ORIGINAL ARTICLE

Effects of combined rusie dutton exercise and locomotion training at home with family involvement on leg muscle strength in older adults with chronic diseases dwelling in Bangkok, Thailand

Porntip Singharat[1], Yupa Jewpattanakul[2*], Juntima Rerkluenrit [2]

[1]Program in Community Nurse Practitioner, Faculty of Nursing, Mahidol University, Bangkok, Thailand
[2]Department of Public Health Nursing, Faculty of Nursing, Mahidol University, Bangkok, Thailand

Corresponding Author: Yupa Jewpattanakul **Email:** yupa.jew@mahidol.ac.th

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ABSTRACT

Older adults with chronic diseases often experience reduced leg muscle strength, an increased fall risk, and a fragile quality of life. Exercise has been shown to improve leg muscle strength. **The study aims** to analyze the effects of combined Rusie Dutton exercise and locomotion training at home with family involvement on leg muscle strength in older adults with chronic diseases dwelling in Bangkok, Thailand. The study employed an experimental design involving older adults aged 60-79 years with chronic diseases from communities in Bangkok. The sample was randomly assigned to either the experimental or control group, with 34 subjects in each group. The experimental group received instructions on increasing leg muscle strength and exercise skill training. They were also trained to use the LINE application for accessing and recording exercise data, setting goals, and planning exercises. The participants performed Rusie Dutton exercises combined with home-based locomotion training three times a week for 50 minutes over a period of ten weeks, supervised by family members. Data collection included demographic interviews, pre-exercise readiness assessments, and the 30-Second Chair Stand Test. Statistical analysis comprised the chi-square test, independent t-test, and paired t-test. Following the intervention, the experimental group exhibited a statistically significant increase in mean leg muscle strength compared to the control group ($p < .05$). Moreover, the experimental group's mean post-test leg muscle strength significantly improved compared to pre-test scores ($p < .05$). Studies suggest that the exercise program significantly increases leg muscle strength in older adults with chronic diseases. The program can be implemented at home with family involvement, demonstrating its potential for improving physical health in this population.

Key words:
rusie dutton, locomotion training, leg muscle strength, older adults

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INTRODUCTION

The world is experiencing a rise in the older adult population due to increased life expectancy and lower birth rates. In 2021, nearly one billion older adults accounted for 13.5% of the global population.[1] In 2024, Thailand has 13.8 million older adults aged 60 and above, representing 20.89% of the population. Thailand has the second highest proportion in Southeast Asia after Singapore.[2] Fall-related deaths in Thailand rose from 888 in 2016 to 1,255 in 2022, straining health systems and finances. The government spends around 12 billion baht annually on treatment.[3] Falls in older adults are complex and stem from multiple risk factors. A significant factor is the degeneration of various bodily organs, often referred to as 'geriatric syndrome,' and chronic diseases, which are complex and multifactorial.

In Thailand, 75 percent of older adults have non-communicable diseases, including hypertension (46.91%), diabetes (21.79%), cerebrovascular disease (2.51%), and coronary artery disease (1.97%), respectively.[4] These conditions, along with related symptoms, complications, and medications, increase fall risk.[5,6] Additionally, multiple chronic diseases in older adults increase fall risk by reducing muscle strength. [7] Factors such as chronic inflammation, muscle cell breakdown from medications, reduced physical activity, poor nutrition, and hormonal changes all contribute to this decline.[8,9,10,11] A third of older adults experience age-related muscle decline, with leg muscles being more affected than arm muscles.[12]

