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An innovative leg self-exercise to reduce knee pain severity among the elderly people in Thailand

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ABSTRACT

Osteoarthritis (OA) is a prevalent health issue that has consistently risen in occurrence among the elderly in Thailand. This issue holds significant importance within Thailand's healthcare system. This research was allocated to the quasi-experimental study aimed at assessing the effectiveness of leg self-exercises for reducing knee pain severity among the elderly. The total sample size was 108 elderly people recruited into the study with an Oxford Knee Score (OKS) between 20 and 48. The participants were divided into two groups: the intervention group received leg self-exercise with a plank for six weeks, and the control group: received health education booklets. All parameters were compared between and within each group using the independent t-test and paired sample t-test in data analysis. At the three-month follow-up, the results revealed that the OKS and self-exercise behavior in the intervention group had considerably increased more than those in the control group ($p<0.001$). Compared with the baseline and three-month follow-up, the within comparison, the OKS, and self-exercise behavior were significantly improved ($p<0.001$). The leg self-exercise with the plank program can lessen the degree of knee discomfort in the elderly and be used to impose and produce recommendations for supporting healthy policies.

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1. INTRODUCTION

Osteoarthritis (OA) is the predominant form of arthritis and the primary contributor to persistent musculoskeletal discomfort and reduced mobility among older individuals. The incidence of OA has continued to increase, and more than 6 million people have OA symptoms [1]. OA is the second most common disease among patients in Thai medicine, with the proportion of patients increasing to 75.69% in 2018. It is a major problem in the health care system for the elderly in Thailand [2]. Considering that the knee joint is big and immediately supports the weight of the body. They must also move practically constantly, which readily leads to joint degeneration [3]. Moreover, the incidence of OA was higher in people aged 50 and older, with 50% of this group being over 65 years [4], [5]. The patient's range of motion is restricted by OA, which causes pain and inflammation in the knee joint. This may result in disability, the inability to walk, and a dependence on a lower quality of life [6].

This research was carried out in Thailand's Pathum Thani Province, which lies on the outskirts of Bangkok. Health officials in this region reported that 64.3% of the population experienced leg and knee pain, which is more likely to cause knee pain and OA problems [7]–[9]. Most senior individuals with knee OA experience sporadic knee pain, which worsens when the knee joint is utilized more regularly [10]. Exercise is useful for increasing the strength of the muscles in the legs and knee joints. It will help to reduce leg and knee pain, reduce bone fractures, and make the elderly better balanced, which causes fewer falls [11]. In addition, it will help to improve bone density, aid in weight control, and reduce stress due to better physical health [12]. Therefore, exercising the legs and the muscles around the knee joint will help stabilize the knee joint and reduce any pain that may occur [13].

The survey and study of community needs in this study revealed that elderly people with knee OA and pain in the knee and legs are often unable to fully support themselves, especially with exercises in the leg and knee organs. Most of the exercises are physical exercises by stretching or slow waking. Furthermore, there is a lack of effective care in the community for the elderly with leg and knee pain problems, and a lack of exercise skills and equipment to reduce leg and knee pain. Leg exercises are body movements performed from the thighs to the feet to enhance or maintain the legs' capacity to function efficiently [14]. Hence, creating a new physical activity and innovative exercises for the knees and legs will aid in reducing pain that might happen in daily life. It will aid in strengthening the muscles surrounding the knee joint, expanding the range of motion, and increasing the coordination of muscles [15], [16]. This intervention program was based on the self-efficacy theory of Bandura [17] to develop the program for promoting self-exercise.

This study aimed to evaluate leg self-exercise with a plank for reducing knee pain severity among elderly people at baseline and after a three-month follow-up. The findings of this research will help establish a health service and promotion system for the organization, implementation, prevention, and management of leg and knee pain, which are the primary symptoms of OA. Furthermore, it can be used as a self-care manual for elderly people with knee pain, allowing them to live better lives by adhering to the goals of knee pain therapy, reducing complications, and remaining happy in society.

2. RESEARCH METHOD

2.1. Research design

The samples for this quasi-experimental study were split into two groups as follows: the control group, which received health education pamphlets on leg exercise, and the intervention group, which received leg self-exercise with the plank. Data collection took place between March and June 2022 and was planned as a six-week leg self-exercise. A total of 16 weeks were employed for study's duration, and there was no blinding.

