Effects of a Cardiac Rehabilitation Program on Perceived Self-Efficacy and Physical Fitness among Thais with Coronary Artery Bypass Graft: A Quasi-Experimental Study.

Thanchanok Noopiam, Piyawan Pokpalagon, Suchira Chaiviboontham, Thumrong Kongkreangkrai*

Abstract: Cardiac rehabilitation is vital for people following cardiac surgery. Despite the proven benefits of cardiac rehabilitation, there is limited research integrating self-efficacy theory into cardiac rehabilitation programs. This quasi-experimental study aimed to evaluate the effects of such a program on perceived self-efficacy and physical fitness among Thais post-coronary artery bypass graft surgery. The sample comprised 40 participants. Firstly, the experiment group (n = 20) was recruited according to the criteria and participated in a clinical phase of the program. Then, the control group (n = 20,) who received only usual care, were recruited and followed up till the day of discharge, the same as the experimental group. Instruments for data collection were the Perceived Self-Efficacy Questionnaire; physical fitness was measured via the Six-minute Walk Test and maximal oxygen consumption. The data were analyzed using descriptive statistics, chi-square, and independent t-test.

The results showed that on the day of hospital discharge, the participants in the experimental group had perceived self-efficacy and physical fitness (the six-minute walk distance and the maximum oxygen consumption rate) significantly higher than the control group. These findings indicate that the Cardiac Rehabilitation Program effectively enhances perceived self-efficacy and physical fitness among Thais with post-coronary artery bypass graft surgery. Nurses can use this program in clinical practice among people with post-coronary artery bypass graft surgery. However, further testing with multi-settings, long-term follow-up, and the use of eHealth is required before it can be widely used.

Keywords: Cardiac rehabilitation program, Coronary artery bypass graft, Perceived self-efficacy, Physical fitness

Received 8 October 2024; Revised 20 December 2024; Accepted 23 December 2024

***Thanchanok Noopiam**, RN, MNS in Adult and Gerontological Nursing (Candidate), Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand. E-mail: chaum.nur@gmail.com*

***Corresspondence to: Piyawan Pokpalagon**,* RN, PhD, Assistant Professor, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand. E-mail: piyawan.pok@mahidol.edu*

***Suchira Chaiviboontham**, RN, PhD, Dip. APMSN Associate Professor, Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University, Thailand. E-mail: suchira.cha@mahidol.edu*

***Thumrong Kongkreangkrai**, MD, Chief of Cardio-Thoracic Surgery, Trang Hospital, Trang, Thailand. E-mail:windsman88@gmail.com*

Author contributions:

TN: Conceptualization, method and design, data collection, data analysis and interpretation, drafting the manuscript, revising the manuscript, and final approval of the manuscript

PP: Conceptualization, method and design, data analysis and interpretation, drafting the manuscript, responding to the editor, review and editing the manuscript, and final approval of the manuscript

SC: Conceptualization, method and design, data analysis and interpretation, and final approval of the manuscript

TK: Program and tool validation, and final approval of the manuscript

https://doi.org/10.60099/prijnr.2025.271551

Introduction

Cardiovascular diseases (CVDs) have been a significant public health problem and the leading cause of death at the global level for the last 20 years.[1] CVDs are now killing more people than ever before. An estimated 20.5 million people died of CVDs in 2021, considered one-third of the global deaths.[2] The world's biggest killer is ischaemic heart disease (IHD), responsible for 13% of total deaths from all causes.[3] The number of deaths from IHD has increased by more than 2.7 million since 2000 to 9.1 million in 2021.[3] In upper-middle-income countries, deaths from IHD have increased by more than 1.4 million in 2021, the second largest rise in terms of absolute number of deaths from this cause.[3] In Thailand, IHD is also the leading cause of death, with the mortality rate increasing from 31.78 to 35.07 between 2018-2022.[4]

Coronary artery bypass graft (CABG) is the gold standard and effective treatment for obstructive coronary artery disease (CAD), especially in people whose coronary arteries cannot be opened and are enlarged by other treatments. The surgery aims to help people recover from chest pain, live longer, and have a better quality of life. CABG uses an artery or vein to make a bypass by connecting the aorta to the lower coronary artery so that the bypass facilitates blood flow to the ischemic heart muscle.[5,6] According to the current situation regarding illness, the number of people needing surgery increases yearly. In Thailand, the Thai Society of Thoracic Surgeons reported that the number of people undergoing CABG increases yearly. In 2021-2023, people received CABG 5,932, 6,942, and 7,829, respectively.[7]

Conventional CABG is a highly effective treatment for coronary artery disease. However, complications and mortality may be risky.[8] Common early-stage complications after surgery include lung deflation and pleural effusion, arrhythmia, surgical wound pain, bleeding, nervous system complications, infected surgical wounds, and acute kidney failure.[9,10] Another concern is stiffness from prolonged bed rest. Such complications cause people to stay in the hospital longer and consequently increase expenses for medical treatment.[9,10]

Cardiac rehabilitation (CR) is a program composed of exercise training, physical activity promotion, health education, cardiovascular risk management, and psychological support to improve outcomes for cardiovascular patients.[11] Rehabilitation gives people a good increase in physical activity and mobility. Consequently, they can return to normal daily life as quickly as possible.[12,13] Despite evidence of cardiac rehabilitation's benefits and strong guideline recommendations, only 5-50% of people with cardiac disease receive rehabilitation.[11] Several barriers contribute to this low participation rate, such as limited availability of programs, lack of perceived need or motivation, and logistical challenges like travel distance and cost.[14,15] Previous studies have emphasized the importance of self-efficacy in CR. Interventions aimed at increasing self-efficacy have shown positive effects on maintaining health behaviors.[16] However, integrating the self-efficacy theory into CR programs and its direct impact on people's outcomes is limited.[16] Therefore, this study developed a rehabilitation program using the integrated conceptual framework of Bandura's self-efficacy theory and CR guidelines to promote perceived self-efficacy and physical fitness among PW-post CABG.

