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ORIGINAL ARTICLE

The Impact of Physical Exercises on Balance Ability, Lower Body Strength, and Risk of Fall in Sedentary Older Adults: a Randomized Controlled Trial

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KEYWORDS

Aging, Functional Ability, Physical Fitness, Sedentary Lifestyle, Physical Capacity.

ABSTRACT

Background. Vietnam is experiencing rapid population aging, with the proportion of individuals aged 60 and older projected to increase. This demographic shift is accompanied by a rise in frailty, a condition characterized by decreased physical and functional abilities, significantly increasing the risk of falls among older adults. **Objectives.** This study aimed to evaluate the impacts of physical exercises on balance, lower body strength, and fall risk in sedentary older adults. The primary hypothesis of this study was that physical exercises would significantly improve balance ability, lower body strength and reduce the risk of falls in sedentary older adults. **Methods.** Sixty subjects aged 65 to 75 were recruited to participate in this study. Subjects were divided into two groups: Experiment group (30 subjects: 17 males, 13 females) and Control group (30 subjects: 17 males, 13 females). Prior to intervention, participants were asked to complete an informed consent. Participants in the experiment group attended a 60-minute physical exercise session twice a week for 12 weeks. Control group participants were informed not to do any new exercise program but to maintain daily activities. **Results.** A randomized controlled trial was conducted. After 12 weeks of physical exercise training, participants in the experiment group showed significantly better results in balance ability and lower body strength via tests compared to the control group determined by statistical one-way ANOVA. Specifically, improvements were observed in standing on one leg with eyes open (F=15.50, P=0.000), standing on one leg with eyes closed (F=92.13, P=0.000), falls efficacy scale (F=106.89, P=0.000), chair stand (F=52.13, P=0.000), and 8-foot up and go test (F=23.12, P=0.000). **Conclusion.** Based on the results, physical exercise can significantly enhance balance ability and lower body strength in sedentary older adults. Further study could be conducted specifically targeting individuals with multiple chronic conditions. Alternatively, studies could explore the impact of exercise interventions on individuals with frailty syndromes.

INTRODUCTION

According to the World Health Organization, by 2030, 1 in 6 people will be 60 years or older. By 2050, the world's population of people aged 60 years and older will double (2.1 billion). The number of persons aged 80 years or older is expected to triple between 2020 and 2050 to reach 426 million (1). Vietnam is experiencing rapid population aging, ranking among the fastestaging countries globally. In 2019, individuals aged 60 and older comprised 11.9% of the total population. This figure is projected to surge to over 25% by 2050. By 2036, Vietnam is poised to enter an "aged" society, signifying a significant shift from its current status as an "aging" society. (2). This demographic shift is accompanied by a rise in frailty, a condition characterized by decreased physical and functional abilities, significantly increasing the risk of falls among older adults (3). In addition, rapid population aging in Vietnam leads to an increase in the prevalence of diseases and puts society and the healthcare system under strain. An increasing rate of falls among senior citizens has been associated with rising injury cases, causing hospitalization, disability, and even premature death (4). Fall injuries impose a substantial financial burden on the elderly, particularly those living alone or with low incomes. Implementing effective fall prevention programs is crucial to reduce the risk of falls and alleviate the associated economic burden on individuals and society. By preventing falls, we can improve the health outcomes and quality of life for older adults in Vietnam (5). Falls in older people are a significant public health issue, as they are associated with increased risks of diseases and death. In Vietnam, a previous study indicated that the prevalence of falls in older people was 23.7%, of which the rate of recurrent falls was 5.8% (4).

Increased lifespan is often accompanied by age-related health conditions impairing daily living and functional capacity, increasing the risk of chronic diseases (6). These challenges impose a substantial socioeconomic burden, necessitating increased expenditure on social welfare and healthcare (7). Age-related impairment can lead to a decline in physiological parameters crucial for balance, such as visual, vestibular, and proprioceptive functions, as well as muscle strength.

