The Effectiveness of Preoperative Quadriceps Exercise and Diet Control Program for Older Adults Waiting for Total Knee Arthroplasty: A Randomized Controlled Trial

Jintana Rittharomya, Suparb Aree-ue, Porntip Malathum, Pisamai Orathai, Basia Belza, Viroj Kawinwonggowit*

Abstract: People with knee osteoarthritis often suffer from pain and disability while waiting for total knee arthroplasty. The purpose of this randomized controlled trial study was to determine the effectiveness of the Preoperative Quadriceps Exercise and Diet Control Program on the self-efficacy quadriceps exercise and diet control behavior, body mass index, pain, quadriceps muscle strength, mobility, and health-related quality of life in older adults on a waitlist for total knee arthroplasty. Ninety-six Thai older adults were randomly assigned either into an experimental (n = 48) or control (n = 48) group. The experimental group received the intervention program in addition to standard care, while the control group received only the standard care. Instruments used to collect data were; Self-Efficacy Expectation Questionnaire, Numeric Pain Rating Scale, Hand-Held Dynamometer, Goniometer, Timed-Up-and-Go Test, Mini-Osteoarthritis of Knee and Hip Quality of Life. Data were analyzed by using two-way repeated analysis of variance and two-way repeated multivariate analysis of variance.

The results revealed that self-efficacy quadriceps exercise and diet control behavior of the experimental group were statistically higher than that in the control group at weeks 2, 8 and 12. The quadriceps muscle strength, range of motion, movement ability, and health-related quality of life of the experimental group were statistically higher whereas pain was statistically lower than those in the control group at weeks 8 and 12, but not significantly different in the body mass index between the two groups. These findings suggest that the program should be recommended for application in nursing practice for older adults waiting for primary total knee arthroplasty. Promoting quadriceps exercise and modifying dietary behavior are independent nurses' roles in enhancing health outcomes in this population. Although pre-operative outcomes are satisfied, a longitudinal effect of the intervention through post-surgery is warranted.

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Introduction

Knee osteoarthritis (OA) is a significant increasing health problem worldwide, including in Thailand. In a global burden of 291 conditions, knee OA was ranked as the 11th highest in global disability and 38th highest in disability-adjusted life years (DALYs)[1]. Over

85% of people aged 65 years or older present with radiographically detectable knee OA[2]. In Thailand, the burden of disease or DALYs lost in most Thai older adults are due to chronic diseases and age-related decline in which knee OA in women was the 8th rank of significant diseases[3]. Conservative treatment includes patient education, physical therapy, weight reduction, exercise, lifestyle modifications, and medication management to delay disease progression. If these are unsuccessful, total knee arthroplasty (TKA) will be considered to relieve pain, restore knee function, and improve aligned knee. The demand for TKA will increase from 5.7, in 2005 to 6.4 times, in 2030 due to an aging population[4]. In Thailand, primary TKA demand is projected to increase every year continuously[5], and is rapidly increasing much more than the supply in recent years. Therefore, Thai people have to wait for several months for TKA.

Many studies indicated that pain, physical function, stiffness, health status, societal role, and health-related quality of life (HRQOL) continue to deteriorate while waiting for TKA[6]. The main consequences of knee OA progression are chronic pain and disability which burden individuals, family, and economic impact. Quadriceps muscle weakness is a critical sign of knee OA, which leads to pain and disability. Increasing muscle strength by quadriceps exercise may decrease pain during wait time and help in recovery after surgery. In addition, obesity is a risk factor for disabled knee OA due to mechanical stress from being obese which induces cartilage breakdown from an excess load[1]. Exercise combined with dietary and weight control is important to decelerate knee OA progression. The adherence to this regimen is largely unsuccessful. This may partly due to the peoples' fear of increasing pain when exercising along with lack of confidence to perform exercise accurately, and lack of concern when knee symptoms did not present as a nature of knee OA. Dietary and weight control behavior is difficult to change[7]. Thus, this study aimed to develop and test the Preoperative Quadriceps Exercise and Diet Control Program (PEDCP) for the self-efficacy quadriceps exercise, diet control behavior, body mass index, pain, quadriceps muscle strength, mobility, and health-related quality of life in older adults on a wait list for total knee arthroplasty.

Review of Literature and Conceptual Framework

Knee OA is commonly known as a high cost-high volume disease since its burden and disability significantly impact on individuals, families, and society[6]. Severe pain and functional limitation are major causes leading to a reduction of patients' health related quality of life (HRQOL)[6]. Health care providers are challenged to find the ways to lessen knee OA symptoms and improve HRQOL while patients are on a waitlist for a TKA. Since quadriceps muscle strength along with a weight reduction are vital factors to decrease knee OA symptoms and promote functional ability, these two factors have been focused interventions. Preoperative exercise interventions (3 times/week for 6 – 8 weeks) significantly lessen pain, and improve physical function, and muscle strength before surgery[8,9], but some studies show controversial results.[10] However, evidence from previous studies demonstrate that education programs consisting of health information about exercise, lifestyle, nutrition, and weight loss could improve health outcomes such as physical function and pain[11]. Therefore, combining health information with dietary control, together with exercise intervention may increase positive health outcomes and lessen knee OA symptoms. However, earlier studies mostly measured pain, physical function, and muscle strength and had less concern for HRQOL[12]. Although quadriceps exercise program aims to help patients achieve positive health outcomes, it may be hard to encourage patients to follow due to fear of pain or never performing an exercise, so these are considered significant barriers to exercise adherence, and to optimize adoption.