The Ministry of Public Health adopted the WHO's concept of active aging to promote mobility health and prevent falls by assessing leg muscle strength, balance, and fall risks, and promoting exercise.[13] Recommended exercise programs include strength/resistance exercises, flexibility exercises, and mobility training exercises. Specifically, anti-gravity exercises (exercises with rubber bands), flexibility exercises (Maneevej exercises and yoga), and mobility training (Tai Chi, dance, Thai traditional dance, and Rusie Dutton exercises) are suggested.[14] The literature review has shown the four effective exercise modalities including yoga, Tai Chi, Rusie Dutton, and locomotion training exercises for improving older adults' leg muscle strength. The previous findings of quasi-experimental and experimental research indicate that 8-24 weeks of mindfulness exercises such as yoga, Tai Chi, and Rusie Dutton effectively increase older adults' leg muscle strength.[15,16] However, yoga and Tai Chi require supervision to prevent injuries, whereas Rusie Dutton involves simpler and slower movements, making it suitable for home practice by older adults.[17,18] Locomotion training exercises have also proven effective in boosting leg muscle strength among older adults in Japan.[19,20] Therefore, a combination of three Rusie Dutton positions and two locomotion training positions will be beneficial for older adults. Moreover, these exercises have not been extensively studied in Thailand, they are used in senior clubs and communities in Bangkok. The Bangkok Health Department's 2019 reports indicate that participants in these programs have improved their physical capacity and leg muscle strength.[21]

Families play a crucial role in promoting exercise among older adults with chronic conditions by setting goals, supporting physical activity, preparing facilities, observing symptoms, guiding postures, and offering encouragement. This approach aligns with the Revised Self- and Family Management Framework focusing on supporting and obstructive factors, self-care management processes, short-term

self-management outcomes, and long-term self-management outcomes.[22] The program included three Rusie Dutton positions and two locomotion training positions, designed to be simple, safe, and suitable for older adults to practice with supportive family members at home without expert supervision. Researchers provided information, manuals, and videos, and monitored progress via the LINE application. Leg muscle strength was assessed before and after the program to evaluate its effectiveness in reducing fall risk.

The study aimed to explore the effects of combined Rusie Dutton exercise and locomotion training at home with family involvement on leg muscle strength in older adults with chronic disease.

METHODS

Randomized Controlled Trial (RCT) Design

Population and Sample

The population of older adults with chronic diseases was 1,018,539 across 2,017 communities in Bangkok, Thailand. The sample size was calculated using the G*Power 3.1.9.7 program with an alpha set at 0.05, a test power of 0.80, and an effect size of 0.67. An additional 20% was added to compensate for the sample attrition/dropout rate.[23,24] The study employed a stratified random sampling method by randomly selecting one of six zones in Bangkok, followed by the random selection of two districts within that zone. Six communities were randomly selected from 126 communities, resulting in 342 older adults with chronic diseases being selected according to the community ratio. Subsequently, 91 older adults with matched eligibility criteria were randomly chosen from various communities. Each group consisted of 34 randomly assigned subjects.

Inclusion criteria: individuals aged 60-79 years with chronic diseases such as diabetes, hypertension, and hyperlipidemia; possessing a mobile phone with internet access and the LINE application; capable of verbal communication, reading, and writing in Thai; having one family member available to provide care during exercises; and willingness to commit to the 10-week program.

Afterward, the researcher screened participants according to the exclusion criteria: 1) Blood pressure (BP) < 90/60 or BP > 140/90 mmHg; 2) Dextrostix (DTX) > 300 mg/dl in type 2 diabetes based on the most recent blood sugar levels recorded in the health log from the latest doctor visit.[25]; 3) Physical disability; 4) Psychological abnormalities; 5) Heart disease, chronic kidney disease, arthritis, gout, bone and muscle disorders, or other conditions restricting exercise; 6) Mini Cog assessment score ≤ 3 indicating risk of cognitive impairment; 7) Barthel Activities of Daily Living (ADLs) index score ≤ 12; and 8) Thai Falls Risk Assessment Test (Thai-FRAT) score < 4, developed for community-dwelling Thai older adults. Initially, 91 participants expressed interest. However, 23 were excluded, leaving 68 who were randomly assigned to two groups using a computer-generated program. Leg muscle strength was assessed with the 30-Second Chair Stand Test at baseline and after the 10-week program. (Fig. 1.)