Literature Review and Conceptual Framework

The clinical phase of cardiac rehabilitation (CR), which occurs after surgery while the patient is still in the hospital, is crucial nursing care to prevent various complications and expedite recovery.[17] The rehabilitation process starts with evaluating patients' physical capabilities and motivation to tolerate rehabilitation. Nurses might begin by guiding the patient with gentle exercises in bed or at the bedside, focusing on improving their range of motion and

activities of daily living, and educating them on avoiding excessive stress.[18] People should receive systematic CR, beginning with evaluating their physical readiness and monitoring abnormalities that may occur during and after performing recovery activities. Then, healthcare providers gradually adjust the patient's recovery activities, requiring low to high energy levels to prevent heart function overload from passive mobilization to a more active range of motion and resistance exercises.[19] Cardiac rehabilitation for people following conventional CABG involves providing education, guidance, and instruction on various activities, such as breathing exercises and muscle, joint, and overall body strength training. Rehabilitation helps people significantly increase their physical activity and mobility, allowing them to return to their normal daily lives as soon as possible.[20] The meta-analysis reveals that engaging in CR significantly benefits individuals with CAD undergoing contemporary medical treatments. Specifically, it demonstrates a marked reduction in cardiovascular mortality rates, decreased recurrent cardiac events, and fewer hospitalizations. Furthermore, this analysis highlights the positive impact of CR on health-related quality of life and its cost-effectiveness.[21] A strong evidence base supports CR as an effective and cost-efficient treatment for people with acute coronary syndrome and after coronary revascularization. However, to perform those physical activities, these people must be confident to do them. Therefore, encouraging individuals to continue these activities and providing instruction on performing rehabilitation exercises properly is crucial.

The conceptual framework of Bandura's self-efficacy theory[22] was used to develop a program to promote CR in people after conventional CABG to increase their self-efficacy in their physical rehabilitation. This self-efficacy includes the ability to do various activities, consisting of four components: mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states. Our CR program is intended to help people recognize their abilities and perform rehabilitation activities confidently with expected better outcomes.

Study Aim and Hypothesis

This study aimed to test the effects of the CR program on perceived self-efficacy and physical fitness (the six-minute walk distance and the maximum oxygen consumption rate) among people with post-CABG (PW-post CABG) with the following hypothesis: people with PW-post CABG in the experimental group receiving the cardiac rehabilitation program would have mean scores on perceived self-efficacy and physical fitness higher than those in the control group received only usual care at the day of hospital discharge.

Methods

Design: A quasi-experimental design was used. This report follows the Transparent Reporting of Evaluation with Non-randomized Designs (TREND) checklist as a guideline.

Sample and Setting: The participants consisted of people with coronary artery disease (PW-CAD) who were treated for the first time with conventional CABG. These PW-CAD had appointments for CABG in advance (elective surgery). They were admitted to the cardiac and thoracic surgery intensive care unit, surgery ward, and special-private-room ward of a tertiary-level hospital in southern Thailand.

Eligibility criteria included PW-CAD aged 18-80 years. If aged over 60 years, they must have passed the cognitive functional test measured with the Six Item Cognitive Impairment Test: 6CIT.[23] Additionally, participants needed to be conscious and orientated to date, time, place, and person, could communicate and understand the Thai language, have no limitations in moving the body and walking, did not have a disease or disability that affected performing CR activities and were in the New York Heart Association (NYHA)[24] functional class at the 1st-3rd level before surgery.

Participants were excluded if their endotracheal tube was not removed within three days after the surgery, had severe complications after surgery, such as severe arrhythmia or a nervous system disorder, underwent reoperation to correct complications or abnormalities, had a cardiac arrest while being treated in the hospital, or had a disease or condition that affected CR.

The sample size was adequately calculated using the G*Power program.[25] Based on power analysis and effect size determinations,[26] the required sample size was established at 40 participants. This determination was made with a one-tailed significance level of 0.05, a power of 0.80, and an effect size of 0.82, derived from prior research.[26] To account for an attrition rate of 10% during the trial, the total cohort size needed for this study was 44. Participants who met the inclusion criteria were recruited through convenience sampling; the first 22 were assigned to the experimental group and completed the CR Program, and the latter 22 were in the control group.

Ethical Considerations: The study was approved by the Institutional Review Board of the Faculty of Medicine Ramathibodi Hospital, Mahidol University (Approval No. COA. MURA2022/54), and the studied hospital (Approval No. ID 003/02-2565). All participants were informed of the study's objectives and procedures and completed written consent forms. They were assured of confidentiality and their right to withdraw at any time. Each participant was assigned a unique number code to protect their anonymity, and personal information was kept secure. The results were presented in general terms to maintain privacy while sharing the findings.

Research Instruments: Three instruments were used for screening, three for data collection, and the CR intervention program.

Instruments for screening:

1. *The Six-Item Cognitive Impairment Test* (6CIT), developed by Brooke and Bullock,[27] was translated into Thai by Aree-Ue and Youngcharoen.[23] The 6CIT was used to screen the cognitive impairment of people over 60 years prior to the study.[23] The 6CIT comprises six items that are categorized into three aspects: surrounding circumstance perception [3 items], attention [2 items], and memory [1 item]. Each item is scored on a scale from 0 to 10.[23] The total score ranges from 0 to 28 points. A score that exceeds 7 indicates an elevated risk of developing cognitive impairment.[23] Upon its translation into the Thai language, the 6CIT underwent rigorous testing to establish its reliability and validity. Notably, the content validity index for scales (S-CVI) and item validity context (I-CVI) of 1 were reported as good. The instrument's concurrent validity was measured against the established Mini-Cog test, resulting in an acceptable correlation ($rs = -0.42$, $p < 0.001$).[23] The stability of the measure was further confirmed through test-retest reliability, which demonstrated a significant positive correlation over two weeks, indicating that the assessment produces consistent results when administered at different times.[23]