An appropriate theoretical model is necessary for developing the intervention program which aims to promote and maintain quadriceps exercise and dietary control behaviors inducing improving health outcomes

of patients who wait for TKA. Self-efficacy theory[7] explains that self-efficacy is a cognitive mechanism mediating behavior change. The efficacy belief forms a major basis for action, and refers to beliefs about one's capabilities to perform and organize the action requiring the accomplishment[7]. Self-efficacy is essential to promote health behavior change through the process of beliefs about person's capability to accomplish performance; high self-efficacy will help a person to maintain performing the specific health behavior such as quadriceps exercise and diet control. The confidence of capability in health behavior will improve the expected health outcomes. Previous studies have been found that self-efficacy beliefs have essential roles for performing the physical task improving pain and mobility[13]. Since no published studies to date have been found in Thailand on a preoperative intervention in persons waiting for TKA, the Preoperative Quadriceps Exercise and Diet Control Program (PEDCP) was introduced. It was developed based on self-efficacy theory using four sources of this: enactive mastery experience, vicarious experiences, verbal persuasion, and physiological and affective states. This was undertaken in procedures of giving health information about quadriceps exercise and dietary control, training quadriceps exercise until participants had confidence and adherence to home exercising, and encouraging to continuously perform quadriceps exercise and dietary control behavior by telephone-monitoring weekly. Monitoring is required for maintaining self-efficacy to maintain quadriceps exercises performance and other health behaviors to improve health outcomes and reduce deterioration of knee OA during the waiting list time; self-efficacy combined with telephone monitoring is an important strategy. Thus, the self-efficacy was used to construct self-efficacy quadriceps exercise and diet control behaviors, ultimately to achieve better health outcomes (body mass index, pain, quadriceps muscle strength, range of motion, movement ability, and HRQOL). Since self-efficacy is acknowledged as a mediator to enhance the continuous performing quadriceps exercise and dietary control behaviors that were difficult to change, the self-efficacy was measured at immediate (week 2) and intermediate times (weeks 8 and 12) to give older participants' the confidence to perform quadriceps exercise and dietary control behaviors continuously. On the other hand, other health outcomes measured need longer time, at least 6-8 weeks, to observe changes[8,9]. So, we proposed these hypotheses:

The mean score on self-efficacy quadriceps exercise and diet control behaviors in the experimental group would be higher than that of the control group at weeks 2, 8 and 12.

The mean score on body mass index, quadriceps muscle strength, range of motion, movement ability, and health-related quality of life in the experimental group would be higher, whereas pain would be lower than that of the control group at weeks 8 and 12.

Methods

Research Design: A randomized controlled trial

Sample and Setting: The sample was older adults with knee OA who were on a waitlist for receiving a primary TKA procedure and follow-up treatment at a university hospital in Bangkok, Thailand. Older adults were selected by purposive sampling based on the inclusion criteria: being young-old and middle-aged old (60 to 79 years old); on a waitlist for a TKA with the surgery planned for longer than three months out at the time of enrollment into the study; no prior knee surgery; no cognitive impairment; independent to perform activities of daily living (ADLs); no uncontrolled or serious medical illness; and no gait problems. The exclusion criteria comprised having an acute illness causing admittance to a hospital during the study and being unable to maintain compliance throughout the study program. The sample size was determined using power analysis by G* power version 3.1.9.2 involving the repeated measures MANOVA with an alpha level of .05, a power of .80, an effect size (f) of .205, the

number of group of 2, and the number of measurements, 4[14]. The calculated results indicated that the total sample size was 74. Accounting for an estimated 30% attrition rate, and the multiple variables being tested[15], the optimal total sample size was 96, or 48 participants in each group. The participants who met the inclusion criteria were matched by gender and age first then randomly assigned into either the experimental or control group. During the study, four participants in the control group dropped out due to receiving a TKA earlier than anticipated. Finally, 92 participants were remained in the study with an attrition rate of 4.16%, but the remaining participants were still more than the minimum calculated sample size. There were 48 participants in the experimental group and 44 participants in the control group. The flow of the study is shown in Figure 1.

