

EFFECTS OF LOW INTENSITY EXERCISES ON BODY BALANCE AND MUSCLE STRENGTH OF COMMUNITY ELDERLY PEOPLE

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ABSTRACT: The purpose of this experimental study was to determine the effects of low-intensity group exercise on muscle strength and balance of elderly people in the communities. Seventy-two healthy elderly people from two communities participated in this study. Thirty-six elderly people were randomly selected and allocated into an experimental group and control group. The experimental group performed a supervised group exercise program in every work day's evening for three months. The exercise program began with warming up for five minutes, followed with low-intensity exercise program, and cooling down for another five minutes. The data were collected before and after three months of performing the exercise program. The outcome measures included muscle strength, body balance, and fear of falling. The data were analyzed by using ANCOVA to compare between the experimental group and the control group. After performing the exercise program for three months, the experimental group had developed better health status than before participating in the program and it was significantly different from the control group. The experimental participants' muscle strength was increased by 1.79 points. Their dynamic balance periods were shorter than before receiving the exercise program by 1.32 seconds. Moreover, it was revealed that the experimental participants' fear of falling was decreased by 17.74 points. After three months of involving in the low-intensity exercise program, their health status remained better and healthier while the participants' health status of the control group remained the same as the starting period. The results revealed that the low-intensity group exercise program could improve muscle strength, body balance, and fear of falling among elderly people.

Keywords: Exercise, Balance, Muscle strength, Elderly

1. INTRODUCTION

The world has been becoming an aging society. Each country where has senior citizen accounting for over 10% of the total population can be classified as an aging society [1]. For example, by the year 2004, the proportion of elderly people in Japan was the highest percentage (31%), followed by Italy and Germany (27% and 26% respectively) [2]. In 2007, in the Southeast Asia region, the proportion of elderly people in Singapore was almost equal to Thailand of which Singapore was 11.9 while Thailand was 10.7 [3].

Not only the proportion of elderly people has been increasing, but the seniors have also encountered an increase in age-related diseases. Around 34.6 percent of people over 80 years through self-assessment were found having poor health status [3]. Naturally, people tend to get chronic health conditions when they are getting older. For example, high blood pressure was commonly found in the seniors at 31.7%, meanwhile, the prevalence of diabetes was 13.3%. Other chronic health conditions prevalence like heart disease, paralysis, coronary artery disease, and cancer

prevalence were 7.0, 2.5, 1.6 and 0.5 percent, respectively [3]. These common health conditions in the ageing people including injuries from falls indicate degenerative health status among the older adults [4].

Falling is one of the common and major health problems occurring in the old-age people. In 2007, a study on falls in the ageing people found that, within six months, the percentage of the falls in the seniors was up to 10.3. As far as gender is concerned, the proportion of falls among female elderly people was 12.6 percent while in the same-age male proportion was 7.4 percent. In addition, age also plays a part. The very senior citizens had the highest proportion of falls at 12.7% whereas the proportion of falls in the middle or early age group was 11.7% and 9.2%, respectively [4]. The major physical cause associated with falls in the elder people is a decline in muscle mass which could result a decrease in physical activities. The decline in muscle mass has always been replaced by free fat, collagen, and fibrous tissue [5]. This includes the deterioration of the neuromusculo-skeletal system, especially in lower extremities which could also cause muscle weakness and fall

in the old-age people [6].

Therefore, an exercise program to improve muscular strength and body balance for elderly people is crucial to prevent their health problems. A low intensity exercise has been recommended for maintaining and improving health status in elderly people because it has low risk and yet could gradually let the elderly participants adapt to physiological as well as psychological effects resulting from the exercise training program. To accomplish and maintain these effects, the exercise program should be regularly performed, enjoyable, and relevant to local culture of physical activities. The main purpose of this study was to develop an appropriate exercise program to improve both muscular strength and body balance of elderly people living in a community.

2. METHODS

2.1 Design and setting

A parallel two-arm, randomized control trial (RCT) was applied. The settings for intervention and data collection were at two districts in Khon Kaen, Thailand.

2.2 Participants

The participants were healthy elderly people aged 60 years and over recruited from the communities. The inclusion criteria were healthy elderly people and have been living in the community over one year. Participants with disability, body balance problem, contraindications to exercise were excluded. Seventy-two participants who met the criteria were randomly allocated either in the experimental or control arms by using a block randomized method.

2.3 Intervention

The exercise program was designed based on the criteria which included low intensity, simple, enjoyable, relevant to local culture, and group participation. The components of exercise consisted of the following supervised group exercises.

