take place in a comprehensive program and consist of a variety of techniques to strengthen muscles, improve balance, and increase endurance are an effective strategy in preventing falls.[19,20] Exercise and physical activity have been found to improve physical performance and balance among older adults.[15, 21] Tai Chi, a kind of physical activity, offers the benefits of flexibility, muscle strengthening, and endurance training.[22] In addition, progressive muscular strengthening and a proprioception training program could lower the incidence of falls. Teixeira and colleagues developed and examined the effect of exercise program that was an 18-week progressive muscular strength and proprioception training in postmenopausal women with osteoporosis.[6] Proprioception physical activity training is comprised of the activities performed to improve postural control using the function of sensory inferences and the muscular strength of the lower limbs.[6] The results demonstrated that the program promoted a significant difference among the groups for SF-36 in the eight sub-scales, the Timed Up & Go Test, the Berg Balance Scale, and also decreased the number of falls in the intervention group compared to the control group. Including self-efficacy to enhance physical activity was found to be associated with the improved physical performance of Thai older adults.[15]

In Thailand, there were some previous studies in this area which were developments of fall risk assessment tool, the intrinsic risk factors of falls among Thai older adults and activity program to prevent falls among older adult.[21, 29] However, very few studies related to fall prevention programs with older adults are found. Thus, a multifactorial fall prevention program that includes 1) education regarding the causes of falls and how to prevent them, 2) self-efficacy for performing activities, and 3) a physical activity program is critical for Thai older adults.

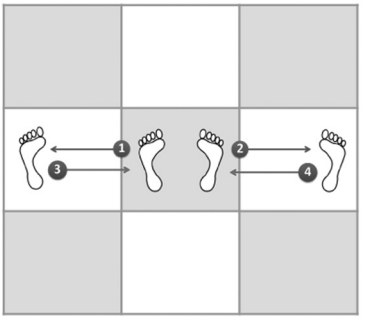
Conceptual Framework

The theoretical framework used to guide the Physical Activity Program for Fall Prevention (PAPFP) is derived from the self-efficacy theory and the concept of movement and balance control. The PAPFP developed for Thai older adults consists of activities to promote self-efficacy in performing physical activity, elastic rubber band exercise, and nine-squared walking. The activities for promoting self-efficacy in physical activity were applied by using the following sources of self-efficacy: 1) mastery experience, 2) verbal persuasion, and 3) emotional and physiological state (described in table 1). Regarding the physical activity

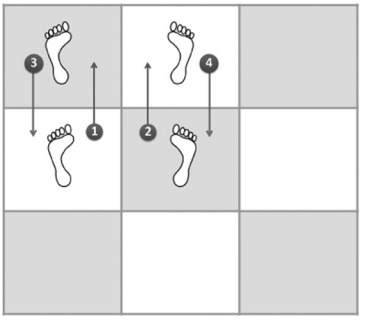
program, using an elastic rubber band and engaging in nine-squares walking were employed as they are easy for older adults to do and they also can perform these activities at their home. The elastic band exercise is a resistant-training exercise that can help improve muscle strength in both upper and lower extremities. A nine-squared walk (see figure 1) was a kind of balance training, where a person walks on a nine-squared board in various directions, such as horizontally, vertically, and obliquely or in various shapes (x, triangle shape). Walking on a nine-squared board is one kind of proprioceptive physical activity that appears to have the best impact on balance control. [7] It can be beneficial in improving balance on the part of older adults and can reduce the risk of falls and ultimately injury.

Table 1 A Physical Activity Program for Fall Prevention Based on Self-Efficacy Theory and the Concept of Movement and Balance