2. *A Physical Readiness Assessment Form* was developed by the PI to assess physical readiness before performing CR activities. This questionnaire was reviewed by five experts, including a cardiothoracic surgeon, two nursing professors, a clinical nurse specialist, and a physical therapist. After receiving content verification from the experts, it would be considered per-item based on their feedback. There were nine criteria to be evaluated as follows (If all criteria were met, the participants were ready to perform CR):

i. Blood pressure (BP): Should meet both SBP and DBP criteria—SBP ≤ 160 mmHg and DBP ≤ 110 mmHg;

ii. Blood pressure (BP) ≤ 20 mmHg lower than usual when changing from a lying position to a sitting position or from a sitting position to a standing position;

iii. Heart rate (HR) ≤ 100 bpm;

iv. No cardiac arrhythmia (from the EKG monitor): If there is no monitor, the exercise therapist (nurse) uses the pulse rate from palpation;

v. Blood oxygen saturation (O_2 saturation) ≥ 95 %;

vi. Tiredness level score (Borg's scale) ≤ 13 points;

vii. Wound pain level less than 4 points;

viii. No unstable angina; and

ix. No abnormal symptoms, such as dizziness, heart palpitations, fainting, and shortness of breath.

3. *The Symptom Assessment Form during CR Activities* was developed by the PI to assess symptoms and vital signs during CR activities. If any abnormal symptoms were found during the CR activities, the participants had to stop the exercise immediately. This instrument was reviewed by the same expert group that reviewed the first instrument. After receiving content verification from the experts, it would be considered per-item based on their feedback.

i. Symptoms of dizziness, staggering, paleness, cyanosis, difficulty breathing, nausea and vomiting, and chest pain;

ii. Tiredness level score (Borg's scale) > 13 points;

iii. Blood pressure (BP) increased > 180/110 mmHg or decreased > 20 mmHg, compared with the blood pressure before starting CR activities;

iv. Heart rate (HR) > 120 bpm or increased > 20-30 bpm or decreased > 10 bpm, compared with the heart rate before starting CR activities;

v. Cardiac arrhythmia (from the EKG monitor): If there is no monitor, the exercise therapist (nurse) uses the pulse rate from palpation; and

vi. Blood oxygen saturation (O_2 saturation) < 95%.

Instruments for data collection:

1. *The Personal Information Record Form* consists of two parts: Part 1 collects sociodemographic data, including gender, age, marital status, religion, education level, occupation, monthly family income, and weight and height. Part 2 collects clinical data, including diagnosis, type of surgery, ICU length of stay, comorbidity, preoperative NYHA functional class, ejection fraction, severity level of angina, and surgical record data.

2. *The Perceived Self-efficacy Questionnaire* (PSEQ) was developed by the PI in Thai language. The PSEQ is composed of a 15-item (e.g., I can sit with my head elevated at a 60-90 degree angle on the bed for 15-30 minutes.), a five-point Likert scale from one (not at all confident) to five (very confident). The total scores range from 15-75; higher scores represent higher confidence levels. The PSEQ was validated by the same experts for the appropriateness of contents. The content validity index (CVI) was 0.93. Then, the questionnaire was pilot-tested with 10 participants who met the same criteria as the participants in the main study. Cronbach's alpha coefficient was 0.86 for the pilot sample and 0.95 for the main study.

3. The Six-Minute Walk Test (6MWT) and The Maximum Oxygen Consumption Rate (VO2max) assessed participants' physical fitness. The 6MWT measured the walking distance on a flat surface in six minutes. The primary measurement is the six-minute walk distance (6MWD). The maximum oxygen consumption rate (VO2max) is calculated as follows: VO2 max = (0.03 x 6MWD) + 3.98. The PI was trained with a physical therapist to assess these two measures until the inter-rater reliability between the PI and the physical therapist was 1.00.

The Cardiac Rehabilitation Program (CR Program) consisted of pre-operative and post-operative periods. It was developed based on Bandura's self-efficacy theory,[22] which consists of four sources of self-efficacy: 1) mastery experiences: the PI provides knowledge and training the participants to perform CR activities by demonstrating to the participants and having them perform a return demonstration to increase their confidence in practicing; 2) vicarious experience: the PI presented a role model of patients successfully demonstrating rehabilitation activities through video media so that they can estimate their chances of success when performing similar activities. Seeing similar others succeed through sustained effort raises participants' beliefs about their capabilities;[6] 3) verbal persuasions: the PI visited the patients and gave them words of

encouragement to make them feel confident and realize their ability to perform these activities. Persuasive boosts in perceived self-efficacy led participants to try hard enough to succeed and promote a sense of personal efficacy;[7] and 4) physiological and emotional states: the PI assessed physical readiness before CR to reduce participants' stress reactions and alter their negative emotional biases and misinterpretations of their physical states and provided emotional support. Hence, a positive mood enhances perceived self-efficacy.[7] The intervention and implementations are shown in **Appendix, Figure 1.** The CR program was reviewed by the same experts who reviewed the instruments. After receiving content verification from the experts, it was used for trial on three PW-post CABG with characteristics similar to those of the sample group.

Usual care: The participants in both groups received usual nursing care according to the hospital's standards for caring for people undergoing conventional CABG. They received this information from the medical team and nurses in the unit/wards, as well as information about the surgery from the ward nurses. The physical therapists trained them step-by-step in the CR activities (only on business days), and ward nurses encouraged them to perform daily activities along with the medical regimen. The CR activities would be voluntary and to the participants' ability. On the day of discharge, they received brief information and a booklet (i.e., wound care, medication administration, abnormal signs and symptoms, and follow-up appointments) from a nurse or pharmacist.