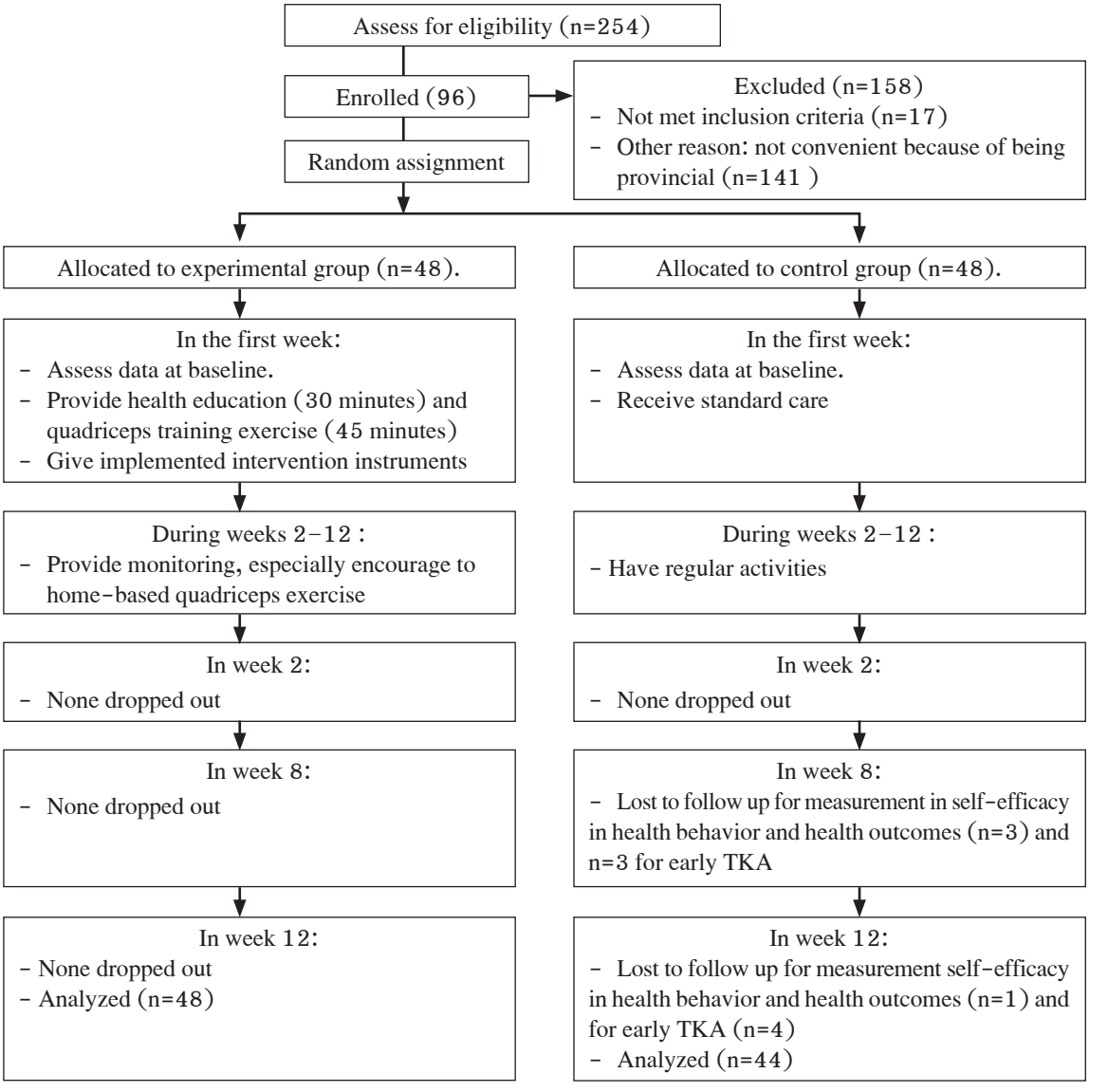

Figure 1. The Flow of Participation through the Trial

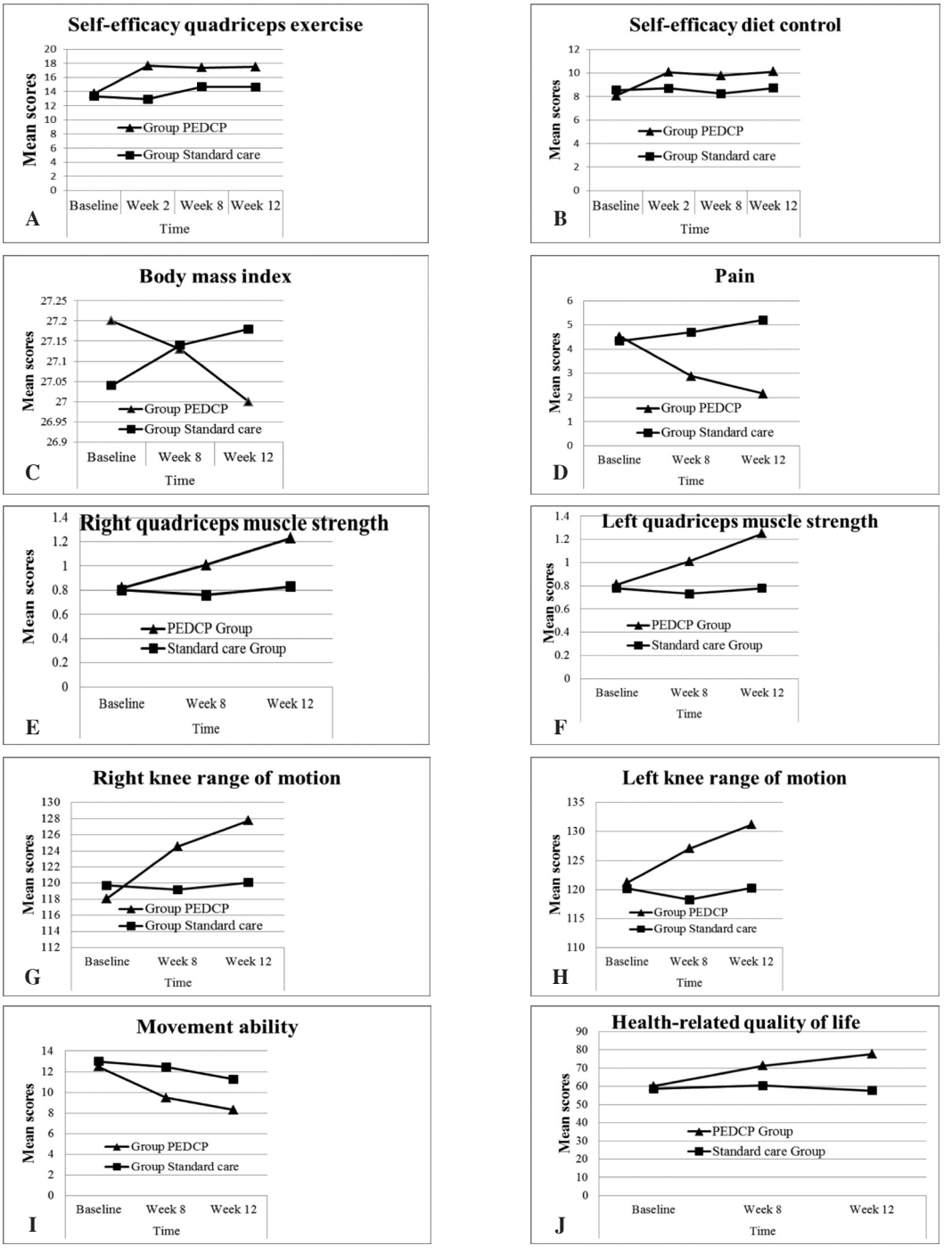

Figure 2 Descriptive analysis for self-efficacy quadriceps exercise (A), self-efficacy diet control (B), body mass index (C), pain (D), right quadriceps muscle strength (E), left quadriceps muscle strength (F), right knee range of motion (G), left knee range of motion (H), movement ability (I), and health-related quality of life (J)