2.2. Participants

The community's medical services were used to enlist participants in the study. The inclusion criteria encompassed individuals aged 60 years and above, who were assessed using the Oxford Knee Score (OKS), a scale that spans from 20 to 48 points. Moreover, they had no history of surgery before joining the leg self-exercise program, and no diagnosis of diseases with barriers to experimentation (for example: heart disease, and asthma). The subjects willingly agreed to take part in this investigation. The exclusion criteria were exempted from the samples who were restricted to activity if they had OA of the knee at level IV.

Knee OA was raised to a crucial situation in Thailand. It can be corrected by doing leg self-exercises to reduce the pain [18]. The participants were chosen based on the inclusion and exclusion criteria for the study's purposive random sampling, with those from the Sam Kok district being placed in the intervention group and those from the Klong Luang district being placed in the control group. The G-power algorithm utilized a confidence interval of 95%, an acceptable error of 5%, and an effect size of 0.705 [19] to determine the sample size for this study. The final sample size after calculating the sample size was 54 individuals for each group.

2.3. Intervention procedure

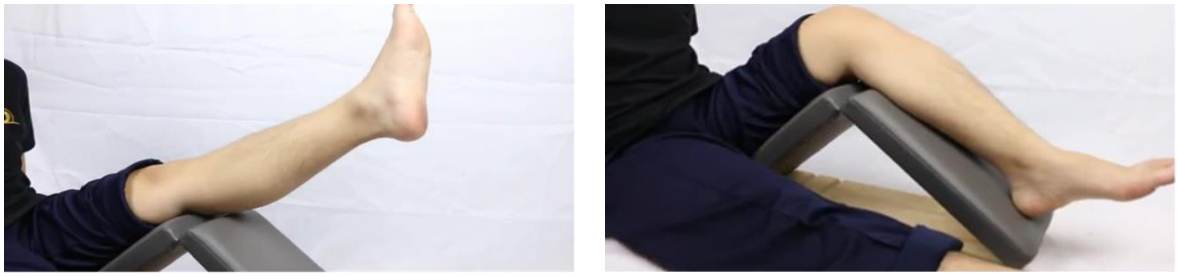
The researcher has developed the program with a literature review of the theories and the previous study and presented it to a specialist for the details and suggestions of the program. This intervention was implemented and monitored by the research team, consisting of the physician, nurse, and public health staff. They were trained for three days to recognize the details of the programs and conduct the standard handbook. Before the program, the researcher conducted the first meeting for orientation, and they received the pre-test measurement at the baseline.

In the first week of the intervention, the researchers invited all of the participants from the intervention group to the primary health care in Sam Kok. This activity was to explain the nature of knee OA

disease, self-care of patients with OA prevention, brief performing exercises on the knee OA to delay the OA by using the picture chart, slide presentation, and video, as well as the method of leg self-exercise with plank and the process to evaluate, follow-up, and visit home. Moreover, the researchers demonstrated the practice of leg self-exercise with a plank slowly and assigned the participants to follow the step-by-step instructions. So, the participant received the educational booklet on leg self-exercise with a plank, which they can implement at their residences, followed by the step postures.

The study's duration was split into two phases: a six-week implementation period at the participant's home, and a three-month follow-up period. After the subject had finished the follow-up program (week 16). The researcher took measurements for all the variables. The leg self-exercise with plank was given to the intervention group, who completed a total of 18 repetitions of it three times per week for 30 minutes each. To monitor the personnel engaged in a certain activity, the researchers designated qualified village health volunteers from the community to visit homes and supervise the exercise program before its commencement. The village health volunteers were tasked with overseeing the individual self-leg exercise using planks among the elderly. They would visit participants' homes every Monday, Wednesday, and Friday, with one village health volunteer assigned to supervise nine participants in the community. The plank leg workout was created with materials and a design that is suitable for elderly people who have knee OA or leg pain. The plank was constructed from a laminated board and has two 10-mm-thick yoga mats placed on top of it. The plank measures 18 cm in width and 60 cm in length.