Data Collection: This quasi-experimental study was conducted in PW-CAD undergoing conventional CABG at a tertiary-level hospital in the southern region of Thailand from March to November 2022 after the IRB approval. The PI explained the study purpose, study procedures, the participant's rights, and the potential benefits and risks of the study to the participants. After the participants had signed the written informed consent form, clinical data were collected from the patient's medical records, and demographic data were collected by interviewing the participants. The PI ran the study in the experimental group first to prevent data contamination. The PI provided the intervention for the experimental group and also collected the data on self-efficacy and physical fitness in both groups using the 6MWT and VO2 max on the day of discharge from the hospital.

Data Analysis: All statistical analyses were performed using the SPSS statistical software package (v.21.0.0). The data were cleaned and coded before being entered into the computer program, and a level of statistical significance of 0.05 was adopted. Descriptive statistics were first used to evaluate the sociodemographic data. A statistical analysis was then performed on the data. The Chi-square test was used to compare the characteristics of both groups, and the independent t-test was used with the statistical assumption being met to compare the mean differences in the perceived self-efficacy and physical fitness between the experimental and control groups.

Results

At the beginning, there were 44 participants, 22 in each group. During the study, 4 participants were excluded (two in the experimental group and two in the control group). In both groups, one in each was unable to have the endotracheal tube removed within three days. For the experimental group, one required a repeat surgery to correct the bleeding, while in the control group, one developed a stroke. Therefore, 40 participants remained in the study: 20 in the experimental group and 20 in the control group. Eighty percent of the participants were males in the control group, and 70% were males in the experimental group. The control group had an average age of 58.75 years (SD = 10.14), and the experimental group had an average age of 58.95 years (SD = 9.58). The Chi-square test showed no significant differences in sociodemographic characteristics of the participants (**Table 1**) and clinical characteristics (body mass index, smoking history, diagnosis, type of surgery, length of ICU stay, comorbidities, preoperative cardiac performance, and blood vessels used for CABG) (**Table 2**) between groups ($p > 0.05$).

Table 1. Comparison of the sociodemographic characteristics according to groups

Characteristics	Control group (n = 20)		Experimental group (n = 20)		p-value
	n	%	n	%	
Sex					
Male	16	80.0	14	70.0	0.715
Female	4	20.0	6	30.0	
Age (Mean, SD)	58.75 ± 10.14		58.95 ± 9.58		
18-60 years	11	55.0	11	55.0	1.000
61-80 years	9	45.0	9	45.0	
Marital status					
Single	0	0	1	5.0	1.000
Married/Couple	20	100.0	19	95.0	
Religion					
Buddhist	17	85.0	19	95.0	0.605
Muslim	3	15.0	1	5.0	
Education level					
Primary education	4	20.0	7	35.0	0.652
Junior high school	10	50.0	7	35.0	
Secondary school	5	25.0	4	20.0	
Bachelor's degree	1	5.0	1	5.0	
Others	0	0	1	5.0	
Occupation					
Not working	4	20.0	4	20.0	0.440
Farmers	2	10.0	4	20.0	
General employment	4	20.0	3	15.0	
Civil servants/ government employees	5	25.0	1	5.0	
Sellers	5	25.0	7	35.0	
Others	0	0	1	5.0	
Income [Baht (USD)]					
< 20,000 (< 580 USD)	6	30.0	5	25.0	0.540
20,000-40,000 (580-1158 USD)	13	65.0	15	75.0	
> 40,000 (> 1158 USD)	1	5.0	0	0	

Note. A significant level is established at $p < 0.05$

Table 2. Comparison of the clinical characteristics according to groups

Characteristics	Control group (n = 20)		Experimental group (n = 20)		p-value
	n	%	n	%	
Body mass index (kg/m^2)					
< 18.50	1	5.0	2	10.0	0.277
18.50-22.90	10	50.0	5	25.0	
23.00-24.90	5	25.0	3	15.0	
25.00-29.90	3	15.0	7	35.0	
> 29.90	1	5.0	3	15.0	

Table 2. Comparison of the clinical characteristics according to groups (Cont.)

Characteristics	Control group (n = 20)		Experimental group (n = 20)		p-value
	n	%	n	%	
Smoking history					
No	7	35.0	8	40.0	1.000
Yes	13	65.0	12	60.0	
Diagnosis					
Double vessel disease	7	35.0	4	20.0	0.479
Triple vessel disease	13	65.0	16	80.0	
Type of surgery					
Double bypass surgery	7	35.0	4	20.0	0.303
Triple bypass surgery	12	60.0	16	80.0	
Quadruple bypass surgery	1	5.0	0	0	
Length of CVT-ICU stay					
2 days	7	35.0	11	55.0	0.340
3 days	13	65.0	9	45.0	
Comorbidities					
Diabetes	0	0	0	0	0.215
High blood pressure	1	5.0	0	0	
Hyperlipidemia	3	15.0	0	0	
Others	1	5.0	1	5.0	
More than 1 disease	15	75.0	19	95.0	
NYHA classification					
Class I	3	15.0	4	20.0	0.337
Class II	15	75.0	16	80.0	
Class III	2	10.0	0	0	
Ejection fraction					
< 30%	2	10.0	2	10.0	0.974
30-40%	5	25.0	4	20.0	
41-50%	4	20.0	5	25.0	
> 50%	9	45.0	9	45.0	
CCSCS					
Class 1	3	15.0	4	20.0	0.337
Class 2	15	75.0	16	80.0	
Class 3	2	10.0	0	0	
Location of vessels used*					
Saphenous vein graft	20	100	20	100	1.000
Internal mammary artery	20	100	19	95.0	
Radial artery	5	25.0	5	25.0	

Note. A significant level is established at $p < 0.05$

*Location of vessels used, one person can hold more than one location.