Enrollment

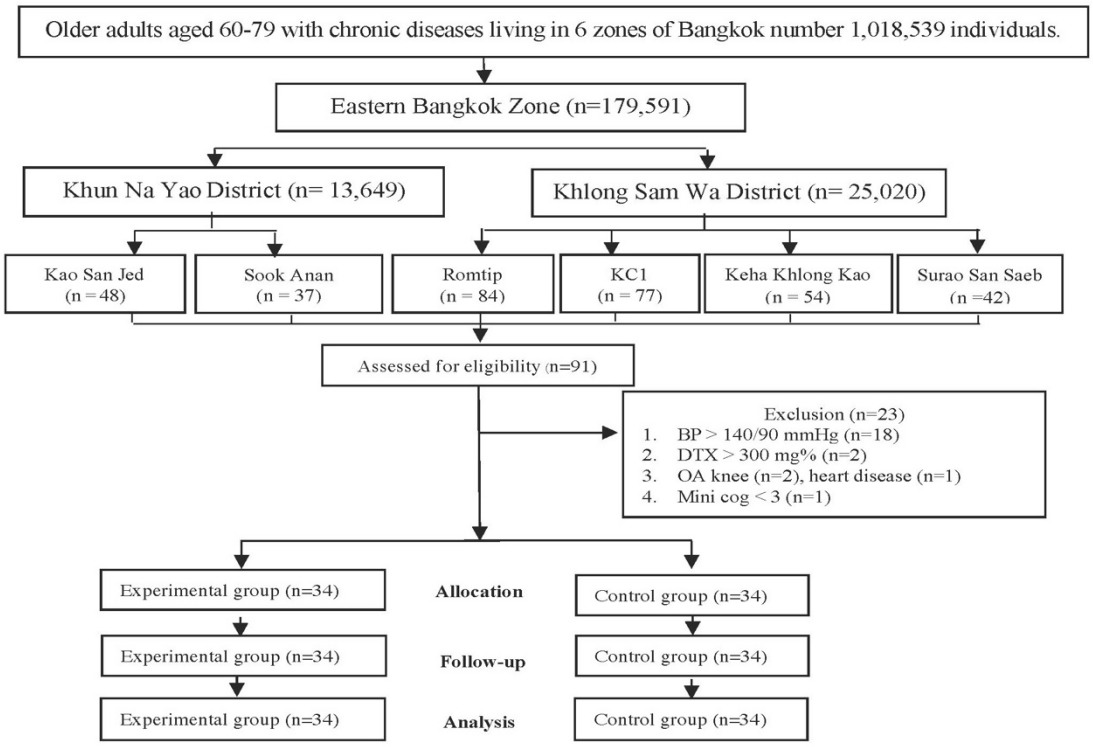

Figure 1. The flow diagram illustrates the selection and randomization of participants into the experimental and control groups, both at baseline and at the end of the 10-week intervention.

Research Instruments

1. Screening Instruments

1.1 The Omron brand HEM-7124 digital blood pressure and heart rate monitor, external type (non-invasive), is an automatic arm-cuff type featuring a digital numerical display screen and utilizing Oscillometric measurement technology. The blood pressure monitor has been calibrated against standard devices for accuracy.

1.2 The Barthel ADLs Index developed by Mahoney & Barthel was translated into Thai and modified by Jitapunkul et al.[26,27] The questionnaire had ten questions on daily living activities, including eating, dressing, moving, toileting, mobility, stair use, bathing, and bowel control, with a maximum score of 20. Higher scores indicated better daily living activities.

1.3 The Mini Cog assessment form developed by Borson et al.[28]and translated by Trongsakul et al.[29] was used to assess cognitive impairment risks. The questionnaire had two questions with a maximum score of five points. Older adults with a total score of less than or equal to three points were considered to have cognitive impairment.

1.4 The Thai Falls Risk Assessment Test (Thai-FRAT) designed for community-dwelling Thai older adults was developed by Tiamwong et al.[30] The questionnaire had six questions assessing gender, vision, balance, medication adherence, fall history, and housing conditions. Scores of 0-3 indicated no fall risk, while scores of 4-11 indicated a fall risk, warranting fall prevention advice.