Ethical Considerations: After this study was approved by the ethical committee, Faculty of Medicine Ramathibodi Hospital, Mahidol University (ID 12-60-15), the principal investigator (PI) met with each prospective participant and explained the study objectives, procedures, duration, benefits, potential risk, and confidentiality. No major risk was anticipated in this study, except participation may disturb their time. The participants were assured that they could withdraw from the study at any time if they wished and that his would not affect any health care services or the relationship between the participants and health care providers. All participant identities were kept confidential, and data were presented only as group data without individual identification. After the participants agreed to participate, they were asked to sign an informed consent form. All participants received transportation cost, meals, and a small gift. For participants in the control group, they were offered the PEDCP after the study had been completed.

Instruments: Data were collected by seven instruments as follows.

The Socio-Demographic and Health Information Form was developed by the PI and consists of participants' characteristics (e.g. age, gender, weight, height, body mass index, marital status, educational level, occupation, income, regular activities or posture), types of housing, and health information (e.g. duration of knee OA since diagnosis, duration of conservative treatment for knee OA, use of pain medication, walking aids, and comorbidities).

The Self-Efficacy Expectation Questionnaire (SEEQ) was used for measuring self-efficacy[16], and consists of 15-items of self-efficacy in two sections: 1) self-efficacy quadriceps exercise (9 items) and diet control (6 items) behaviors. The score for each positive item is 0 (no), 1 (uncertainty), and 2 (yes), while the reverse score is assigned for negative items. A higher score reflects a stronger self-efficacy. Cronbach's alpha coefficient was .75[16]. In this study, the reliability was tested with 30 pilot samples and the Cronbach's alpha reliability of self-efficacy quadriceps exercise and diet control behavior were .77 and .62, respectively. Also, the Cronbach's alpha reliability of self-efficacy quadriceps exercise and diet control behavior at four-time points range from .68 to.85 and .46 to .52, respectively.

The Numeric Pain Rating Scale (NPRS) was used to assess knee pain intensity over the previous 24 hours. It is an 11-point pain intensity scale ranging from 0 - 10 on a 10 cm line, with 0 representing no pain to 10 representing the worst possible pain. The test-retest reliability tested in participants aged 40-80 years with knee OA was .95 [17]. In this study, the test-retest reliability was .82 in the 30 pilot samples.

The Hand-Held Dynamometry (HHD) is a Lafayette Manual Muscle Testing (MMT) System Model-01165 used to measure quadriceps muscle strength quantified as torque (force [newtons] x distance between the knee joint and pressing area [meter]) per kilogram body weight. A higher score reflects more quadriceps muscle strength. The HHD was reported the intraclass correlation coefficient ranging from .94 to .96[18].

A goniometer was used for measuring the direct joint range of motion (ROM) of the knee in term of flexion. The knee flexion range is between 0-145 degrees. The inter-rater reliability was reported at .99 tested in patients undergoing TKA[19].

The Timed-Up-and-Go Test (TUGT) was used for measuring the speed of movement ability. The participant was asked to rise from a chair, walk 3 meters away, and return to sit on the same chair while timing was recorded. The inter-rater reliability was 1.00[20].

For inter-rater reliability of HHD, goniometer, and TUGT, two research assistants (Ras) were trained by an orthopaedist before actual data collection. The inter-rater reliability between them and the orthopedist tested in 10 participants for HDD was .85 and .96, goniometer was .95 and .96, and TUGT was 1.00 and 1.00.

The Mini-Osteoarthritis of Knee and Hip Quality of Life (Mini-OAKHQOL) was used for measuring HRQOL in patients with knee OA. It contains 20

questions for five dimensions comprising physical activities (7 items), mental health (3 items), pain (3 items), social support (2 items), social functioning (2 items), and three independent items. Each item is rated as 0 to 10. The score of each dimension is calculated to a normalized score, ranging from 0 (worst possible QOL) to 100 (best possible QOL). A high score reflects high HRQOL[21]. In this study, HRQOL was measured by the Thai version, which was translated by the back translation method[22]. In this study, 18 question from the OAKHQOL were used for calculation, and two independent items were not (as most of the older sample no occupation or sexual activity). The Thai version was used with 200 Thai older people with knee OA; the Cronbach's alpha coefficient was .92[22]. In this study, the reliability was tested with the 30 pilot samples and the Cronbach's alpha was .90. Also, the Cronbach's alpha reliability ranged .86 - .87 in 92 study samples at three-time points in the main study.

Intervention Program: The Preoperative Quadriceps Exercise and Diet Control Program (PEDCP) was developed and delivered to the participants by the PI. The PEDCP was synthesized from previous studies and Bandura's self-efficacy theory. It consists of providing health information, quadriceps training exercise, and monitoring through telephone or LINE application as shown in **Table 1.**

Table 1 Preoperative quadriceps exercise and diet control (PEDCP) implementation

Time Schedule	Component	Strategies	Content/ Activities
Week 1			
Session 1 (30 minutes)	Health information : knee OA progression and the benefit of quadriceps exercise and dietary control	Verbal persuasion Vicarious experience	**Content:** 1) how knee OA progress during waiting time and its impacts; 2) lifestyle modification, especially quadriceps exercise and diet control to decelerate the disease progression during waiting time **Activities:** 1) provide health information; 2) question and answer; 3) explain a symbolic model in DVD and poster; 4) encourage and motivate performing appropriate quadriceps exercise and diet control.
Session 2 (45 minutes)	Quadriceps training exercise: quadriceps static exercise and leg extension	Enactive mastery experience Vicarious experience Verbal persuasion Physiological and affective states	**Content:** isometric exercises and isotonic exercises **Activities:** 1) demonstrated the quadriceps exercises; 2) return-demonstration until the participants had confidence in their capability; 3) share experience with a live model and symbolic model in poster; 4) encourage and motivate to adhere home-based quadriceps exercise 60-100 times daily and three times weekly; 5) give compliments for participants' effort; 6) assess participants' feeling and fill the positive reinforcement.