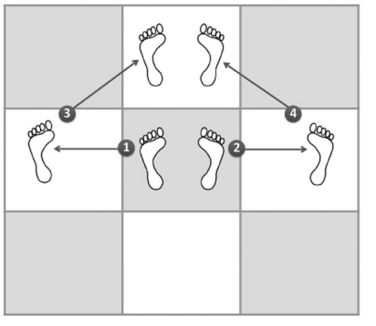
Component of theory	Strategies	Description of intervention based on theory
Sources of Self-efficacy		
- Mastery Experiences	Older adult-nurse interaction	Nurse-older adults' discussion regarding success and failure of doing physical activity
	Goal setting	The investigator discusses with older adults appropriate goals for physical activity each week.
	Self-monitoring	The investigator teaches the older adults to observe and record in their diary their physical activity and to identify their barriers.
- Physiological states	Education and discussion	The investigator educates and discusses their physiological state such as pain, fatigue, and fear of falling and how to overcome these barriers.
- Verbal persuasion	Education and discussion	The investigator persuades them that they have the capability to engage in physical activity and exercise and encourages them to perform physical activity regularly.
Concept of movement and balance		
- Basic moments in daily living activities	Education and training	The investigator teaches them how to do sitting, standing, and transferring from chair to bed correctly and the range of motion of the joints.
- Muscle strength, flexibility, balance and coordination	Training to perform elastic band exercise and nine squared walking	The investigator teaches them how to perform the elastic band exercise and how to walk on the nine squared model in various patterns



A: A walk using the horizontal plan (left and right)



B: A walk using the vertical plan (forwards and backwards)



C: A walk in a triangular shape

Figure 1 Examples of a nine-squared walk

Aim

The purpose of this study was to examine the feasibility of the Physical Activity Program for Fall Prevention (PAPFP) and its effect on fall efficacy, physical performance, and balance among Thai older adults.

Hypothesis

At week 4 and 8, the older adults receiving the PAPFP will have significantly greater changes of mean score in their fall efficacy, physical performance, and balance than those engaging the usual activities comparable with the baseline.

Methods

Design

This study was a 2 group, quasi-experimental design with repeated measures.

Ethical Considerations

The research study was approved by the Health Science Review Board of Thammasat University. All participants received information regarding the purposes of the study, benefits, risks, confidentiality, and the right to withdraw from the study at any point. After considering participating in the study, all of the participants signed a consent form.

Sample and setting

The study was undertaken in a community in a province close to Bangkok. There were two steps in obtaining the sample for this study. Multistage random sampling was done during the first step to randomize the villages from one district. Villages 2 and 6 were selected for the first step. A screening was carried out on 70 older adults that exhibited the risk of falling and that had physical performance scores of 4-11. Fifty older adults who met the following inclusion criteria were selected: a) either male or female, aged 60 years and over; b) had a fall risk score = 4 or over; c) had a physical performance score of 4-11; d) had no chronic illness which would make them unable to participate in the physical activity program; and e) were literate in Thai. Those excluded were those that were: a) taking medications affecting balance and b) having a balance problem. The selected villages were randomly assigned into experimental group and control groups. Village 2 was the control group and village 6 was the experimental group. Both study groups engaged in their activities as usual; the experimental group received a PAPFP given by the investigators.

The appropriate sample size calculation was based on the power analysis for experimental research. Using Steven's table for the analysis of variance for the power of 80%, medium effect size = 0.10, alpha = 0.05, and 30 subjects per group were needed.[39] However, as time was limited and the political conditions made it difficult to recruit the sample, 50 older adults per two group were recruited for the first time. Ten older adults were not able to participate in the full program. During the experiment, four participants moved to live with their daughters in other provinces; three went to a temple for religious practice, two could not attend because they had to look after their grandchildren, and one had eye surgery. Therefore the sample size for this study was 40 participants, 20 for each group. According to a small sample size, the feasibility study would be appropriate to determine whether this program could be implementing in the community. Findings from this study may offer additional knowledge to fall prevention. In addition, they may have important implications for older adults to prevent falls.

Experimental Intervention. The intervention was introduced at weeks 1, 2, and 4 at the Health Promotion Center, Faculty of Nursing, or at the health office of the community. The length of the intervention given at each session was 45 minutes. The PAPFP was divided into two phases: phase one (Get Started) and phase two (Keep Going). In phase one (week 1-week 2), the participants were given knowledge related to falls and how to prevent them, mobility training such as sitting, standing, elastic band exercise, and nine- squared walking training. Older adults were also taught how to regulate themselves to perform physical activity at home by using a diary record. In phase two (week 2 and week 4), the investigators discussed increasing their physical activity at home, monitoring themselves with a diary record, and their activities as planned in the program were encouraged. The participants were also evaluated via the older adults' physical activity diary record if

they had engaged in any physical activity at least 3 days a week. If they did not, the investigators would discuss their problem in doing so with the participants. The Fall Efficacy Scale, the physical performance test, and the Berg balance test were used for measurement on the first day of the program to establish a baseline, and then at week 4 for time 1 and week 8 for time 2.