Previous research has established that fall-related injuries constitute a significant public health concern, impacting the lives of elderly individuals (8). While falls can have serious consequences at any age, older adults are particularly vulnerable (9). With the increase in the elderly population, the fractures associated with falls in the elderly are becoming a major social problem. In addition, falls are the leading cause of injury for adults ages 65 years and older (10), and unintentional falls are the leading cause of injury and death resulting from an injury among adults aged ≥65 years (older adults) (11). Falls among older adults constitute a significant global public health problem, leading to a range of serious physical injuries, such as fractures and head trauma, as well as psychosocial consequences, including fear of falling, reduced mobility, and decreased quality of life (12).

Musculoskeletal diseases and vision problems were common medical problems responsible for falls. Falls pose a significant danger to the elderly. However, most of them are preventable. Poor balance, low mood, and a less active lifestyle are predictors of falls, and slower walking speed predicts fall-related fractures among community-dwelling older people with pain (13). Numerous intrinsic and extrinsic factors can cause falls in the elderly and lead to injury (8). Often, with multiple medical problems, older persons move through their daily routine and are exposed to many environmental risk factors such as grass, curbs, steps, slippery surfaces, etc. Among the intrinsic risk factors that the elderly face are changes in vision and hearing, use of medications, and a declining strength in bones and muscles. As the number of risk factors present increases, so does the risk for falls. Falls are a common, costly and preventable consequence of sensorimotor impairments that increase in prevalence with advancing age (14). Falls and injuries are also among the top geriatric issues because falls are often devasting and costly (15), and the rate of falls and severity of the resulting complication increases with age. Falls among the elderly pose a significant public health concern, leading to a cascade of negative consequences. These include health complications, increased healthcare costs, and a substantial societal burden. Falls can result in disabilities, hospitalizations, and even mortality (16).

Aging is inevitable, and with it comes an increased risk of falls. We must find practical solutions to prevent these falls. Hence, this study aimed to assess the impact of physical exercises on balance ability, lower body strength, and risk of falls of sedentary older adults to develop an effective fall prevention intervention for this population.

MATERIALS AND METHODS

Participants. Eighty subjects were asked to participate in the first survey concerning falls. Sixty subjects were recruited for the research.

Twenty subjects were rejected due to exclusion criteria. Subjects were randomly divided into two groups: the experiment group and the control group. Subjects aged sixty-five and older. The written informed consent was obtained from participants after the experimental procedures were explained. Inclusion criteria included subjects aged 65 and older who could perform all tests fully at the pretest. Exclusion criteria included subjects with serious diseases such as symptomatic coronary insufficiency, angina, arrhythmia, orthostatic hypertension, neurological impairments, persistent joint pain, or musculoskeletal impairment; subjects requiring assistance from another person or a device during ambulation; subjects with severe vision problems, and dementia (Figure 1).

Intervention Protocol. A randomized controlled trial was conducted with the hypothesis that physical exercises would improve balance ability, lower body strength, and reduce the risk of falls in sedentary older adults. Subjects were randomly divided into experimental and control groups using Excel. The steps are as follows: First, subjects were numbered (subjects had to remember their numbers), then the researcher used the command Sampling in Data analysis in Excel, next chose Input range, then chose Number of Samples (30). The experiment group included 30 subjects who were instructed to practice selected exercises in 12 weeks and were tested (pretest and post-test) by qualified and experienced physical education experts of Vinh University. In contrast, the control group, consisting of 30 subjects, was instructed not to participate in any exercise program. All one-hour sessions consisted of 10 minutes of warm-up and stretching, 40 minutes of main exercise, and 10 minutes of calm down. Qualified experts collected pretest (baseline) and post-test (endpoint) data for both groups at the sports hall.

Outcomes Measures and Test Protocol. Romberg test: For assessing static and dynamic balance, it includes standing on one leg with eyes open (SOLEO) and standing on one leg with eyes closed (SOLEC), as described in (17). The Romberg test is a physical test. For the eyes open test, subjects stand with both ankle bones touching each other with hands crossed and touching the opposite shoulders. Stand without shoes on. If possible, look straight ahead. Try to stay in this position for 30 seconds. The test is stopped if the subject moves their feet on the floor or changes their arm starting position. The test is timed and could be rated for the amount of sway. For the eyes closed test, stand with both ankle bones touching each other with hands crossed and touching the opposite shoulders. Stand without shoes on, if possible, and look straight ahead with eyes closed. Try to stay in this position for 30 seconds. The test is stopped if the subject moves their feet on the floor, opens their eyes, or changes their arm starting position. The test is timed and could be rated for the amount of sway—equipment: stopwatch, paper, and pencil.