2. Data Collection Instruments

2.1 The demographic data interview form, created by the researcher,

consisted of 23 questions with fill-in-the-blank and multiple-choice responses. It was divided into three parts: demographic data, family and housing data, and community data.

2.2 The Physical Activity Readiness Questionnaire (PAR-Q) developed by Shephard[26] was translated into Thai by the Department of Health, Ministry of Public Health. The questionnaire contained seven questions to assess physical activity readiness before exercise. Respondents answering 'Yes' to any question were advised to consult a doctor before starting exercises. Respondents answering 'No/Never' to all questions were considered ready and safe to exercise.

2.3 The 30-Second Chair Stand Test (30-SCST) was used to measure leg muscle strength in older adults. Participants repeatedly stood up and sat down in a chair for 30 seconds. Fewer than 8 repetitions indicated weaker leg muscles and a higher fall risk. The normal range was defined as the middle 50% of the population, separated by gender.[31]

3. Research Instruments Used in the Experiment

3.1 The exercise program combined Rusie Dutton exercises and home-based locomotion training using the Revised Self- and Family Management Framework over ten weeks. This program was based on the average duration of studies showing that an 8-week Rusie Dutton exercise program and a 12-week locomotion training program can significantly improve leg muscle strength in older adults. The researcher provided leg muscle strength test results and discussed improvements with participants and families. Information on fall risks, prevention, and family support was provided. Participants watched a researcher-created video on Rusie Dutton and locomotion training.[32,33] Home exercises and Line app usage were explained, and exercise manuals were distributed. At Week 4, participants and families discussed successes, problems, and experiences via video call. At Week 8, the researcher measured participants' weekly exercise behavior, and at Week 10, reassessed leg muscle strength. Weekly messages, pictures, and videos were sent to encourage exercise, and inquiries about participants' conditions post-exercise were made. Families were encouraged to provide support in achieving exercise goals.

3.2 Educational media included: 1) slides on falls, risk factors, effects, and prevention in older adults; 2) a manual on Rusie Dutton exercises combined with locomotion training; 3) a video and images demonstrating these exercises; and 4) motivational and encouraging messages sent to the experimental group via the LINE application.

Validation of Research Instrument Quality

The researcher brought instruments used in the experiment to be tested for content validity and indices of item objective congruence (IOC) by five qualified experts and obtained an IOC of 0.84. The Physical Activity Readiness Questionnaire and the Thai Falls Risk Assessment Test were tested for accuracy with 30 older adults who had chronic diseases, aged 60-79 years and living in the Kanna Community. It was found the Physical Activity Readiness Questionnaire yielded a Cronbach’s alpha coefficient of 0.75, while the Thai Falls Risk Assessment Test was found to have a Cronbach’s alpha coefficient of 0.73.

Research Ethics

This study protocol has been approved by the institutional Review Board, Faculty of Nursing, Mahidol University, COA No. IRB.NS2023/779. 3005. Participants received an explanation of the experimental procedure, risks, and benefits before providing written informed consent.

Data Collection

This study collected data from both the experimental and control groups over a 10-week period from October 2023 to January 2024, as follows:

Experimental Group

During their first community center visit, participants completed a demographic interview, the Physical Activity Readiness Questionnaire, and the 30-Second Chair Stand Test. The researcher invited them to join a LINE group, shared leg muscle strength test results and discussed improvement strategies. Information on fall risks, prevention, and the importance of family support during exercise was provided.

Participants and their families attended a lecture, watched videos, and observed demonstrations of combined Rusie Dutton exercises and locomotion training led by the researcher. The session was divided into three periods: 1) the warm-up period with breathing exercises, meditation, static stretching, and dynamic stretching for ten minutes; 2) the exercise training period with three Rusie Dutton and two locomotion positions, each held for 30 seconds (Figure 1). In Weeks 1-4, participants repeated positions 1-4 five times and position 5 ten times, totaling 30 minutes.; and 3) the cooldown period with static stretching and dynamic stretching took ten minutes. During the exercises, the researcher monitored movements, provided care, and offered recommendations.