Self-efficacy enhancement was encouraged through nurse-participant interaction and discussion, aimed at increasing the participants' confidence to perform the activity and exercise. However, they were also informed that doing physical activity regularly and with analgesics could help relieve their discomfort.

Basic movements were considered in terms of the mobility used to perform daily living activities such as sitting down/rising from a chair, standing after rising from a chair, and transferring from chair to chair. The participants practiced how to perform these activities correctly.

The physical activity program including elastic band exercise and a nine squared-walk was designed by an expert in order to improve muscle strength and flexibility of upper and lower extremities and balance of the older adults. The frequency and duration of the exercise program was at least three time a week and 20-30 minutes per set.

The elastic band exercise is a progressive resistance exercise with an elastic band device developed by Krabuawnrat[31]. This device is used by older adults in performing progressive resistance exercises so that they can develop their muscle strength, flexibility, and the endurance of the lower and upper extremities. Older adults can easily make such an elastic band and can take it everywhere for their exercises and physical activities.

A nine-squared walk, one kind of physical activity, is a walk on a nine-squared model (Figure 1). This model was first established by Krabuawnrat[31], aimed at developing a learning program for children based on the belief that the movements of hands on a nine-squared model can help develop the brain cells and the cognitive function of the children. The nine-squared walk in this study was a walk in many directions (left to right, upper to lower, oblique or complex direction) so that older adults could develop their muscle strength, flexibility, proprioceptive functions, and coordination and balance. The content of the PAPFP was validated by 3 experts (a physician, a community nurse, and a sport scientist) and was piloted with 3 older adults to determine if this program fitted with older adults.

Instruments

Physical Performance Test (PPT): developed by Guralnik, Ferrucci, Simonsick, Salive, and Wallace[28], tests standing balance, walking speed, and the ability to rise from a chair. Guralnik and colleagues[28] created five performance scores ranging from 0 to 4 for each test, with the score of 0 representing the inability to complete the test and 4 being able to complete the test independently according to the protocol and within the determined time. To ensure that the procedures were appropriate for Thai elders, the PPT was pilot tested with five healthy older adults at a senior center. The inter-rater reliability between the investigator and three research assistants was piloted with 5 Thai elders. The correlation coefficients revealed interrater reliability of 1.0 for the standing balance, .96 for walking, and .97 for the chair stand test.

Fall Efficacy Scale (FES): was developed by Tinetti [13]. It is a tool for assessing the degree of perceived self-efficacy in avoiding a fall during basic activities of daily living. This measure consists of 10 questions such as "How confident do you feel at taking a bath or shower?", with scores ranging from 0 (no confidence) to 10 (high confidence). Respondents are asked to identify how confident they feel at performing each of these activities such as taking a bath and preparing simple meals without falling. A lower score reflects lower efficacy or confidence and a higher score corresponds to higher confidence.

The test-retest reliability of the original version was .71. The instrument was translated into Thai language by a professor of nursing with prior experience in instrument translation and backward translation by an educator that is expert in the English language and literature with prior translating experience. Afterwards, the investigators and English professor determined that the inconsistencies in translation were resolved.[34] Then, internal consistency was established with a pilot study with 30 older adults in the community. Cronbach's alpha demonstrated an internal consistency of 0.89 for this pilot study and 0.72 for the main study.

Berg's Balance Test Berg's Balance test is a tool to measure a person's ability to balance. It is a test that assesses the ability of older adults to perform 14 activities, ranging from the ability to sit independently to the ability to stand in tandem position. Each activity has a score ranging from 0 to 4 and the total score of the test is 56. The examples of activities are sitting to standing and picking up an object from the floor from a standing position. A lower score reflects lower balance. The intraclass correlation coefficient (ICC) for the total score was .98. The inter-rater reliability between the investigator and three research assistants was piloted with 5 Thai elders. The correlation coefficients revealed that the inter rater reliability was 0.98.