Table 1 Preoperative quadriceps exercise and diet control (PEDCP) implementation (Cont.)

Time Schedule	Component	Strategies	Content/ Activities
Weeks 2-12	Monitoring: telephone or LINE application weekly	Enactive mastery experience Vicarious experience Verbal persuasion Physiological and affective states	**Content:** monitoring to maintain home-based quadriceps exercise and diet control with telephone or LINE application **Activities:** 1) track the progress of home-based quadriceps exercise and diet control; 2) return to review a symbolic model in the poster; 3) provided positive feedback, encouragement, and compliments; 4) talk about quadriceps exercise and diet control ensure participants feel more confidence. Note: when the participants came to be assessed the outcomes at week 8, the PI gave them time to share their feelings about performing home-based quadriceps exercise, controlling diet, and a progression of their physical ability. Then the PI gave them encouragement and compliments to continue performing quadriceps exercise and diet control.

The experimental group received the PEDCP, whereas the control group received standard care. The standard care involved general preoperative advice through giving leaflet to patients to read by themselves. The experimental group was set to meet the PI for giving health information and quadriceps training exercise in a small group (5-10 persons) on the first day of week 1 and health behavior was monitored by telephone calls or LINE application throughout the 12 weeks. Moreover, the experimental group was asked to record their performance of quadriceps exercise in a logbook. The aim was to keep track of their adherence to the quadriceps exercise. Besides, the intervention fidelity was incorporated in this study to ensure that all the participants in the experimental group received all essential components of the intervention. The groups were scheduled on a separate day to prevent intervention contamination so they were blinded as study participants.

Data Collection: Data were collected by the two RA who were trained, particularly measuring quadriceps muscle strength and ROM. Self-efficacy quadriceps exercise and diet control behavior were assessed at baseline, and at weeks 2, 8, and 12. The body mass index, pain, quadriceps muscle exercise, range of motion, movement ability, and HRQOL were assessed at baseline, and weeks 8 and 12. The RAs did not know about the intervention so that the participants received them as blinded data collectors.

Data Analysis: Data were analyzed by the Predictive Analytics Software (PASW) Statistics Version 18 downloaded@ Mahidol University License. Descriptive statistics were used to analyze the participants' characteristics; two-way repeated measures analysis of variance (ANOVA) and multivariate analysis of variance (MANOVA) were used to examine the differences of mean scores of outcome variables between the experiment and the control groups. Assumptions were tested before running statistical analysis.

Results

A total of 96 participants was enrolled and randomly assigned, but the remaining 92 participants were analyzed. Most participants in both the experimental and control groups were female (89.58% and 88.64%, respectively), and also pre-obesity was found in both experimental (60.42%) and control (47.73%) groups. There were no significant differences in participants' characteristics (**Table 2**) and the outcome variables at baseline.

Table 2 Comparisons of the participants' characteristics between the experimental and control groups (N = 92)

Health information characteristics	Experimental group (n = 48)		Control group (n = 44)		Total		χ^2	*p*
	n	%	*n*	%	*N*	%		
Gender								1.000[a]
Female	43	89.58	39	88.64	82	89.13		
Male	5	10.42	5	11.36	10	10.87		
Age (years)							.00	1.000
Young-old (60-69)	26	54.17	23	52.27	49	53.26		
Middle-aged old (70-79)	22	45.83	21	47.73	43	46.74		
Body mass index (kg/m^2)							3.44	.328
Normal (18.5-22.9)	3	6.25	8	18.18	11	11.95		
Overweight (23-24.9)	7	14.58	7	15.91	14	15.22		
Pre-obese (25-29.9)	29	60.42	21	47.73	50	54.35		
Obese (≥30)	9	18.75	8	18.18	17	18.48		
Duration of knee osteoarthritis								.473[a]
1-10 years	45	93.75	39	88.64	84	91.30		
>10 years	3	6.25	5	11.36	8	8.70		
Duration of treatment								.421[a]
1-10 years	46	95.83	40	90.91	86	93.48		
>10 years	2	4.17	4	9.09	6	6.52		
Use of pain relief medication							1.82	.402
5-7 days/week	9	18.75	5	11.36	14	15.22		
1-4 days/week	21	43.75	25	56.82	46	50.00		
None	18	37.50	14	31.82	32	34.78		
Use of walking aids							.01	.946
Yes	15	31.25	15	34.09	30	32.61		
No	33	68.75	29	65.91	62	67.39		
Comorbidities							.98	.323
Yes	34	70.83	36	81.82	70	76.09		
No	14	29.17	8	18.18	22	23.91		

[a] Fisher's exact test

Effectiveness of the PEDCP

Table 3 and Figure 2 show that all outcome variables in the experiment group changed from the baseline in the direction as expected. There were both main effect of the intervention and interaction effect between intervention and time.

Both mean scores of the self-efficacy quadriceps exercise and diet control behaviors of the experimental group were significantly higher than that of the control group in all measure points at weeks 2, 8 and 12.