1. Kae Klon Pattakat and Kae Sen Maha Sanook Ra-ngub Position Aim: To relieve soreness in the chest and leg muscles.	
2. Damrong Kai Ayuyuen Position Aim: To strengthen the muscles in the front of the lower legs, the muscles assisting in hip extension, and to stretch the muscles of the inner thighs.	
3. Kae Lai, Ka, and Kae Kao Ka Position Aim: To stretch the muscles at the back of the thighs and strengthen the calf muscles and wrists.	
4. Squat Position Aim: To increase the strength of the muscles in the front thighs, hip muscles, and back thigh muscles.	
5. Heel Raise Position Aim: To increase the strength of the calf muscles and the muscles used for bending the ankles and toes.	

Figure 2. Summary of combined Rusie Dutton exercises and locomotion training.

The researcher advised participants to exercise three times a week for 50 minutes, with sessions spaced 24-48 hours apart, over ten weeks. Participants and families set exercise goals, learned to use the LINE app, and received exercise manuals and care guidelines. Family members reviewed fall risk factors, prevention strategies, and Rusie Dutton exercises, while the researcher scheduled the next activity.

Weeks 1-3 Exercises at the participants' homes: During the first exercise session, the researcher requested family members to record initial home exercises for assessment. Follow-ups were conducted via LINE with messages, reminders, encouragement, images, and videos. Participants reported their post-exercise symptoms weekly.

Week 4 – Group discussion to monitor exercise consistency via group video calls on the LINE application: Participants from the Kao San Jed, Sook Anan, Romtip, KC1, Keha Khlong Kao, and Surat San Saeb communities, with 2, 4, 9, 8, 6, and 5 people respectively, joined their family members to build relationships. They discussed exercise success, barriers, goals, and plans during 20-30 minute video calls via LINE, depending on group size. From weeks 5-10, exercise intensity and frequency increased to seven times for groups 1-4 and 15 times for other groups. The researcher reinforced self- and family management knowledge, encouraged goal-oriented exercise, reviewed records, and scheduled the leg muscle strength test for Week 10.

Weeks 5-7 Exercise activities at the participants' homes: The researcher followed up on home exercises via LINE, sending messages, reminders, encouragement, images, and videos. Each week, they inquired about post-exercise symptoms, provided recommendations, and answered questions.

Week 10 – Group activities were organized at the activity field: After the experiment, participants' leg muscle strength was assessed with the 30-Second Chair Stand Test, followed by discussions with families on post-exercise symptoms, management methods, and lessons learned.

Control Group

At the community center, the control group completed a demographic data form, including age, sex, height, weight, medical history, daily exercise routine, and family, housing, and community data. They also filled out the Physical Activity Readiness Questionnaire and performed the 30-Second Chair Stand Test. The control group continued their usual activities or received home visits throughout the study. At week 10, they were tested for leg muscle strength with the same test as the experimental group. After the study, interested participants received information on fall prevention, exercise demonstrations, and program manuals from the researcher (30 minutes).

Data Analysis

Data were analyzed using SPSS (Version 26.0), including descriptive demographic data (frequency, percentage, mean ± SD). Nominal and ordinal data were compared using chi-square or Fisher's exact test, and interval data were analyzed using the independent t-test. Normality was assessed with the Kolmogorov-Smirnov test. Mean leg muscle strength between groups was compared using the independent t-test, and pre-post intervention was analyzed using the paired t-test ($p < .05$ considered significant).

RESULTS

The study involved 68 participants, including 6 men and 62 women. There were no significant differences in age between the experimental (67.79 ± 4.91 years) and control groups (67.71 ± 5.33 years). Body Mass Index (BMI) was not significantly different between the experimental (23.23 ±

3.10) and control groups (24.50 ± 3.49). Most participants in both groups had one underlying chronic disease and typically exercised less than 150 minutes per week with no significant differences between the groups in these aspects. (Table 1)

Table 1. The comparison of baseline characteristics between the experimental and control groups with mean and standard deviation (N = 68)