The Thai Fall Risk Assessment Tool (Thai FRAT) The Thai FRAT was used in this study to screen the older adults who had a risk of falling. This tool was developed by Theimwong, Jitapunkul and Panyachevin[12] and consists of the following components: 1) gender, 2) visual deficit, 3) balance deficit, 4) medication used, 5) fall history, and 6) Thai-style home. The total score is 11, where the scores of 4-11 indicate a risk, and the scores of 1-3 no fall risk. The sensitivity of the tool was 22-52% with the specificity of 66-73%[12].

Procedure: The investigators appointed the community leaders to meet with older adults from village 2 or village 6, and then to determine if they fitted the inclusion criteria and to seek consent. The control and experimental group were randomly assigned by villages. The participants in village 2 were control group and those in village 6 were experimental group. The investigators conducted the PAPFP with the participants in the experimental group. All of the participants were asked to assess the outcome measures (PPT, FES, Berg balance test) at baseline and at weeks 4 and 8 after receiving the program. For the control group, the participants were informed that they would be evaluated using the outcome measures (PPT, FES, Berg balance test) and would receive the PAPFP at the end of the study.

Data analysis. Descriptive statistics were used to analyze the demographic data. The normality, homogeneity of variance, homogeneity of variance-covariance matrix, and compound symmetry of the dependent variable data was tested. As the assumption was met, two-way repeated measure ANOVA with repeat on one factor was used to examine the mean differences between and within groups for the outcome variables (PPT, FES, Berg balance test).

Results

Initially, 50 potential participants were approached to join in the study. However, during the experiment, 10 older adults could not participate in the full program. Therefore the attrition rate was 20%. All participants were Buddhist, most of whom were female (82.5%) and living with family members (87.5%). They were widowed/divorced (47.5%), married (45%) and had ages ranging from 62 to 87 years (Mean = 71.08, SD = 1.15). The highest level of education for most of the participants (60%) was the fourth grade. Sixty percent had a history of falling. There were no significant differences between groups for any of the following characteristics (age, gender, education, marital status, numbers and types of chronic illness, exercise, and fall history). The control group had greater experience of regular physical activity and exercise than the experimental group ($p < .05$). (Table 2). Moreover, no statistical significant differences were found between groups on any baseline outcome variables (FES, PPT, Berg's balance). (Table 3)

Table 2 Comparison of Sample Demographic Characteristics between the two Groups

Variable	Frequency				
	Total (n=40)	Experimental Group (n=20)	Control Group (n=20)	Statistics value	p
Gender				173[b]	1.00
Male	7(17.5)	4(20)	3(15)		
Female	33(82.5)	16(80)	17(85)		
Marital status				1.696[a]	.638
Married	18(45)	10(50)	8(40)		
Widowed	19(47.5)	8(40)	11(55)		
Separated	1(2.5)	1(5)	0(0)		
Never married	2(5.0)	1(5)	1(5)		
Education				4.00[a]	.549
Secondary or less	33(82.5)	15(75)	18(90)		
High school or more	7(17.5)	5(25)	2(10)		
Chronic illness				3.138[b]	.182
No	6(15)	1(5)	5(25)		
Yes	34(85)	19(95)	15(75)		
Diabetes mellitus	14(35)	9(45)	5(25)		
Hypertension	22(55)	12(60)	10(50)		
Fall history				4.738[a]	.192
No	24(60)	11(55)	13(65)		
One time	7(17.5)	6(30)	1(5)		
Two times	3(7.5)	1(5)	2(10)		
Three times or more	6(15)	2(10)	4(20)		
Regular exercise				6.46[b]	.026
Yes	20(50)	6(30)	14(70)		
No	20(50)	14(70)	6(30)		

a = chi square, b = Fisher's exact test

Table 3 Mean Scores and Standard Deviation of Fall Efficacy, Physical Performance, and Balance in the Experimental and Control Groups at Baseline and Each Follow-up Session