CABG = Coronary artery bypass graft surgery, CVT-ICU = Cardiovascular Thoracic Intensive Care Unit, NYHA = New York Heart Association, CCSCS = Canadian Cardiovascular Society Classification System

Effectiveness of the CR Program

As shown in **Table 3,** the mean score of perceived self-efficacy of the experimental group (4.38 ± 0.39) was significantly higher than that of the control group (3.91 ± 0.45) ($p < 0.05$). For physical fitness, the mean distance of 6MWD of the experimental (258.00 ± 40.01 m) was significantly longer than that of the control group (227.90 ± 30.88 m) ($p < 0.05$). Furthermore, the means of VO2 max of the experimental group (11.71 ± 1.19 mL/kg/min) was significantly higher than that of the control group (10.81 ± 0.92 mL/kg/min) ($p < 0.05$).

Table 3. Comparison of perceived self-efficacy, 6MWD, and maximum oxygen consumption (VO2 max) mean scores by groups

	Mean	SD	t	p-value
Perceived self-efficacy				
Control group	3.91	0.45	3.458	0.001
Experimental group	4.38	0.39		
6MWD				
Control group	227.90	30.88	2.663	0.011
Experimental group	258.00	40.01		
VO2 max				
Control group	10.81	0.92	2.656	0.012
Experimental group	11.71	1.19		

Note. A significant level is established at $p < 0.05$.

Discussion

Our study demonstrated the effectiveness of the CR Program in increasing perceived self-efficacy and increased physical fitness, which supports our hypotheses. Our finding was supported by numerous studies indicating that self-efficacy-based intervention effectively enhances self-efficacy in PW-CAD,[30,31] and persons post-heart surgery.[32,33] These results could be explained by the fact that the CR program was based on the concepts of Bandura's self-efficacy theory,[22] which provided knowledge and training skills programs for patients, including teaching, demonstrating, and providing feedback. The CR program presented a role model of a successful CR patient demonstrating rehabilitation activities through video media so that the participants can estimate their chances of success when performing similar activities; seeing similar others succeed through sustained effort raises participants' beliefs about their capabilities. Additionally, motivational discussions are held to encourage patients and build their confidence, helping them follow the rehabilitation program successfully. These sources of self-efficacy could increase their self-efficacy and emphasize the importance of CR, resulting in higher self-efficacy in the experimental group than in the control group. Based on these explanations, Bandura's self-efficacy theory is a useful framework for CR.

Also, the participants in the experimental group could walk longer distances in six minutes (6MWD) and had maximum oxygen consumption (VO2 max) than in the control group. This can be explained by the fact that the experimental group received a CR program, including efficient respiratory and lung exercises, effective coughing techniques, and muscle training for the arms, legs, wrists, and ankles. This program also involves practicing sitting, standing, walking, and climbing stairs, allowing the body to recover efficiently without displaying signs of fatigue and facilitating a

rapid return to a normal state. This indicates a high level of physical fitness.[34,35] Performing CR activities helps improve cardiac performance and the circulatory system. It is an important factor indicating the body's ability to use oxygen. The highest ability to use oxygen (VO2 max) reflects the good health condition of the heart in pumping blood to various parts of the body efficiently so that various muscle cells can carry oxygen to produce energy well. Consequently, the body has well-coordinated respiratory and circulatory systems and can move large muscles to work well together, resulting in good health.[35,36]

Previous studies supported our findings that after people with CABG who participated in the early exercise rehabilitation program had 6MWT and maximal oxygen consumption (VO2 max) significantly higher than those in the control group,[8] and the participants who received a self-efficacy program were able to perform daily functions significantly higher than those in the control group.[37] Correspondingly, a study of the effects of 8-week CR aerobic exercise found that the functional capacity and injection fraction in the experimental group that received 8-week CR aerobic exercise increased significantly in the post-exercise period compared to the pre-exercise period, and there was a significant difference between the changes in functional capacity and injection fraction between the two groups.[38] Another study also found that primary heart patients enrolled in a CR exercise program increased 6MWD, and the average distance the patients could walk after CR was significantly longer than before CR.[39] Similarly, a randomized clinical trial investigated the effect of different rehabilitation protocols in inpatient CR after CABG revealed that the VO2 max was statistically higher in the group receiving muscle-breathing training and upper and lower limb exercise training than in the control group.[40] Moreover, a meta-analysis examining the impact of CR on cardiopulmonary function after CABG found that participating in CR within one week after CABG led to greater improvement in peak VO2, workload, resting heart rate (HR), peak HR, and 6MWD compared to those who started CR more than a week after CABG.[14] CR after CABG can effectively enhance cardiopulmonary function, as demonstrated by increased peak oxygen consumption, improvements in 6MWD, and reductions in resting HR.[14] Therefore, it is recommended that people who have undergone CABG participate in CR to improve their cardiopulmonary function. Additionally, education should be provided to enhance their self-efficacy regarding this beneficial intervention.

Limitations and Recommendations

There were a number of limitations in this study. Firstly, the participants were recruited from a single-site setting; thus, generalization is limited. Secondly, perceived self-efficacy and physical fitness were assessed at only one time point, so the long-term effect of the program could not be warranted. Thirdly, the potential bias was that the PI provided both intervention and data collection. Thus, future studies should conduct long-term follow-ups to assess the outcomes of continuous home-based cardiac rehabilitation programs over extended periods, focusing on involving the relatives in their care to attain improved outcomes in cardiac rehabilitation and using eHealth to provide continuous care.

Conclusions and Implications for Nursing Practice

The results indicate that a clinical phase cardiac rehabilitation program can benefit people following conventional CABG, helping them achieve a better recovery. This study's findings have significant practical implications for the fields of CR and nursing, providing a clear guideline for the clinical practice of CR, especially for people after CABG.

Therefore, nurses can apply for this CR Program with PW-CABG as early as possible during their cardiac recovery. However, further testing of the

program with different samples in different settings is required before widespread implementation into practice. Nurses need to be involved in such research to improve outcomes for patients requiring cardiac rehabilitation.