Variable	Experimental (n=34)	Control (n=34)	p-value
Sex			.673 [f]
Male	2 (5.88%)	4 (11.76%)	
Female	32 (94.12%)	30 (88.24%)	
Age (years)	67.79 ± 4.91	67.71 ± 5.33	.944 [t]
Body Mass Index (BMI; kg/m^2)	23.23 ± 3.10	24.5 ± 3.49	.119 [t]
Chronic Disease			
One Chronic Disease	26 (76.47%)	21 (61.76%)	.189 [c]
More Than One Chronic Disease	8 (23.53%)	13 (38.24%)	
Daily Exercise Routine			.197 [f]
No Exercise	1 (2.94%)	5 (14.70%)	
Exercise < 150 min./week	19 (55.88%)	15 (44.12%)	
Exercise > 150 min./week	14 (41.18%)	14 (41.18%)	

Abbreviations: kilogram; m^2, [t] = independent t-test, [f] = fisher exact test, [c] = chi-square test

At pre-test, there were no significant differences in the 30-Second Chair Stand Test (30-SCST) scores between the experimental (17.59 ± 3.7 repetitions) and the control groups (16.76 ± 3.07 repetitions). After ten weeks, the older adults in the experimental group showed a significantly higher mean leg muscle strength score compared to the control group ($p < .05$). The experimental group scored an average of 18.5 points (SD = 3.71), which was 2.26 points higher than the control group's 16.24 points (SD = 3.10). (Table 2)

After ten weeks, older adults in the experimental group showed a statistically significant increase in mean leg muscle strength compared to their pre-test scores ($p < .05$). The mean post-test leg muscle strength score for the experimental group was 18.5 points (SD = 3.71), which was 0.91 points higher than the pre-test score of 17.59 points (SD = 3.70). (Table 2)

Table 2. Mean and standard deviation of the 30-second Chair Stand Test (30-SCST) at pre-test and post-test between the experimental and control groups.

Variables	Program	Experimental Group		Control Group		t	df	p-value
		M	*SD*	*M*	*SD*			
30-second Chair Stand Test (repetitions)	Pre-test	17.59	3.70	16.76	3.07	.999	66	.321
	Post-test						66	.008*
		18.50	3.71	16.24	3.10	2.733		
p-value +		.004*				-3.074	33	

Abbreviations: M=Mean, SD=Standard Deviation, + Data for pre-test and post-test were compared using paired t-test, *significance < .05.

The mean difference scores of leg muscle strength before and after the experiment revealed that the experimental group had a mean difference score of 0.91 (SD = 1.40), whereas the control group had a mean difference score of -0.52 (SD = 0.96). There was a statistically significant difference between the groups ($p < .05$), as shown in Table 2.

Table 3. Mean and standard deviation of the difference in leg muscle strength scores using the 30-second Chair Stand Test (30-SCST) at pre-test and post-test between the experimental and control groups.

Variable	Experimental Group		Control Group		t	df	p-value
	$\bar{D}$	*SD*	$\bar{D}$	*SD*			
30-second Chair Stand Test (repetitions)	0.91	1.4	- 0.52	0.96	5.143	66	< .001*

Abbreviation: D =Mean difference, SD=Standard Deviation, *significance < .05

DISCUSSION

This study demonstrates that a 10-week combined Rusie Dutton and locomotion training exercise program significantly enhances leg muscle strength in older adults with chronic diseases. Discussion of the findings according to two hypotheses is as follows.

Responding to the first hypothesis, after the program, older adults in the experimental group had significantly higher leg muscle strength than the control group ($p < .001$). These findings are consistent with previous research showing that both specific and combined exercise interventions improve leg muscle strength for three reasons. First reason might be that this study used specific exercise positions for strengthening muscles. The program combines two types of exercises: Rusie Dutton mindfulness practices, which involve controlled breathing and slow movements, and locomotion training with anti-gravity exercises. This approach blends physical and mental training, improving concentration, calmness, and relaxation. It includes five simple, safe exercises that can be performed at home without a trainer. Requiring just 50 minutes of exercise three times a week, the program is both practical and accessible for older adults due to its light to moderate intensity. Previous studies have shown that the Rusie