Two positions—lying and sitting position—shown in Figure 1 were used in the leg self-exercise program using the plank. For the lying position shown in Figure 1(a), the elderly people must lie on their backs, place the leg that they want to strengthen on the plank board, and keep the crook of the knee aligned with the hinge position of the board. In the sitting position shown in Figure 1(b), the elderly people must lift their legs and hold them for 10 seconds while straightening their knees and flexing their toes with the crook still pressing on the plank, not floating to the floor for 10 seconds, then drop the leg down. According to the handbook given to the elderly, the leg self-exercise with plank is comprised of two postures: sitting and laying. Each posture was practiced ten times per round, on the left and right legs. After resting for one minute, the exercise was repeated three times.



(a) (b)

Figure 1. Shows the postures of self-exercise for the plank leg workout in (a) lying position and (b) sitting position

2.4. Measurement tool

Face-to-face interviews were conducted using the structured interviewing method with this instrument. Utilizing relevant theories and scholars, a literature review was used to construct the instrument. The instrument's specifications are as follows;

Part 1: the survey of fundamental characteristics: there were seven questions in all in this section. This section was used to record sociodemographic and health information, including sex, age, educational attainment, level of economic sufficiency, occupation, health issues, and accident history. These were the open-closed questions.

Part 2: the functional ability assessment form: this study used the barthel index of activities of daily living to measure functional ability [20], [21]. The total scores were calculated from a range of 0 to 20. The high total scores meant the participant had a high level of functional ability.

Part 3: the OKS. The 12-item OKS was created by patients for patients to report how their knees and legs functioned and felt in pain: the OKS was originally developed and validated by reporting the validity with Index of Item-Objective Congruence (IOC) was 0.95 and the reliability with Cronbach's alpha coefficient was 0.97 [22]. The grading scale, which varied from 0 (worst outcome) to 48 (best outcome), was given a

1–5 score for each question. The high score suggests a reduction in pain severity, which is considered the optimal outcome.

Part 4: the self-exercise behavior assessment form: the total of this part was 10 questions. Each question has three answer choices including regular practice (more than three times a week), sometimes practice (1-2 times a week), and nothing (0 times a week). If they answered as a regular practice, sometimes practice and nothing, the scores were given 3, 2, and 1, respectively. The score ranged from 10-30 points. The high total scores indicated a good level of self-exercise behavior.

The tools evaluated the validity of a peer from three experts in physical therapy, medicine, and public health and presented an IOC of greater than 0.95. Thirty elderly people from the same Pathum Thani Province in Thailand as the study area, whose features were similar to those of the participants, were used to assess the reliability. Cronbach's alpha coefficient exceeded 0.90.

2.5. Data analyzing

The SPSS 22.0 for Windows program was used to analyze the data: i) descriptive statistics were used to evaluate the baseline attribute data; ii) baseline characteristics between the groups were estimated using the Chi-square test and independent t-test; iii) the normality test was evaluated using the Kolmogorov-Smirnov goodness of fit test. The findings revealed that the outcome variables had a normal distribution; and iv) the mean difference between the group and within the group at baseline and the three-month follow-up was compared using the independent t-test and the paired t-test, respectively. The statistical significance of all findings was set at $p<0.05$.

2.6. Ethical consideration

This study was approved by the Ethics Committee on Human Research at Valaya Rajabaht University, Thailand. The certification number was REC No. 0059/2021 and COA No. 0003/2022, with the date of approval being January 7, 2022. The participants were required to sign a consent form before participating in the research project. The participants were informed of the necessary confidentiality and data collection procedures.

3. RESULTS AND DISCUSSION

3.1. Results

In this study, a total of 108 participants took part, with 54 in the intervention group and 54 in the control group. Post-measurements were evaluated at the three-month follow-up. As shown in Table 1, baseline parameters were comparable between the two groups. The results showed that the baseline characteristics were similar between both groups ($p>0.05$). The findings revealed that the 108 individuals had an average age of age of 72.2 years (S.D.=8.1), with a roughly equal gender ratio of males to females. The majority (42.6%) had completed elementary education, 55.6% had sufficient financial resources, and 37.1% were unemployed. Additionally, most participants (56.6%) had a history of accidents, and 81.5% had co-morbidities. Their functional competency level was generally good as shown in Table 1.