Acknowledgments

We would like to express our sincere gratitude to all participants in this study and are deeply appreciative of the funding support provided by the Ramathibodi School of Nursing, Faculty of Medicine Ramathibodi Hospital, Mahidol University.

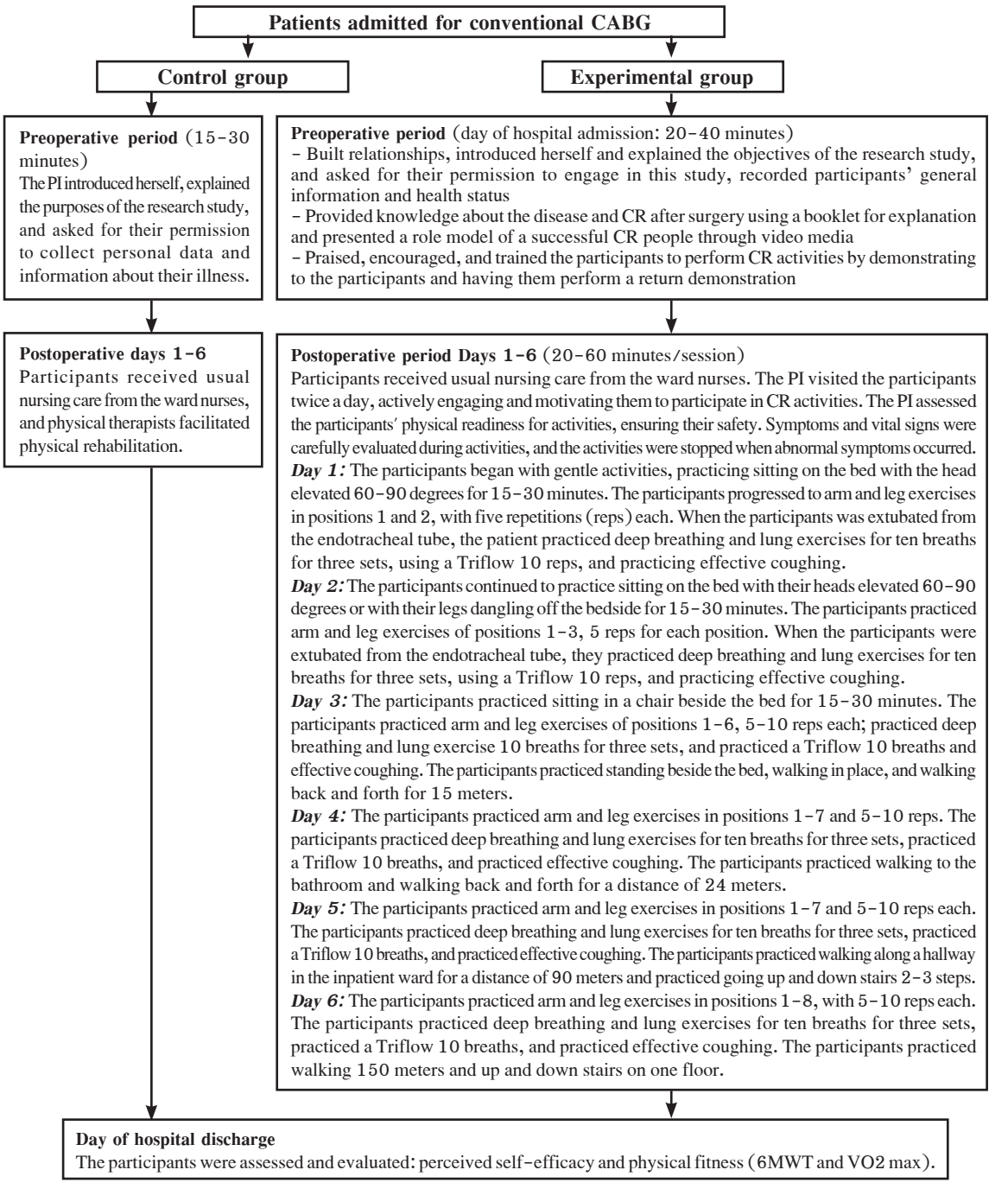
References

1. Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera SF, Abyu G, et al. Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. J Am Coll Cardiol. 2017;70(1):1-25. doi: 10.1016/j.jacc.2017.04.052.
2. World Heart Federation. World Heart Report 2023 [Internet]. 2023 [cited 2024 Dec 1]. Available from: https://www.world-heart-federation.org/resource/world-heart-report-2023/
3. World Health Organization. The top 10 causes of death 2024 [Internet]. 2024 Aug 7 [cited 2024 Dec 1]. Available from: https://www.who.int/news-room/fact-sheets/detail/the-top-10-causes-of-death
4. Department of Disease Control, Ministry of Public Health Thailand. Number and mortality rate, noncommunicable diseases year 2018-2022 [Internet]. 2024 Jan 11 [cited 2024 Dec 1]. Available from: https://www.ddc.moph.go.th/dncd/news.php?news=39911 (in Thai).
5. Dimeling G, Bakaeen L, Khatri J, Bakaeen FG. CABG: when, why, and how? Cleve Clin J Med. 2021;88(5):295-303. doi:10.3949/ccjm.88a.20115.
6. Ghandakly EC, Iacona GM, Bakaeen FG. Coronary artery surgery: past, present, and future. Rambam Maimonides Med J. 2024;15(1)::e0001. doi: 10.5041/RMMJ.10515.
7. The Society of Thoracic Surgeons of Thailand. Heart surgery statistics in Thailand in 2023 [Internet]. 2024 Feb 14 [cited 2024 Dec 1]. Available from: https://www.thaists.or.th/ (in Thai).
8. McNichols B, Spratt JR, George J, Rizzi S, Manning EW, Park K. Coronary artery bypass: review of surgical techniques and impact on long-term revascularization outcomes. Cardiol Ther. 2021;10(1):89-109. doi: 10.1007/s40119-021-00211-z.
9. Jawitz OK, Gulack BC, Brennan JM, Thibault DP, Wang A, O'Brien SM, et al. Association of postoperative complications and outcomes following coronary artery bypass grafting. Am Heart J. 2020;222:220-8. doi: 10.1016/j.ahj.2020.02.002.
10. Montrief T, Koyfman A, Long B. Coronary artery bypass graft surgery complications: a review for emergency clinicians. Am J Emerg Med. 2018;36(12):2289-97. doi: 10.1016/j.ajem.2018.09.014.
11. Taylor RS, Dalal HM, McDonagh STJ. The role of cardiac rehabilitation in improving cardiovascular outcomes. Nat Rev Cardiol. 2022;19(3):180-94. doi: 10.1038/s41569-021-00611-7.
12. Miao J, Yang H, Shi R, Wang C. The effect of cardiac rehabilitation on cardiopulmonary function after coronary artery bypass grafting: a systematic review and meta-analysis. iScience. 2023;26(12):107861. doi: 10.1016/j.isci.2023.107861.
13. Shan R, Zhang L, Zhu Y, Ben L, Xin Y, Wang F, et al. Effect of early exercise rehabilitation on cardiopulmonary function and quality of life in patients after coronary artery bypass grafting. Contrast Media Mol Imaging. 2022;2022:4590037. doi: 10.1155/2022/4590037.
14. Sérvio TC, Britto RR, Ghisi GLM, Silva LPD, Silva LDN, Lima MMO, et al. Barriers to cardiac rehabilitation delivery in a low-resource setting from the perspective of healthcare administrators, rehabilitation providers, and cardiac patients. BMC Health Serv Res. 2019;19:615. doi: 10.1186/s12913-019-4463-9.
15. Thomas RJ. Cardiac rehabilitation—challenges, advances, and the road ahead. N Engl J Med. 2024;390(9):830-41. doi: 10.1056/NEJMra2302291.
16. Walters R, Leslie SJ, Sixsmith J, Gorely T. Health literacy for cardiac rehabilitation: an examination of associated illness perceptions, self-efficacy, motivation and physical activity. Int J Environ Res Public Health. 2020;17(22):8641. doi: 10.3390/ijerph17228641.

17. Wang SR, Zhou K, Zhang W. Application progress of nursing intervention in cardiac surgery. World J Clin Cases. 2023; 11(33):7943-50. doi: 10.12998/wjcc.v11.i33.7943.
18. Tessler J, Bordoni B. Cardiac rehabilitation. 2023 Jun 4. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024. PMID: 30725881.