Dutton exercise program, conducted over 8 or 12 weeks, improves leg muscle strength, and that locomotion training alone can enhance leg muscle strength over a period of 12 weeks in older adults.[14]

Second reason is that family involvement is essential for successful exercise programs for older adults. Using the Revised Self- and Family Management Framework helps identify facilitators and barriers like daily activities, health status, and community resources. Understanding these factors allows for better exercise planning and promotion. Family members should help with planning, support, and motivation.[34] Healthcare providers contribute by offering fall risk information, promoting exercise benefits, and supporting self-management through manuals, goal-setting, exercise planning, progress monitoring, and communication via LINE with exercise videos and weekly logs.[35]

Third reason is that online information sources accessible via mobile phones and exercise demonstration videos provided through the LINE application are important for supporting older adults in reviewing exercise at any time.[36] These resources include self-care development activities, exercise demonstrations, practices, and manuals on fall prevention and exercises. Communication between healthcare providers, older adults, and their families through online platforms helps reduce travel costs and increases convenience, enabling close contact and easier monitoring and evaluation.[37] However, smartphone data recording was limited as older adults struggled with typing, prolonging instruction time.

For reflecting on the second hypothesis, after the program, the experimental group had a higher mean score for leg muscle strength than before the experiment with statistical significance (p-value .004). This improvement might be because of effective steps of exercise schedule, the use of exercise manuals, and the exchange of knowledge and exercise experiences, which encouraged older adults to exercise continually, causing them to have stronger legs than before the experiment. The findings can be discussed under separate points as follows:

Point 1: Exercises in the program used effective steps in the exercise schedule aimed at strengthening leg muscles. The program maintained effective frequency, intensity, time, and type to improve leg muscle contraction. Afterwards, based on this schedule, in weeks 5-10 leg muscle strength progress is monitored. The findings were consistent with a previous study in which participants performed 14 Rusie Dutton exercises for 60 minutes per week over eight weeks. After the experiment, mean pretest and posttest scores for leg muscle strength were found to be different with statistical significance (p-value < .005). [18] Furthermore, the findings were also consistent with another study in which participants performed 15 Thai yoga exercises, holding each position for 20 seconds, twice a week, in 90-minute sessions over twelve weeks. The aforementioned finding found older adults who performed Thai yoga exercises to have better lower body strength with statistical significance (2 8 . 4 %, F= 4.624, p-value <.001).[39]

Point 2: Older adults in the experimental group can always review exercise knowledge from exercise manuals whenever they want. The findings were consistent with a study among older adults in communities engaged in self-care development activities for preventing falls. This study included exercise demonstrations, practice sessions, and manuals on fall prevention and exercise routines with detailed steps for older adults to practice at home.[37] According to the findings, older adults in the experimental

group demonstrated a higher mean post-test score for behavior than before the experiment (p-value < .001).

Point 3: The experimental group of older adults had meetings via the LINE application. In Week 4, they used LINE to exchange exercise information, knowledge, and experiences, and discuss goals, success factors, barriers, and encouragement. The findings were consistent with a previous study conducted to prevent falls among older adults in tall building communities by engaging in discussions about performing tai-chi exercises for eight weeks.[15] The findings were also consistent with a study conducted on a physical activity promotion program for older adults with a study period of 12 weeks. In the activities group, activities were organized to exchange knowledge about problems and barriers, provide encouragement, and plan physical activity for the following week.[40] Post-experiment, the experimental group showed significantly improved leg muscle strength (p-value < .001).

The improved outcomes in this study may stem from combining mental and physical training. However, uncontrolled external factors, such as previous exercise routines or exposure to other exercises, could influence leg muscle strength gains. Future research should address these factors to better validate the program's effectiveness.

RECOMMENDATIONS

Exercise programs that combine Rusie Dutton exercises with locomotion training enhance leg strength and reduce fall risk. Involving family members can help improve outcomes. Older adults should be trained in using exercise tools and technology, with support from user-friendly interfaces. Regular fall risk assessments, tailored to leg strength, balance, and other factors, enhance the effectiveness of exercise programs.

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