Falls Efficacy Scale (FES): The FES was developed by Tinetti et al. in 1990 to measure fear of falling in mainly community-dwelling older population. The study was based on the operational definition of fear of falling: "low perceived self-efficacy at avoiding falls during essential, non-hazardous activities of daily living." (18). The subject is invited to rate each activity on a scale from 1 to 10, with one being very confident and 10 being not confident at all, concerning confidence in performing said activities without falling. FES results range from 0 to 100, with scores greater than 70 indicating a higher fear of falling (lowers self-efficacy and confidence) that impedes activities of daily living—equipment: paper and pencil.

Chair stand test: For lower body strength assessment. Participants sit in the middle of the chair with their back straight, feet flat on the floor, arms crossed at the wrists and held against the chest. On the signal "go," the participant rises to a complete stand and returns to a fully seated position in 30 seconds (19). Equipment: straight back chair - LAT6101, Ho Chi Minh City, Vietnam (width: 39cm x 39, height: 75cm, seat height: 43cm), stopwatch (PC 530 30LAP, China), scorecard.

8-foot-up-and-go test: For agility and dynamic balance assessment. Participants sit in the middle of the chair with their backs straight, feet flat on the floor, and their thighs. The torso slightly leans forward. On the signal "go," the participant gets up from the chair, walks around either side of the cone as quickly as possible, and sits back in the chair. The distance is 8 feet (244cm) (19). Equipment: straight back chair - LAT6101, Ho Chi Minh City, Vietnam (width: 39cm x 39, height: 75cm, seat height: 43cm), stopwatch (PC 530 30LAP, China), tape measure (Taky, Vietnam), cone (Dainam Sport, Vietnam), scorecard.

Warm-up and cool-down exercises and participants' instructions: Before testing begins, participants should engage in five to eight minutes of warm-up and stretching activities such as brisk walking, jogging in place, arm circles, leg swings, and gentle joint rotations. After completing the central part, participants take five to eight minutes of cool-down, such as static stretches (focus on major muscle groups such as calves, hamstrings, quadriceps, chest, shoulders, and back) and deep breathing.

Statistical Analysis. All analyses were conducted using SPSS. An independent sample t-test was performed to analyze the differences between groups. Analysis of variance (ANOVA) was used to analyze the differences in test phases. A p-value <0.05 was considered to be statistically significant. The normal distribution of the data was tested. The skewness value of all variables is between −1 and +1). It suggests that the data distribution is relatively symmetric, meaning the data are normally distributed.

Physical Exercises for Intervention. Exercises were taken from All-Active, balance exercises for older adults (https://allactive.co.uk/wp-content/uploads/2016/04/Balance-exercises-for-older-adults-AllActive-Information-Guide) (20). Before these exercises were applied to the experiment, we interviewed experts and lecturers in physical education to select the most suited exercises for this study (Table 1). In addition, participants were asked to fill out the interview form to select which exercises they most preferred.