Variables	Experimental Group	Control Group	t	p-value
Fall Efficacy				
Baseline	8.18 ± 1.67	7.86 ± 1.61	0.61	.55
Week 4	8.83 ±1.33	8.74 ±1.40	.20	.84
Week 8	9.54 ± 0.51	8.49 ± 1.41	.84	<.001
Physical Performance				
Baseline	9.15 ± 1.87	8.00 ± 1.97	1.89	.06
Week 4	10.65 ±1.27	7.90 ± 1.94	5.29	<.001
Week 8	11.40± 0.99	8.70 ± 1.75	5.99	<.001
Balance				
Baseline	49.5 ± 2.78	46.95 ± 4.68	2.09	.055
Week 4	52.0 ± 2.45	47.50 ± 3.30	4.72	<.001
Week 8	52.55± 2.06	47.20 ± 3.66	5.68	<.001

The experimental group significantly improved its physical performance and Berg's balance over the control group (F= 21.72, p< .001; F = 21.68, p<.001). Table 4 shows the mean differences of the FES, PPT, and Berg's balance within and between groups, and Table 5 shows the mean differences in the FES, PPT, and Berg's balance test within the experimental and control groups. The intervention and time of the physical activity program significantly influenced the increase in physical performance and the Berg's balance score (F = 9.54; p< .001; F= 5.34, p< .05) (Table 4). The program did not significantly increase the Fall Efficacy Scale (FES) score. However, the experimental group significantly improved its FES score overtime after receiving the program.

Table 4 Mean Difference in Fall Efficacy, Physical Performance, and Balance Scores between and within the Experimental Group and Control Group Subjects

Outcome and Source of variation	Sum of Squares	df	Mean Square	F	P value
Fall Efficacy					
- Between subjects					
Group	7.34	1	7.34	2.07	>.05
Error	134.94	38	3.55		
- Within subject					
Time	22.38	2	11.19	10.36	<.001
Time x group	5.23	2	2.61	2.48	.09
Error	80.21	76	1.06		
Physical Performance					
- Between subjects					
Group	145.20	1	145.20	21.723	<.001
Error	254.00	38	6.68		
- Within subject					
Time	69.95	2	21.78	25.11	<.001
Time x group	43.55	2	8.28	9.54	<.001
Error	65.90	76	.87		
Balance					
- Between subjects					
Group	516.94	1	516.94	21.68	<.001
Error	858.33	38	23.84		
- Within subject					
Time	69.96	2	34.98	8.15	<.05
Time x group	45.82	2	22.91	5.34	<.05
Error	309.04	76	4.29		

Discussion

The findings showed that the PAPFP based on self-efficacy theory significantly improved the physical performance and Berg's balance for the Thai older adults. The experimental group significantly improved its physical performance over the control group at weeks 4 and 8 after receiving the program (F = 21.72, p

<.001). The results of this study are consistent with the studies of Puggard,[37] and Whitney [26] which found that older adults receiving multicomponent training increased their physical performance and balance. The PAPFP of the present study was a multifactorial intervention program which included self-efficacy enhancement activities, movement training, elastic band exercises, and the nine-squared walking and was seen to help improve the physical performance (walking speed, standing balance, and chair stand) among Thai older adults. The elastic band exercise is a progressive resistance exercise that helps older adults increase their muscle strength and demonstrates benefits for their physical performance.[32] The participants' performance of the elastic band exercises and the nine-squared walk in this study resulted in physical performance improvement.

The experimental group increased their Berg balance more than the control group significantly ($F = 21.68$, $p < .001$). This finding supported other studies,[17, 33] which demonstrated that long-term exercise or dance can help older adults improve their balance and prevent them from falling. One reason for this might be that nine-squared walking increases proprioceptive functions, coordination, and balance. Older persons receiving a combination of activities, including balance training, exhibited changes in the measures of their gait/balance.[26] In addition, a nine-squared walk was performed on a board or a floor which was designed from a model of nine squares so that older adults could be trained to walk in various directions following different patterns, such as forwards and backwards), (left and right), obliquely forwards or backwards, or in various patterns (triangle, x- shape). This type of walking is a form of proprioceptive balance training. Walking on a nine-square board helped to improve the balance in the experimental group and these findings support the study of Gauchard and colleagues,[7] who found that regular practice of proprioceptive physical activities significantly improved dynamic postural control.[7] In contrast, the control group, engaging in their usual activity, showed no improvement in their balance score at each follow-up session after the program. Moreover, the findings of this study have revealed significant improvement in physical performance and balance across study periods both weeks 4 and 8 after the program. This has shown the effectiveness of the PAPFP offered in the current study on physical performance and balance in the long term effect.