19. Kourek C, Dimopoulos S. Cardiac rehabilitation after cardiac surgery: an important underutilized treatment strategy. World J Cardiol. 2024;16(2):67-72. doi: 10.4330/wjc.v16.i2.67.
20. Piathip D, Liangchawengwong S, Satdhabudha O. The effects of enhancing self-efficacy in early cardiac rehabilitation program on physical outcomes and anxiety among patients post coronary artery bypass graft surgery. JRN-MHS. 2018; 38(3):12-24. Available from: https://he02.tci-thaijo.org/index.php/nur-psu/article/view/148282 (in Thai).
21. Dibben GO, Faulkner J, Oldridge N, Rees K, Thompson DR, Zwisler A-D, et al. Exercise-based cardiac rehabilitation for coronary heart disease: a meta-analysis. Eur Heart J. 2023; 44(6):452-69. doi: 10.1093/eurheartj/ehac747.
22. Bandura A. Self-efficacy: the exercise of control. New York: WH Freeman; 1997.
23. Aree-Ue S, Youngcharoen P. The 6 Item Cognitive Function Test- Thai Version: psychometric property testing. Rama Nurs J. 2020;26(2):188-202. available from: https://he02.tci-thaijo.org/index.php/RNJ/article/view/217560 (in Thai).
24. The Criteria Committee of the New York Heart Association. Nomenclature and criteria for diagnosis of diseases of the heart and great vessels. 9th edition. Boston: Little, Brown & Co; 1994.
25. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175-91. doi: 10.3758/bf03193146.
26. Ahmed HH, Ibrahim YM, El Soussi AH, El Said MM, editors. The effect of early activity on patients outcome after open heart surgery. AJAIC. 2006;9(3):34-43.
27. Brooke P, Bullock R. Validation of a 6 item cognitive impairment test with a view to primary care usage. Int J Geriatr Psychiatry. 1999;14(11):936-40. PMID: 10556864.
28. Wood R, Bandura A. Social cognitive theory of organizational management. Acad Manag Rev. 1989;14(3):361-84. doi:10.5465/AMR.1989.4279067.
29. Bandura A. Self-efficacy. In: Ramachandran VS, editor. Encyclopedia of human behavior 4. New York: Academic Press; 1994. pp. 71-81.
30. Umarangsee P, Unaphak N. The effect of perceived self-efficacy promoting program of bradycardia patients treated by permanent pacemaker implantation in Udonthani Hospital. Udonthani Hosp Med J. 2020;28(3):397-412. Available from: https://he02.tci-thaijo.org/index.php/udhhosmj/article/view/248517/169015 (in Thai).
31. Vibulchai N, Thanasilp S, Preechawong S. Randomized controlled trial of a self-efficacy enhancement program for the cardiac rehabilitation of Thai patients with myocardial infarction. Nurs Health Sci. 2016;18(2):188-95. doi: 10.1111/nhs.12243.
32. Pilab S, Binhosen V, Pakdevong N. Effectiveness of an enhancing self-efficacy in phase I cardiac rehabilitation program on physical fitness among older persons post open heart surgery. J Nurs Healthc. 2019;37(3):192-200. Available from: https://he01.tci-thaijo.org/index.php/jnat-ned/article/view/219756/152055 (in Thai).
33. Borzou SR, Amiri S, Salavati M, Soltanian AR, Safarpoor G. Effects of the first phase of cardiac rehabilitation training on self-efficacy among patients undergoing coronary artery bypass graft surgery. J Tehran Heart Cent. 2018;13(3): 126-31. PMID: 30745925.
34. Dewi IP, Dewi KP, Tanojo T, Mulia EPB, Adriana M. Pearls of exercise-based cardiac rehabilitation frame in post coronary artery bypass graft. Anaesth Pain Intensive Care. 2021;25(3):367-75. doi:10.35975/apic.v25i3.1383.
35. Moneruzzaman M, Sun WZ, Changwe GJ, Wang YH. Efficacy of multiple exercise therapy after coronary artery bypass graft: a systematic review of randomized control trials. Rev Cardiovasc Med. 2023;24(5):141. doi: 10.31083/j.rcm2405141.
36. Suksuwan C, Deerod P. The highest oxygen utilization capacity of physical Thailand national team judoist. TAHPER. 2020;46(1):212-21 (in Thai).
37. Onpetch P, Ua-Kit N. The effect of self-efficacy program on functional capacity among patients with post coronary artery bypass graft. Thai J Cardio-Thoracic Nurs. 2022; 32(2):89-104. Available from: https://he02.tci-thaijo.org/index.php/journalthaicvtnurse/article/view/244682/174688 (in Thai).