Table 1. The baseline features of each respondent group (n=108)

Variables		Total	Intervention group	Control group	p-value
Age (years)	Mean±SD	72.2±8.1	70.02±6.3	74.12±5.4	0.102
Gender	Male	53 (49.1%)	25 (46.3%)	28 (51.9%)	0.564
	Female	55 (50.9%)	29 (53.7%)	26 (48.1%)	
Income sufficiency	Sufficiency	48 (44.4%)	22 (40.7%)	26 (48.1%)	0.103
	Insufficiency	60 (55.6%)	32 (59.3%)	28 (51.9%)	
Education level	No education	24 (22.2%)	14 (25.9%)	10 (18.6%)	0.922
	Primary school	46 (42.6%)	21 (38.9%)	25 (46.3%)	
	Secondary school	23 (21.3%)	11 (20.4%)	12 (22.2%)	
	Bachelor degree and higher	15 (13.9%)	8 (14.8%)	7 (12.9%)	
Occupational	Merchants	22 (20.4%)	12 (22.2%)	10 (18.6%)	0.701
	Agriculturist	32 (29.6%)	16 (29.6%)	16 (29.6%)	
	Employee	14 (12.9%)	7 (12.9%)	7 (12.9%)	
	Unemployed	40 (37.1%)	19 (35.3%)	21 (38.9%)	
History of accident	Yes	59 (54.6%)	19 (35.1%)	40 (74.1%)	0.102
	No	49 (45.4%)	35 (64.9%)	14 (25.9%)	
Comorbidity	Yes	88 (81.5%)	45 (83.3%)	43 (79.6%)	0.455
	No	20 (18.5%)	9 (16.7%)	11 (20.4%)	
Functional ability	Poor (0-8 scores)	6 (5.5%)	3 (5.5%)	3 (5.5%)	0.233
	Moderate (9-11 scores)	19 (17.6%)	11 (20.4%)	8 (14.8%)	
	Good (12-20 scores)	83 (76.9%)	40 (74.1%)	43 (79.7%)	

Table 2 indicated that there was no significant difference (p>0.05) in the mean change of all parameters between the intervention group and control group at the baseline. The average difference in all indicators was evaluated within and between groups after the three-month intervention program. The results indicated that there was a substantial rise in the OKS and self-care behavior score in the intervention group compared to the control group (p<0.001). Upon comparing all parameters in the intervention group at the three-month follow-up and baseline, it was determined that the OKS increased significantly from 28.28±4.14 to 34.89±3.31 (p<0.001). The self-care behavior score exhibited a substantial increase from 23.96±0.19 to 29.70±0.57 (p<0.001). Furthermore, when comparing all measures in the control group before and after the 3-month intervention program, it was shown that the OKS improved considerably from 26.67±2.90 to 28.22±3.12 (p<0.001). The self-care behavior score had a mean value of 22.88±4.24 and experienced a substantial increase to 26.91±1.70 (p<0.001). Upon concluding the experiment, it was evident that the control group exhibited higher scores in both the OKS and self-exercise behavior assessments. Before the implementation of the intervention, their level of physical activity was low and their exercise technique was incorrect. However, after receiving health education pamphlets on leg exercise, the majority of participants engaged in physical exercises such as stretching or slow walking. This resulted in an improvement in their scores after three months. However, it should be noted that the effectiveness of these exercises was not as significant as that of plank leg exercises.

Table 2. the average difference between the intervention group and control group for all parameters (n=108)

Variable		Baseline (mean±SD)	Three months follow-up (mean±SD)	p-value (a)
OKS	Intervention group	28.28±4.14	34.89±3.31	<0.001*
	Control group	26.67±2.90	28.22±3.12	<0.001*
	p-value (b)	0.665	<0.001*	
Self-exercise behavior score	Intervention group	23.96±0.19	29.70±0.57	<0.001*
	Control group	22.88±4.24	26.91±1.79	<0.001*
	p-value (b)	0.309	<0.001	

Observation: paired t-tests were used to assess the data within each group (p-value (a)) and independent t-tests between groups (p-value (b)). *At the 0.05 level of statistical significance

3.2. Discussion

The study's quasi-experimental approach, compared two groups before and after three months of follow-up testing. This intervention was appropriate for assessing the program's efficacy. At the three-month follow-up, the results revealed that both the self-exercise behavior score and the OKS significantly increased between the two groups (p<0.001).