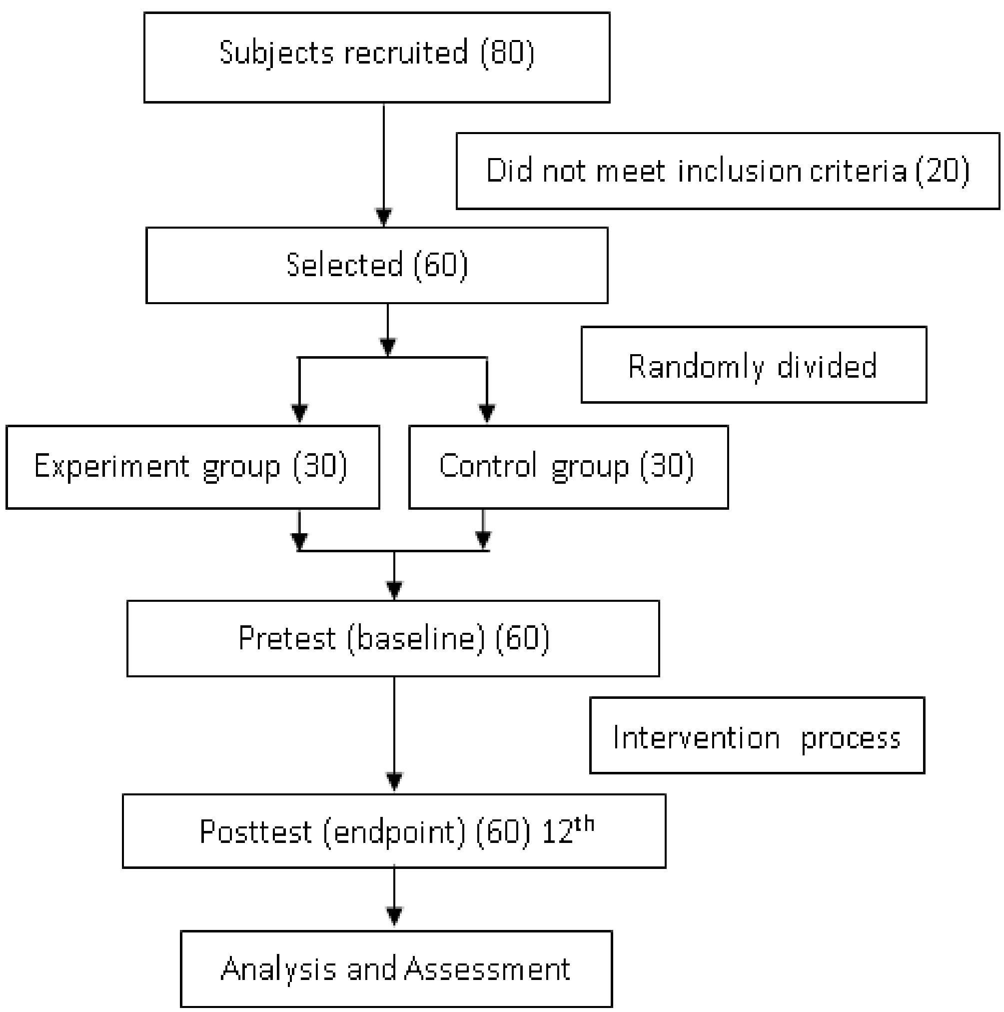

Figure 1. Recruitment flow.

Table 1. Physical exercises for balance and lower body strength training.

Exercises	Effectiveness	Introduction and Intensity
Feet-apart standing	for balance ability	Hold for 15 seconds, 3–4 sets, rest for 10 seconds between each set
Tandem	for balance ability	Hold for 15 seconds, 3–4 sets, rest for 10 seconds between each set
Semi-tandem standing	for balance ability	Hold for 15 seconds, repeat with the other foot in front, 3–4 sets, and rest for 10 seconds between each set.
Heel-to-toe standing	for balance ability	Hold for 15 seconds, repeat with the other foot in front, 3–4 sets, and rest for 10 seconds between each set.
Single -foot standing	for balance ability	Hold for 15 seconds, repeat standing on the other foot, 3–4 sets, rest for 10 seconds between each set.
Toe standing	for balance ability	Hold for 15 seconds, rest for 10 seconds, 5-7 sets
Heel standing	for balance ability	Hold for 15 seconds, 5-7 sets, rest for 10 seconds between each set
Sideways walk	for lower body strength	Repeat alternating side steps to the left and right, 10-12 reps, 8-10 sets, and rest for 10 seconds between each set.
Backwards walk	for lower body strength	10-12 reps, 8-10 sets, rest for 10 seconds between each set
Heel-to-toe walk-forwards	for lower body strength	10-12 reps, 8-10 sets, rest for 10 seconds between each set
Heel-to-toe walk-backwards	for lower body strength	10-12 reps, 8-10 sets, rest for 10 seconds between each set
Knee bends	for lower body strength	Bend for 10 seconds, 6-8 reps, 3-4 sets, rest for 10 seconds between each set.
Knee raises	for lower body strength	Raise for 10 seconds, 6-8 reps, 3-4 sets, rest for 10 seconds between each set.
Side raises	for lower body strength	Raise for 10 seconds, 6-8 reps, 3-4 sets, rest for 10 seconds between each set.
Rear leg raises	for lower body strength	Raise for 10 seconds, 6-8 reps, 2-3 sets, rest for 10 seconds between each set.
Leg curls	for lower body strength	Curl for 10 seconds, 6-8 reps, 2-3 sets, rest for 10 seconds between each set.