2.3.1 Squats exercise

The instructor commanded with demonstration to the group of participants as follows. "Stand as tall as you can with your feet apart about shoulder-width. Lower your body as far as you can by pushing your hips back and bending your knees. Push yourself back to the starting position while squeezing your glutes. Repeat the movement 10 times, performing 2 sets. For each repetition,

count to 3 on the way up and on the way down to ensure you are not going too fast. Then rest 30 seconds in between sets."



Fig. 1 Squats exercise

2.3.2 Calf exercise

The participants stood on the feet while the hands grasp the chair back to balance the body. Then they raised their heels up, and put the body weight on the toes, and old in this position for 5 seconds. Then returned to the starting position and repeated 10 times. They performed 2 sets and rested 30 seconds in between.



Fig. 2 Calf exercise

2.3.3 Sideways walking

The participants stood with their feet together, and knees slightly bent. Then, they stepped sideways in a slow and controlled manner by moving one foot to the side, and then they moved the other to join it. Repeat 10 steps each way or step from one side of the room to the other. They repeated the movements 10 sets.



Fig. 3 Sideways walking

2.3.4 Heel to toe walk

They stood upright. Then, they placed the right heel on the floor directly in front of the left foot. Then they did the same with the left heel. They were instructed to keep looking forward at all times. If necessary, they were allowed to put their fingers against the wall for stability. Repeated 10 steps and performed 5 sets.



Fig. 4 Heel to toe walk

Participants in the control group were suggested to maintain their routine daily life activities although they didn't participate in the exercise program.

2.4 Procedure

The objectives and the study design were described to all the participants for both the experimental and control groups. The consent form was read and signed at the Local Health Promoting Hospital. The appointment was arranged right after screening accordingly to the criteria in order to participate in the study and signed the informed consent. Every participant was provided with a recording-book to sign every time he/she participated in the exercise. The exercise program was performed at the community meeting center in the village where most of the elderly people regularly came for chatting. Outcome measures including dynamic body balance (timed up-and-go test), muscle strength (thirty-second chair stand test), and fear of falling (Falls Efficacy Scale) were recorded before and 3 months after participating the study. Village health volunteers supervised the daily group exercise whereas Health Promoting Hospital officers followed up to ensure the exercise program had been regularly performed. All the participants were encouraged to regularly participate accordingly to the study design.

The researcher and research assistants regularly visited and interviewed the participants.

2.5 Measurement Equipments

The timed up-and-go test (TUG) was used to measure the dynamic body balance purposely to assess the balance, walking ability, and fall risk of elderly people. The participants were suggested to wear their regular footwear while they were performing the test. The procedure of TUG measurement began with the advice for each of the participants to sit on a chair. When the researcher gave a signal, he/she got up and walked along the three-meter line, then went back to the seat. The duration of this performance was timed and recorded.

A thirty-second chair stand was tested (30CST). This test aimed to measure leg strength and endurance of elderly people. Each participant sat at the middle of the chair. Place their hand on the opposite shoulder while keeping the feet flat on the floor, back straight, and arms against the chest. After receiving the signal "Go" he/she stood up straight, then sat down again. This was repeated for 30 seconds. The researcher counted the number of completed rounds.

A Falls Efficacy Scale (FES) was a test aimed to assess perception of balance and stability during activities of daily living and fear of falls among the elderly population. The Falls Efficacy Scale was a 10-item question-naire designed to assess confidence of their ability to perform 10 daily tasks without falling as an indicator of how one's fear of falling impacts physical performance. Each item was rated from 1 ("very confident") to 10 ("not confident at all"), and the per item ratings were added to generate a summary total score. Total scores could be ranged from 10 (best possible) to 100 (worst possible). Thus, lower scores indicated more confidence and higher scores indicated lack of confidence and greater fear of falling.

3. STATISTICAL ANALYSES

Data were analyzed by using SPSS for Windows Version 19 (IBM Corp. Released 2010, IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.) under licensed of Khon Kaen University. Shapiro-Wilk test was used to verify the normal distribution of continuous variables. An intention-to-treat analysis was used for avoiding misleading data. The data were analyzed by using Independent t-test for comparing between the experimental and control groups before the experiment. After experiment data were analyzed by using analysis of covariance

(ANCOVA) for between-group comparison. Paired t-test was used for within-group comparison. Differences were considered statistically significant at $p < 0.05$.