For mean scores of quadriceps muscle strength both right and left, movement ability, and health-related quality in the experimental group were significantly higher, than that of the control group, whereas the mean pain score was significantly lower at weeks 8 and 12. However, the mean body mass index score was not significantly different between the two group at both weeks 8 and 12.

As to ROM, the mean score of the right knee in the experimental group was not significantly different to the control group at week 8, however, the experimental group had significantly a higher mean score of the right knee than the control group at week 12 only. Also the mean score on the left knee in the experimental group was significantly higher than the control group at both weeks 8 and 12.

For the effect size, the findings revealed large effect sizes among groups: on self-efficacy quadriceps exercise at all time points, pain at week 12, both right and left quadriceps muscle strength and TUGT at weeks 8 and 12, and HRQOL at week 12. Also, fairly large effect sizes were observed for self-efficacy diet control at all time points, pain at week 8, left ROM at week 12, and HRQOL at week 8, as shown in Table 3.

Table 3 Main effects of PEDCP and time, interaction effect on outcomes variable, and effect size (N = 92)

Variable	Time (week)	Group		*F*Group	*F*Time	*F*Group* Time	η_p^2
		Experimental	control				
		M(*SD*)	*M*(*SD*)				
SEQE				32.56***	31.62***	17.67***	
	baseline	13.73(3.38)	13.34(4.21)				
	2	17.65(.73)	12.91(3.80)				.44
	8	17.38(1.35)	14.70(3.45)				.22
	12	17.50(1.07)	14.66(2.68)				.34
SEDC				7.12**	13.35***	11.36***	
	baseline	8.08(2.08)	8.55(2.43)				
	2	10.08(1.67)	8.70(2.37)				.11
	8	9.79(2.02)	8.25(2.19)				.12
	12	10.13(1.99)	8.73(1.95)				.11
BMI				.00	.37	4.40*	
	baseline	27.20(3.52)	27.04(4.82)				
	8	27.13(3.57)	27.14(4.84)				.00
	12	27.00(3.64)	27.18(4.90)				.00
Pain				11.35**	4.19*	16.89***	
	baseline	4.52(3.07)	4.34(3.05)				
	8	2.88(2.52)	4.70(2.31)				.12
	12	2.15(2.16)	5.20(3.08)				.25
Rt.QMS				35.00***	67.84***	46.89***	
	baseline	.82(.18)	.80(.20)				
	8	1.01(.18)	.76(.22)				.28
	12	1.23(.24)	.83(.23)				.42

Table 3 Main effects of PEDCP and time, interaction effect on outcomes variable, and effect size (N = 92) (Cont.)

Variable	Time (week)	Group		*F*Group	*F*Time	*F*Group* Time	η_p^2
		Experimental	control				
		M(*SD*)	*M*(*SD*)				
Lt.QMS				47.38***	66.82***	67.16***	
	baseline	.81(.19)	.78(.20)				
	8	1.01(.17)	.73(.26)				.29
	12	1.25(.20)	.78(.24)				.53
Rt.ROM				1.42	13.16***	12.15***	
	baseline	118.08(17.84)	119.73(13.78)				
	8	124.54(16.69)	119.18(15.64)				.03
	12	127.79(16.45)	120.09(16.50)				.05
Lt.ROM				5.33*	11.69***	12.33***	
	baseline	121.23(15.43)	120.18(12.37)				
	8	127.06(15.54)	118.23(15.99)				.07
	12	131.17(15.06)	120.27(18.08)				.10
Move				7.51**	33.77***	7.78**	
ment	baseline	12.47(5.06)	12.98(5.96)				
	8	9.49(2.53)	12.45(4.55)				.14
	12	8.31(2.37)	11.27(3.93)				.18
HRQOL				13.46***	17.46***	19.94***	
	baseline	60.10(18.54)	58.69(13.15)				
	8	71.30(17.00)	60.36(15.42)				.10
	12	77.57(16.91)	57.68(15.28)				.28

SEQE = self-efficacy quadriceps exercise; SEDC = self-efficacy diet control; BMI = body mass index; Rt. QMS = right quadriceps muscle strength; Lt. QMS = left quadriceps muscle strength; Rt. ROM = right range of motion; Lt. ROM = left range of motion; movement = movement ability by Timed-Up-and-Go Test; HRQOL = health-related quality of life. Two-way repeated MANOVA revealed overall Pilai's Trace group (p<.001), time (p<.001), and group*time (p<.001). Greenhouse-Geisser univariate are reported above. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$ for testing the significance. η_p^2 = effect size as small ($\eta_p^2 = .01$); moderate ($\eta_p^2 = .06$); or large ($\eta_p^2 = .14$)

Discussion

The results of this study indicated the effectiveness of the PEDCP on all outcome variables except body mass index. Self-efficacy quadriceps exercise and dietary control behavior of the PEDCP group (experimental group) was significantly different from the control group, which was consistent with former studies[23,24]. Notably, this latter study applied interventions based on the self-efficacy theory using four sources of self-efficacy as enactive mastery experience, vicarious experience, verbal persuasion, and physiological and affective states[7] the same as in the present study. These strategies might be the key to improving successfully the health behavior self-efficacy of the PEDCP group. Regarding the time effect on self-efficacy in this study, we suggest the beneficial effect of three combination components of giving health information especially about exercise and diet control behavior, quadriceps training exercise, and monitoring was very useful.

Monitoring with telephone calls or LINE application by the PI weekly encouraged participants to adhere to continual performance of home-based quadriceps exercise led to time impacts on desired outcomes, observed by the large effect sizes at both weeks 8 and 12. Concordantly, a previous study[23] showed that intervention programs designed by applying self-efficacy theory as a basis could improve self-efficacy during the times of measurement.