Reps: repetition.

RESULTS

Characteristics of Study Samples. This is a randomized controlled trial. Participants were randomly divided into two groups. None of the subjects dropped or resigned from this study. The average age of the two groups is equal. There are no significant differences in gender, age, height, weight, and BMI between experiment and control group (P>0.05) (Table 2).

Table 2. Characteristics of research samples.

Characteristics	Experiment Group (n=30)	Control Group (n=30)	Sig.
Gender (female/male)	13/17	13/17	
Average age	73.60 ± 2.23	73.13 ± 2.68	0.468
Height (m)	1.62 ± 0.73	1.61 ± 0.74	0.456
Weight (kg)	64.05 ± 6.11	64.56 ± 8.19	0.783
BMI (kg/m^2)	24.10 ± 1.45	23.88 ± 2.16	0.647

BMI: Body Mass Index.

Assessing the Impact of Physical Exercises on Balance Ability, Lower Body Strength, and Reducing the Risk of Falls of Sedentary Older Adults.

There is no significant difference within the control group at pretest and post-test for balance and lower body strength tests, except standing on one leg with eyes closed test showed a statistically significant difference at the 0.037 significance level (Table 3). Statistical results of the paired samples t-test showed no significant differences between the tests. Standing on one leg with eyes open test is 0.10 with t(29df) = 0.27, p = 0.788; fall efficacy scale is 1.13 with t(29df) = 0.66, p = 0.510; chair stand test is 0.10 with t(29df) = 0.36, p = 0.717; 8-foot up and go test is -0.02 with t(29df) = -0.82, p = 0.415, respectively.

Significant differences existed between the pretest and post-test of the experiment group for balance and lower body strength tests (Table 4). Statistical results of paired samples t-tests showed differences for all tests. Namely, standing on one leg with eyes open test is -3.42 with t(29df) = -8.09, p = 0.000; standing on one leg with eyes closed test is -3.25 with t(29df) = -20.85, p = 0.000; fall efficacy scale is 1.89 with t(29df) = 17.64, p = 0.000; chair stand test is with t(29df) = -10.78, p = 0.000; 8-foot up and go test is 0.52 with t(29df) = 8.04, p = 0.000, respectively.

Table 3. Comparison of test performance within the control group at pretest and post-test.

Tests	Pretest		Post-test		Difference	Sig*.
	Mean	SD	Mean	SD		
SOLEO (s)	15.60	2.79	15.50	3.05	0.10	0.788
SOLEC (s)	3.16	1.14	3.46	1.07	-0.30	0.037
FES (scale)	53.63	4.69	52.50	8.39	1.13	0.510
Chair stand (time/30s)	17.20	2.20	17.10	2.24	0.10	0.717
8-foot up and go (s)	7.02	0.57	7.05	0.60	-0.02	0.415

*: Determined by paired-samples t-test; SD: Standard Deviation; SOLEO: Standing on one leg with eyes open mean of 3 trials (s); SOLEC: Standing on one leg with eyes closed mean of 3 trials (s); FES: Falls Efficacy Scale.

Table 4. Comparison of test performance within experiment group at pretest and post-test.

Tests	Pretest		Post-test		Difference	Sig*.
	Mean	SD	Mean	SD		
SOLEO (s)	14.96	2.74	18.38	2.61	-3.42	0.000
SOLEC (s)	3.51	1.48	6.76	1.54	-3.25	0.000
FES (scale)	52.96	6.49	34.00	5.05	1.89	0.000
Chair stand (time/30s)	16.96	2.29	21.23	2.17	-4.26	0.000
8-foot up and go (s)	6.80	0.76	6.28	0.64	0.52	0.000

*: Determined by paired-samples t-test; SD: Standard Deviation; SOLEO: Standing on one leg with eyes open mean of 3 trials (s); SOLEC: Standing on one leg with eyes closed mean of 3 trials (s); FES: Falls Efficacy Scale.