The PAPFP did not increase the fall efficacy score of the participants in the experimental group compared with the control group ($F = 2.07$, $p = .052$), which was consistent with the results of a study of Donat and Ozcan,[27] who found that there was no difference of fall efficacy between groups that engaged in different kinds of exercises. One possible reason may be that the control group of this study had significantly more regular exercise than the experimental group and the control group might have had more confidence in performing physical activity, thus resulting in the increase in the fall efficacy score especially in week 4 (Table 5). Fear of falling is commonly reported among older adults, regular physical activity would make them more confident to perform their activities.[38] Another reason might be that the small sample size ($n = 20$ per group) of the present study could not reach the power of the intervention to influence the outcome as expected. However, the experimental group significantly increased its FES at week 8 ($p < .001$) (Table 5). The older adults in the experimental group might have needed more time to regain their confidence to perform the activities without fear of falling; this may be because the exercise and physical activity training of the program, especially during the first phase (week 1 and week 2), might have caused them to have pain and fatigue. According to older adults' diary records, the reasons that prevented them from doing the exercise and physical activity were pain and fatigue, as they noted that they had muscle pain in the shoulder and arms and legs at the beginning of the program. Their pain and fatigue during the first phase (2 or 4 week of the program) of exercise made

them have low confidence in performing the activity and then had a low FES score.[3,24] At week 4, the control group had increased the mean difference of the FES significantly from baseline (Table 4). This might be because the control group performed its usual activities and had no barriers preventing the participants from doing physical activities. The experimental group had a mean difference in the FES at week 8 from baseline ($p < .001$) and from week 4 ($p < .05$) (Table 5). One reason for this may be that the experimental group knew how to relieve their pain, understood that regularly performing physical activity could decrease their pain, and their self-monitoring made them learn that they had a good outcome and then they had the confidence to perform activities at week 8 of the program. Understanding one's physiological state, such as pain and fear of falling occurring while doing physical activity, is believed to enhance self-efficacy. Persons rely partly on information from their physiological state in judging their capabilities. Furthermore, outcome expectations are also believed to influence behavior. It is widely assumed that belief in the personal determination of outcomes creates a sense of efficacy and power.[24] In addition; the experimental group had improved its physical performance and balance at weeks 4 and 8, resulting in an increased FES. It is suggested that improving physical function and balance control, and increasing one's self-efficacy and sense of control over the environment, can decrease sources of the fear of falling.[38]

Table 5 Multiple Comparisons of Fall Efficacy, Physical Performance, and Balance at Baseline and Each Follow-up Session in the Experimental and Control Groups

Variables	Experimental Group		Control Group	
	d	SE	d	SE
Fall Efficacy				
Baseline − Week 4	-.65	.35	-.88*	.28
Baseline − Week 8	-1.37*	.33	.64	.35
Week 4 − Week 8	-.72*	0.26	.25	.37
Physical Performance				
Baseline − Week 4	-1.5*	.37	.10	.25
Baseline − Week 8	- 2.25*	.34	-.70*	.33
Week 4 − Week 8	-.75*	.24	-.80**	.20
Balance				
Baseline − Week 4	-2.44*	.56	-.55	.71
Baseline − Week 8	-3.33*	.61	-.25	.92
Week 4 −Week 8	-.89*	.39	.30	.65

* The mean difference is significant at the .05 level.

Conclusions and Implications for Nursing Practice

The findings of this study demonstrate that a PAPFP can help older adults improve their fall efficacy, physical performance, and balance. It is feasible that the PAPFP in this study may be one kind of strategy to prevent older adults from falling, specifically in Thailand. In applying this program to older adults effectively, regularly performing physical activity has to be emphasized. Nurses and family members should help older adults overcome barriers such as pain and fatigue, especially during the first phase, and monitor how much physical activity they can perform. Studies

with longer follow-up time and a larger sample size are suggested for future analyses.