The results showed no statistically difference in body mass index between the two groups. However, the mean scores of body mass index of the experimental group decreased throughout the study, whereas it increased in the control group. Hence, losing bodyweight is not easy. It requires encouragement, discipline, self-control, and correctly understanding of nutrition and exercise. However, losing a little bit of bodyweight can help reduce pain from knee OA. Also, weight reduction by dietary control is likely to be even more difficult and use more long time. Weight control studies showed significant results for a 6-month[25] and 18-month program[26]. The experimental group tends to lose bodyweight because of performing both dietary control and exercise. The beneficial effect of the PEDCP focusing on behaviors of controlling diet results in losing weight, whereas, the control group tends to gain weight.

The participants in the PEDCP experienced statistically less pain than the control group, which has been found in previous studies[24,27]. Exercise therapy has been shown to have anti-inflammatory effects by reducing IL-6, which is a cytokine inducing an inflammation process[28]. In a study, the IL-6 and pain in the regular exercise group were significantly decreased when compared with those persons who did not perform an exercise.[28] According to the concept of the physio-biomechanical of muscle and bone joints, the strengthening of quadriceps muscle helps to pull the other muscles surrounding the knee joint, which absorbs the force to protect knee from friction and loading during movement of joints, resulting in pain reduction during physical activity[29]. Regarding the time effect on pain at only week 12, this might be due to the participants in this study having severe knee OA requiring surgery which was related to more destruction of articular cartilage of knee joint and a higher level of the inflammatory cytokines. Evidence demonstrates that exercise has an anti-inflammatory effect resulting in decreasing IL-6 and pain at week 12 follow-up[28].

The quadriceps muscle strength of the experimental group was increased significantly more than the control group, which consistent with previous studies[8,30]. Interestingly, participants in the PEDCP regularly performed quadriceps exercise 60-100 repetitions with a frequency of 3-7 days per week throughout 12 weeks. Exercise can improve the numbers of cellular mitochondria, increase capillary density, and increase the mass and strength of connective tissue[31]. Actually, exercise affects the muscle strength, which promotes actin and myosin increasing in the structure of muscle fibers resulting in improved muscle strength[31]. The duration of exercise affected quadriceps muscle strength in this study. It can be explained by the physiological exercise undertaken, which affects muscle contraction. Contracting dynamically refers to an isometric exercise; the muscle acts either shortening as a concentric contraction or lengthening as an eccentric contraction. These mechanisms are related to increasing muscle strength. Moreover, neural and muscle adaptation have a role in increasing myofibril and muscle mass resulting in the strength of muscle, which the muscle is new to strengthen at least 6 weeks[32]. In addition, the present study demonstrated the large effect sizes on both quadriceps muscle strength at weeks 8 and 12.

Regarding ROM, the left knee ROM of PEDCP had a significant difference to the control group. Yet, there was not a significantly different between groups on the right knee at week 8. One explanation is that the right knee had more severity than left knee as shown in the ROM measured at baseline; the study participants in both groups had less ability to flex their

right knee than their left knee. Literature mentions that more severity of knee OA is related to more knee joint stiffness because knee OA causes destruction of the articular cartilage, synovial tissue, subchondral bone, and meniscus, which results in limited knee joint ROM in movement[33]. However, exercise can cause changes in muscle performance by improving the stretching of the soft connective tissue, muscle, and tendon, which in turn helps increase in the flexibility and range of motion and decreases stiffness[34]. However, a longer duration of constant exercise is considered to improve muscle strength and range of motion significantly. Also, time effect on ROM in this study was shown significantly at week 12 but not for week 8. In a previous study neuromuscular training for 4-12 weeks was not significant on ROM in severe knee OA waiting for surgery when compared with the control group[35].

The movement ability of the PEDCP group was the significantly shortened time spent than the control group. This finding may be related to reduced pain, increased quadriceps muscle strength and ROM since a previous prospective study indicated that gait function was associated with physical function (knee pain and ROM) in patients with knee OA undergoing TKA[36]. Also the benefits of exercise are shown in relation to movement ability and physical ability because strengthening exercise produces increased muscle fibers and induces changes in metabolic, biochemical, and myosin of the fibers, resulting in increased muscle mass relating to improving physical movement. During exercise, the straining band of muscle fibers is widened. This mechanism improves strength and flexibility in muscles and increases ROM, which results in the improved ability of movement[37]. Regarding the time effect, there was a significant improvement of movement ability at weeks 8 and 12, congruent with previous studies regarding the exercise program[38]. These previous studies showed a significant increase in the walking speed at week 8 in patients with knee OA who performed strengthening and stretching exercises. Actually, the benefits of exercise are shown in relation to muscle strengthening and movement ability.

The HRQOL of the experimental group demonstrated significantly more improvement than the control group. This finding of the present study is consistent with a previous study[39], which showed that HRQOL was significantly increased in older adults with knee OA waiting for TKA receiving health education combined with exercise when compared to the control group. Thus improving HRQOL resulted from decreased pain and increased quadriceps muscle strength, knee ROM, and movement ability, which can decelerate the suffering from knee OA progression during waiting time. Certainly, when suffering from pain and disability were eliminated, the HRQOL increased. Accordingly, evidence underlines that the severity of knee OA progression when low physical activity is performed is related to a low health-related quality of life[40]. The present results were consistent with a previous study regarding a substantial improvement in HRQOL in patients with knee OA at week 8[38]. Notably, an increased HRQOL at week 12 was higher than at week 8. In addition, there were moderate effect sizes at week 8 and a large effect size at week 12. However, long-term satisfaction of HRQOL is an important issue for future investigation in this population.

Limitations

A limitation of our study should be taken into consideration. The participants represented only some aspects of the population of individuals possible as young-old and middle-aged old as well as the majority of females. Therefore, generalization of the intervention findings may be limited for other older adults waiting for TKA in the larger population and for males.