There are no significant differences between the experimental and control groups at baseline regarding balance ability and lower body strength (Table 5). Statistical results of one-way ANOVA showed standing on one leg with eyes open test [F(1, 58) = 0.81; p = 0.369]; standing on one leg with eyes closed test [F(1, 58) = 1.00; p = 0.320]; fall efficacy scale test [F(1, 58) = 0.20; p = 0.650]; chair stand test [F(1, 58) = 0.16; p = 0.689]; 8-foot up and go [F(1, 58) = 1.62; p = 0.207].

The one-way ANOVA shows significant differences between the experimental and control groups at the post-test for balance ability and lower body strength (Table 6). As shown in Table 3, participants in the experiment group performed better in all tests than control group participants. Specially, significant differences were found in the following tests; standing on one leg with eyes open test [F(1, 58) = 15.50; p = 0.000]; standing on one leg with eyes closed test [F(1, 58) = 92.13; p = 0.000]; fall efficacy scale test [F(1, 58) = 106.89; p = 0.000]; chair stand test [F(1, 58) = 52.32; p = 0.000]; 8-foot up and go [F(1, 58) = 23.12; p = 0.000], respectively.

Table 5. Comparison of test performance between experiment and control groups at pretest.

Tests	Experiment group		Control group		F value	Sig.*
	Mean	SD	Mean	SD		
SOLEO (s)	14.96	2.74	15.60	2.79	0.81	0.369
SOLEC (s)	3.51	1.84	3.16	1.14	1.00	0.320
FES (scale)	52.96	6.48	53.63	4.69	0.20	0.650
Chair stand (time/30s)	16.96	2.29	17.20	2.20	0.16	0.689
8-foot up and go (s)	6.80	0.76	7.02	0.57	1.62	0.207

*: Determined by paired-samples t-test; SD: Standard Deviation; SOLEO: Standing on one leg with eyes open mean of 3 trials (s); SOLEC: Standing on one leg with eyes closed mean of 3 trials (s); FES: Falls Efficacy Scale.

Table 6. Comparison of test performance between experiment and control groups at post-test.

Tests	Experiment group		Control group		F value	Sig.*
	Mean	SD	Mean	SD		
SOLEO (s)	18.83	2.61	15.50	3.05	15.50	0.000
SOLEC (s)	6.76	1.54	3.46	1.07	92.13	0.000
FES (scale)	34.00	5.05	52.50	8.39	106.89	0.000
Chair stand (time/30s)	21.23	2.17	17.10	2.24	52.32	0.000
8-foot up and go (s)	6.28	0.64	7.05	0.60	23.12	0.000

*: Determined by paired-samples t-test; SD: Standard Deviation; SOLEO: Standing on one leg with eyes open mean of 3 trials (s); SOLEC: Standing on one leg with eyes closed mean of 3 trials (s); FES: Falls Efficacy Scale.

DISCUSSION

In this study, sedentary older adults' balance ability and lower body strength were assessed through physical exercises. After 12 weeks of exercise training, sedentary older adults' balance ability and strength of lower body were significantly improved.

Previous studies have documented that physical exercise positively influences older adults' strength, balance, and physical function (21-23). A previous finding demonstrates that a physical exercise program based on balance and strength exercises with simple and readily available equipment can significantly improve the strength and balance of women with osteoporosis (24). Another finding suggests that a 12-week exercise program targeting strength and balance can be an effective and low-cost solution for improving older adults' physical ability and health. Physical activity is critical to maintaining this population's strength, flexibility, and balance. In addition to improving physical ability, the benefit of completing the exercise program is the education of the elderly on the benefits of physical activity (25). Research indicates that a 15-week Thera-band exercise program had a beneficial effect on older women's muscle flexibility, balance ability, and muscle strength (26). The results of our study are consistent with the results of previous studies that prove that physical exercise can reduce the probability of falling in older adults (27), contributes to the maintenance of functional independence, can prevent the onset of various diseases, enhance functional abilities, and mitigate the risk of falls and injuries (28).