4. RESULTS

The demographic variables based on gender, age, income, and occupation were stratified between the experimental and the control groups (EX and CON). Thirty-six participants were allocated in each group. Most of them were female (52.78% in EX group, and 72.22% in CON group). The average age was 70.89(5.38), and 70.58(7.03) years and their average income were 2,500(3,600), and 1,000(3,025) Baht/Month for the EX and CON respectively. (Table 1)

Table 1 The characteristic of EX and CON group

Characteristics	EX n(%)	CON n(%)
<i>Gender</i>		
Male	17(47.22)	10(27.78)
Female	19(52.78)	26(72.22)
<i>Age</i>		
60-69	17(47.22)	18(50.00)
70-79	15(41.67)	15(41.67)
≥80	4(11.11)	3(8.33)
($\bar{x} \pm S.D.$)	70.89±5.38	70.58±7.03
(MIN, MAX)	(63, 86)	(60, 83)
<i>Income (Baht)</i>		
500-1000	19(52.78)	26(72.22)
1001-1500	12(33.33)	7(19.44)
Over 1500	5(13.89)	3(8.33)
($\bar{x} \pm S.D.$)	2500±3600	1000±3025
(MIN-MAX)	600-20000	600-10000

Baseline data before the intervention were compared between the two groups and found no significant difference in terms of body balance, muscle strength, and fear of falling (Table 2).

Table 2 Baseline data before the intervention of both groups.

Variables	EX Group $\bar{x} \pm S.D.$	CON Group $\bar{x} \pm S.D.$	<i>p</i>
Balance	11.91±2.07	12.89±4.34	0.231
Muscle strength	12.42±2.85	12.44±3.48	0.971
Fear of falling	22.50±36.20	17.42±27.36	0.504

Note: Independent t-test

After 3 months of participating in the intervention, the experimental group had significantly improved in their body balance, muscle strength, and fear of falling when compared to the control group (Table 3).

Table 3 Comparison between the two groups after 3 months of intervention.

Variables	EX Group $\bar{x} \pm S.D.$	CON Group $\bar{x} \pm S.D.$	<i>p</i>
Balance	11.28±2.01	12.60±4.43	0.002
Muscle strength	13.94±2.80	12.15±4.64	0.006
Fear of falling	15.91±22.51	33.65±36.09	0.001

Note: ANCOVA, adjusted mean using baseline as covariate

Within-group analysis of the experimental group revealed that after 3 months of participating in the exercise program, the participants had significantly increased their body balance and muscle strength, whereas the fear of falling was not significantly improved (Table 4).

Table 4 Within-group analysis of the experimental group

Variables	Baseline $\bar{x} \pm S.D.$	After 3 m. $\bar{x} \pm S.D.$	<i>p</i>
Balance	11.91(2.07)	10.97(2.02)	0.004
Muscle strength	12.42(2.85)	14.14(2.80)	0.001
Fear of falling	22.50(36.20)	10.33(22.51)	0.089

Note: Paired t-test

Within-group analysis of the control group revealed that after 3 months without any intervention, the participants had no significantly changed in their body balance and muscle strength, but the fear of falling was significantly increased from the baseline (Table5).

Table 5 After the experiment in CON group

Variables	Baseline $\bar{x} \pm S.D.$	After 3 m. $\bar{x} \pm S.D.$	<i>p</i>
Balance	12.87(4.34)	12.96(4.44)	0.784
Muscle strength	12.44(3.48)	11.94(4.64)	0.318
Fear of falling	17.42(27.36)	36.97(36.09)	0.010

Note: Paired t-test

The results showed that participating in the 3 months of low-intensity exercise could significantly improve both body balance and muscle strength. None of the participants had shown any serious adverse effect. These findings were in the line with those of the previous study that employed the three-month home based low intensity exercise for elderly people in different settings and cultures [7]-[9]. In the current study, the participants' fear of falling after 3 months of the intervention had significantly decreased in the experimental group compared to the control group. This could be due to the increase in muscle strength of the lower extremities and body balance of the experimental group as a result of participating in the low intensity exercise program [10].

According to the study design, this study employed a randomized controlled trial of which has been known as the gold standard for intervention study. This could provide the high quality of the study. However, this study had some limitations because the blind assessment was not possible due to the nature of the community trial. In addition, it might be possible that group contamination might occur since the participants in the control group could easily access in the exercise group. Fortunately, this group contamination did not occur since the participation to this exercise program was strictly controlled by the community's health volunteers and the research assistants.

5. CONCLUSIONS

Based on the results of this study, participation on regular (low intensity) exercise, 5 times a week and lasted for 3 months, may increase muscle strength, improve the dynamic body balance and reduce fear of falling in elderly people. This kind of activity could contribute a lot to the communities where there are a lot of elderly people in terms of health promotion, opportunities for social gathering, having fun, more importantly low cost. Any elderly people with any social status can perform this exercise program. Beneficially, older people could use their leisure time worthwhile for the rest of their lives.

6. ACKNOWLEDGEMENTS

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