Conclusions and Implications for Nursing Practice and Recommendations

The findings of this study suggest that the PEDCP based on self-efficacy theory with four sources

of information consisting of giving health information, quadriceps training exercise, dietary control, and monitoring components is beneficial.

Remarkably, continued monitoring along with persuasion the participants by integrating technology—telephone and LINE application—reinforced their confidence to perform quadriceps exercise and diet control behaviors gradually although they have some barriers. The older adults waiting for TKA performed specific health behaviors, which include quadriceps exercises and diet control enhancing their positive health outcomes, including reducing pain and improving quadriceps muscle strength, ROM, movement ability, and HRQOL. Therefore, nurses and other health professionals such as physical therapists, could deliver the PEDCP for older people waiting for TKA to decelerate the disease progression and to promote their health. However, to increase the accessibility of care, further research should be conducted on various issues as follows: 1) in more span of age or all older age groups; 2) in secondary or primary hospitals in more than one setting to achieve expanding of the effectiveness of the intervention; and 3) a longitudinal effect of the intervention post-surgery.

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ประสิทธิผลของโปรแกรมการบริหารกล้ามเนื้อต้นขาร่วมกับการควบคุมอาหารก่อนการผ่าตัด ในผู้สูงอายุรอการผ่าตัดเปลี่ยนข้อเข่าเทียม: การศึกษาทดลองแบบสุ่ม

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บทคัดย่อ: ผู้ป่วยข้อเข่าเสื่อมที่รอการผ่าตัดเปลี่ยนข้อเข่าเทียมมักเผชิญกับความทุกข์ทรมานจากอาการปวดและการสูญเสียความสามารถในการทำกิจกรรม การศึกษาทดลองแบบสุ่มตัวอย่างเปรียบเทียบในครั้งนี้มีวัตถุประสงค์เพื่อศึกษาประสิทธิผลของโปรแกรมการบริหารกล้ามเนื้อต้นขาร่วมกับการควบคุมอาหารก่อนการผ่าตัด ต่อการรับรู้ความสามารถตนเองในการบริหารกล้ามเนื้อต้นขาและการควบคุมอาหาร ดัชนีมวลกาย ความปวด ความแข็งแรงของกล้ามเนื้อต้นขา การเคลื่อนไหว และคุณภาพชีวิต ในผู้สูงอายุที่รอการผ่าตัดเปลี่ยนข้อเข่าเทียม กลุ่มตัวอย่างจำนวน 96 คนได้รับการสุ่มเข้ากลุ่มทดลองหรือกลุ่มควบคุม กลุ่มละ 48 คน กลุ่มทดลองได้รับโปรแกรมการบริหารกล้ามเนื้อต้นขาร่วมกับการควบคุมอาหารก่อนการผ่าตัด และการดูแลตามปกติ ส่วนกลุ่มควบคุมได้รับการดูแลตามปกติ เครื่องมือที่ใช้ในการเก็บรวบรวมข้อมูล ได้แก่ แบบประเมินการรับรู้ความสามารถตนเอง แบบประเมินความปวดแบบตัวเลข เครื่องมือวัดความแข็งแรงของกล้ามเนื้อ เครื่องมือวัดองศาการเคลื่อนไหวข้อ การทดสอบความสามารถในการเคลื่อนไหว และแบบประเมินคุณภาพชีวิตสำหรับผู้ที่มีข้อเข่าและข้อสะโพกเสื่อม วิเคราะห์ข้อมูลด้วยสถิติวิเคราะห์ความแปรปรวนแบบวัดซ้ำสองทาง และแบบตัวแปรตามหลายตัวแปร

ผลการศึกษาพบว่า กลุ่มทดลองที่ได้รับโปรแกรมการบริหารกล้ามเนื้อต้นขาร่วมกับการควบคุมอาหารก่อนการผ่าตัด มีการรับรู้ความสามารถตนเองในการบริหารกล้ามเนื้อต้นขาและการควบคุมอาหารเพิ่มขึ้นมากกว่ากลุ่มควบคุมอย่างมีนัยสำคัญทางสถิติในสัปดาห์ที่ 2, 8, และ 12 อีกทั้งกลุ่มทดลองมีความแข็งแรงของกล้ามเนื้อต้นขา องศาการงอข้อเข่า ความสามารถในการเคลื่อนไหว และคุณภาพชีวิตเพิ่มขึ้นอย่างมีนัยสำคัญทางสถิติ ในขณะที่ความปวดลดลงอย่างมีนัยสำคัญทางสถิติ เมื่อเปรียบเทียบกับกลุ่มควบคุมที่สัปดาห์ที่ 8 และ 12 แม้ดัชนีมวลกายระหว่างกลุ่มทดลองและกลุ่มควบคุมแตกต่างกันอย่างไม่มีนัยสำคัญ จากผลการศึกษาครั้งนี้แสดงให้เห็นถึงประสิทธิผลของโปรแกรมการบริหารกล้ามเนื้อต้นขาร่วมกับการควบคุมอาหารก่อนการผ่าตัด ซึ่งสามารถนำไปใช้ในการปฏิบัติการพยาบาลดูแลผู้สูงอายุโรคข้อเข่าเสื่อมระหว่างรอการผ่าตัดเปลี่ยนข้อเข่าเทียม

Pacific Rim Int J Nurs Res 2020; 24(4) 485-501

คำสำคัญ: การควบคุมอาหาร การบริหารกล้ามเนื้อต้นขา ผลลัพธ์ทางสุขภาพ ความแข็งแรงของกล้ามเนื้อผู้สูงอายุ โปรแกรมการดูแลก่อนผ่าตัด คุณภาพชีวิต การรับรู้ความสามารถตนเอง การผ่าตัดเปลี่ยนข้อเข่าเทียม การรอผ่าตัด

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