Furthermore, physical exercise and activity are effective interventions for improving physical function in frail populations (29), play an important role in the primary, secondary, and tertiary prevention, in the management of diseases, to counteract sarcopenia and falls as well as improving physical performance and activities of daily living (30). Physical exercise also positively affects all physical fitness and depression levels of elderly individuals (31). It improves static and dynamic balance and walking speed, possibly improving muscle strength (32) and physical function (33).

Previous findings proved that strength and lower limb strength and time for muscle reaction and balance might be improved with suitable exercises (34). Furthermore, previous studies have indicated that physical exercises may reduce falls for the elderly in the community (35). The results of this study align with previous research demonstrating that physical exercises improve flexibility balance (36) and increase muscle strength in older adults (37). Physical activity can improve balance and reduce fall rates in the elderly (38). Another study suggested that exercise provides a cost-effective way to improve balance control and confidence in older adults. This study also demonstrated that enhancing balance control and stability is possible in relatively healthy community-dwelling older adults through regular performance of a few balance exercises (39). In addition, physical activity is suggested as an important non-pharmacological approach that can benefit cognitive functions and balance and reduce the risk of falls (40), develop strength for older adults (41), improve balance, and strengthen the lower extremities (42).

Despite achieving the aforementioned results, the first limitation of this study is the small sample size. A larger sedentary population may not represent it. The experiment group subjects were instructed to exercise in the initial two weeks. Then they did it at home by themselves. This made it difficult to experiment perfectly, and reliability decreased. This self-administered approach raises concerns about potential limitations. Without direct observation, participants may not perform exercises with proper form and technique, which could compromise the effectiveness of the intervention and potentially impact the accuracy of the study's findings. Future research can be conducted with a larger sample size to be fully representative, accurate, and reliable for the larger population. One more limitation of this study is the potential influence of confounding factors. These factors, such as socioeconomic status, baseline physical activity levels, medication use, adherence to the exercise program, environmental factors, and nutritional status, could have impacted the study's results. Future research should rigorously address these confounders through methods like statistical control or careful participant selection to enhance the reliability of findings.

CONCLUSION

This study revealed that participants from the experiment group had better results in standing on one leg with eyes open and eyes closed tests, chair stand test, and 8-foot up and go test. This suggests that physical exercise improves balance ability and lower body strength, which may help reduce the risk of falls for sedentary older adults. Future studies could be conducted explicitly targeting individuals with multiple chronic conditions (e.g., diabetes, arthritis, cardiovascular disease, Alzheimer's disease) as they are at higher risk of falls. Alternatively, studies could explore the impact of exercise interventions on individuals with frailty syndromes.

APPLICABLE REMARKS

- Physical exercise is beneficial in helping prevent the risk of falls for older people.
- Programs incorporating balance-challenging exercises are more effective at preventing falls.
- The physical exercises in this study can be widely applied in the community to reduce the risk of falls in the elderly.

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AUTHORS' CONTRIBUTIONS

Study concept and design: Hung Manh Nguyen. Acquisition of data: Luc Tri Nguyen, Tho Thi Nhu Ngo. Analysis and interpretation of data: Hung Manh Nguyen. Drafting of the manuscript: Luc Tri Nguyen, Tho Thi Nhu Ngo. Critical revision of the manuscript for important intellectual content: Hung Manh Nguyen. Statistical analysis: Hung Manh Nguyen, Luc Tri Nguyen. Administrative, technical, and material support: Tho Thi Nhu Ngo. Study supervision: Hung Manh Nguyen.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this article.

FINANCIAL DISCLOSURE

The researchers declared that they did not receive financial support from anywhere.

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ETHICAL CONSIDERATION

Informed consent was obtained from each participant included in the study, and the study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a priori approval by the institution's human research committee. During intervention, participants might experience adverse events, such as accidents, injuries, or fatigue. Researchers and physical experts would closely monitor participants throughout each training session (in person or by telephone) to promptly identify and address such occurrences.

ROLE OF THE SPONSOR

This study is not sponsored.

ARTIFICIAL INTELLIGENCE (AI) USE

As non-native speakers, we used AI to check papers for English spelling and grammatical errors.

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