Limitations

This study was conducted in a semi-urban area in a province in the middle of Thailand and may not be generalized to other settings with different contexts. Further studies focusing on self-efficacy enhancement and either elastic band or nine-square walking exercises with a larger sample size and longer follow-up time is recommended.

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ผลของโปรแกรมกิจกรรมทางกายเพื่อป้องกันการหกล้มในผู้สูงอายุ

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บทคัดย่อ: การหกล้มเป็นปัญหาที่พบบ่อยของผู้สูงอายุซึ่งนำไปสู่ความพิการและการเสียชีวิต การศึกษานี้เป็นการศึกษาความเป็นไปได้ของการใช้โปรแกรมกิจกรรมทางกายเพื่อป้องกันการหกล้มต่อความมั่นใจในการปฏิบัติกิจกรรมโดยปราศจากความกลัวการหกล้ม ความสามารถในการปฏิบัติกิจกรรม และการทรงตัวของผู้สูงอายุ เป็นการวิจัยกึ่งทดลอง โดยใช้ทฤษฎีการรับรู้สมรรถนะแห่งตนและแนวคิดเกี่ยวกับการเคลื่อนไหวและการควบคุมการทรงตัวเป็นแนวทางในการสร้างโปรแกรม กลุ่มตัวอย่างเป็นผู้สูงอายุในชุมชนที่มีคุณสมบัติตามเกณฑ์ที่กำหนดจำนวน 40 คน แบ่งเข้ากลุ่มทดลอง 20 คน และกลุ่มควบคุม 20 คนโดยการสุ่มหมู่บ้าน กลุ่มทดลองได้รับโปรแกรมกิจกรรมทางกายเพื่อป้องกันการหกล้มที่มีพื้นฐานจากทฤษฎีการรับรู้สมรรถนะแห่งตน โปรแกรมนี้ประกอบด้วย กิจกรรมการส่งเสริมการรับรู้สมรรถแห่งตน การเคลื่อนไหวพื้นฐาน การออกกำลังกายด้วยยางยืดและการเดินบนตารางเก้าช่อง เครื่องมือที่ใช้ประกอบด้วย แบบประเมินความมั่นใจในการทำกิจกรรมโดยปราศจากความกลัวการหกล้ม แบบประเมินความสามารถในการปฏิบัติ แบบทดสอบการทรงตัวเบิร์ก วิเคราะห์ข้อมูลโดยใช้สถิติเชิงบรรยายและสถิติการวิเคราะห์ความแปรปรวนแบบวัดซ้ำ

ผลการศึกษา พบว่า กลุ่มทดลองมีการเพิ่มขึ้นของความสามารถในการปฏิบัติและการทรงตัวภายหลังโปรแกรมสัปดาห์ที่ 4 และ 8 มากกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติ วิธีการของโปรแกรมไม่เพิ่มค่าเฉลี่ยของคะแนนความมั่นใจในการปฏิบัติกิจกรรมโดยปราศจากความกลัวต่อการหกล้ม แต่กลุ่มทดลองมีการเพิ่มขึ้นของความมั่นใจในการปฏิบัติกิจกรรมโดยปราศจากความกลัวการหกล้มภายหลังโปรแกรมสัปดาห์ที่ 8 มากกว่าก่อนทดลองอย่างมีนัยสำคัญทางสถิติ แสดงว่าโปรแกรมการป้องกันการหกล้มนี้เป็นโปรแกรมที่มีความเป็นไปได้ในการที่จะนำไปใช้เป็นวิธีการหนึ่งที่สามารถเพิ่มการทรงตัวเพื่อป้องกันการหกล้มได้ ควรมีการทำวิจัยที่มีขนาดกลุ่มตัวอย่างมากขึ้นและระยะเวลาที่นานขึ้น

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คำสำคัญ : การป้องกันการหกล้ม การทรงตัว ผู้สูงอายุ กิจกรรมทางกาย ความสามารถในการปฏิบัติกิจกรรม ความมั่นใจในการทำกิจกรรมโดยปราศจากความกลัวหกล้ม

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