The outcome is consistent with the findings of the Ahmad *et al*. [23], which showed that participants in the leg exercise program had a statistically significant lower level of disease severity (p<0.05) than those who had not. Additionally, findings Chuaychan *et al*. [24] demonstrated that the self-care practices of people with knee OA considerably improved after implementation compared to before implementation (p<0.05). And in line with findings Yuenyongviwat *et al*. [25], which suggested that when participants joined the program, the intensity of their pain decreased.

This finding might explain that; firstly, knee OA is a crucial health problem that is more common in adults aged 50 years and older [26], [27], and it has deteriorated with increasing age [28]–[30]. Exercise for the legs involves movement from the thighs to the feet to improve or maintain leg fitness. For elderly people with knee OA, the leg self-exercise with planks program is a good option. The exercise can improve the strength and stamina of the surrounding leg muscles and knee joints. Additionally, it can aid with stretching exercises and enhance range of motion exercises for better joint movement or to preserve the function of the movement. This exercise was conducted according to the physical activity standards recommended by the World Health Organization [31]. It indicated that individuals should participate in 150 minutes of moderate-intensity exercise per week.

Secondly, during the three-month follow-up, the intervention group participants had higher scores on the self-exercise behavior and OKS than the control group. This result is in line with Bandura's self-efficacy theory [17], which claims that a person's conviction in their capacity to use their abilities (self-efficacy) to achieve a goal. A person will exhibit the behavior necessary to accomplish the stated goal if they perceive their efficacy and have outcome expectations for their performance [32]. The three-step self-efficacy method can be used to characterize this behavior: i) self-observation; the information on the pain score was delivered to the intervention group. The elderlies then watched their conduct during their leg exercises and discovered that the plank program, followed by the intervention program, helped them relieve their pain symptoms. This would have been avoided if the individual had set a goal to practice the leg exercise with a plank three times each week for a total of 18 sessions. Setting their goal to practice 3 times/week for 30 minutes per time, a total of 18 times;

ii) judgment process; a successful comparison between their objectives and the evaluation of the leg self-exercise with plank behavior was made. The value of plank exercises for self-exercise may become clear to the participants as a result. They can choose to design the exercise using the plank as a result and keep a record of their leg self-exercise activity to remind themselves. It enables the elderly to be visible, carry on exercising for six weeks, and sustain practice for their everyday lives [33]; and iii) self-reaction; by recoding self-appreciation, communicating the feelings through social media or visit home by the village health volunteers, and rewarding their possessions when able to lessen pain severity, the intervention group is encouraged or reinforced to maintain continuous leg self-exercise with plank behavior. The elderly can continue to do plank leg exercises, which can help to lessen the intensity of their pain [34]. This finding is consistent with previous studies [35], [36] showed that after using the exercise, the self-care behaviors and severity of knee pain were significantly higher than before and higher than the comparative group ($p<0.05$).

4. CONCLUSION

In conclusion, leg self-exercise with a plank helps to reduce pain symptoms, enhance self-exercise behavior ratings, and encourage sustainable exercise behavior. It can also make people feel good about their progress in improving fitness. In this investigation, there were two limitations. Urban areas make up the study area. Because of variations in disease complications, lifestyles, demographics, and economic status, the findings cannot be applied to rural locations. Additionally, the brief duration of the leg exercises performed as part of the plank program was a constraint of this study's duration. For recommendations on further research, it is recommended that the follow-up period be increased from three to six months and that the outcome measurements be precise. The leg self-exercise with plank program can increase the OKS and the self-exercise behavior score which reported they had the best outcome of knee pain. Recommendations to apply these results can be described: i) the findings can also be used to improve the service and health promotion system, as well as to plan and implement strategies for preventing leg and knee pain; ii) caregivers can use this innovation as a way to help older individuals with knee discomfort take care of themselves and prevent complications; iii) health professionals can incorporate a plank leg training regimen into their standard care for the elderly; and iv) administrators can use this to create a health policy for employing plank exercise to relieve knee pain in the elderly.

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