38. Behzad KM, Tofighi AA, Tolouei AJ, Hosseini SH, Madani Z. The effect of cardiac rehabilitation exercises on functional capacity and ejection fraction in patients after coronary artery bypass graft surgery. Razi J Med Sci. 2020;27(7): 130-9. Available from: https://sid.ir/paper/409143/en
39. Rodphothong P, Rangkra S, Pasanam J. The 6-min walk test and quality of life in heart patients participated cardiac rehabilitation clinic, King Chulalongkorn Memorial Hospital. Chula Med J. 2017;61(6):731-43. Available from: https://he05.tci-thaijo.org/index.php/CMJ/article/view/487 (in Thai).
40. Zanini M, Nery RM, de Lima JB, Buhler RP, da Silveira AD, Stein R. Effects of different rehabilitation protocols in inpatient cardiac rehabilitation after coronary artery bypass graft surgery: a randomized clinical trial. J Cardiopulm Rehabil Prev. 2019;39(6):E19-25. doi: 10.1097/HCR.0000000000000431.

Appendix



Appendix Figure A1. Research procedures and data collection in the control and experimental groups

ผลของโปรแกรมฟื้นฟูสมรรถภาพหัวใจต่อการรับรู้สมรรถนะแห่งตนและสมรรถภาพร่างกายของคนไทยที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ : การศึกษากึ่งทดลอง

ธันย์ชนก หนูเปี่ยม ปิยะวรรณ โภคพลากรณ์ สุชิรา ชัยวิบูลย์ธรรม ธำรง ก้องเกรียงไกร*

บทคัดย่อ: การฟื้นฟูหัวใจเป็นการดูแลรักษาที่มีความสำคัญสำหรับผู้ที่ได้รับการผ่าตัดหัวใจ แม้ว่าการฟื้นฟูสมรรถภาพหัวใจจะมีประโยชน์ แต่ยังขาดงานวิจัยที่บูรณาการแนวคิดทฤษฎีการรับรู้สมรรถนะแห่งตนเข้ากับโปรแกรมการฟื้นฟูสมรรถภาพหัวใจ และศึกษาผลของโปรแกรมต่อการรับรู้สมรรถนะแห่งตนและสมรรถภาพร่างกายในคนไทยที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ การศึกษากึ่งทดลองครั้งนี้ มีวัตถุประสงค์เพื่อศึกษาผลของโปรแกรมฟื้นฟูสมรรถภาพหัวใจต่อการรับรู้สมรรถนะแห่งตนและสมรรถภาพร่างกายของคนไทยที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ กลุ่มตัวอย่างเป็นผู้ที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ จำนวน 40 ราย กลุ่มแรกเป็นกลุ่มทดลอง 20 ราย คัดเลือกแบบเฉพาะเจาะจงตามคุณสมบัติที่กำหนดและได้รับโปรแกรมฟื้นฟูสมรรถภาพหัวใจตามแนวคิดทฤษฎีการรับรู้สมรรถนะแห่งตนของแบนดูรา ตามด้วยกลุ่มควบคุม 20 รายที่ได้รับการพยาบาลตามปกติ ได้รับการคัดเลือกแบบเฉพาะเจาะจง และติดตามจนถึงวันจำหน่ายออกจากโรงพยาบาลเช่นเดียวกับกลุ่มทดลอง เครื่องมือที่ใช้ในการเก็บรวบรวมข้อมูลประกอบด้วย แบบบันทึกข้อมูลส่วนบุคคล แบบประเมินการรับรู้สมรรถนะแห่งตน และแบบประเมินสมรรถภาพร่างกายด้วยการเดินบนพื้นราบใน 6 นาที และอัตราการใช้ออกซิเจนสูงสุด วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา สถิติไคสแควร์ และสถิติทีอิสระ

ผลการศึกษาพบว่าในวันจำหน่ายจากโรงพยาบาล ผู้ที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจในกลุ่มที่เข้าร่วมโปรแกรมฟื้นฟูสมรรถภาพหัวใจมีการรับรู้สมรรถนะแห่งตน และสมรรถภาพร่างกาย (ระยะทางการเดิน 6 นาทีและอัตราการใช้ออกซิเจนสูงสุด) สูงกว่ากลุ่มที่ได้รับการพยาบาลตามปกติอย่างมีนัยสำคัญทางสถิติ ผลการศึกษาชี้ให้เห็นว่าโปรแกรมฟื้นฟูสมรรถภาพหัวใจมีผลทางบวกต่อการรับรู้สมรรถนะแห่งตนและสมรรถภาพร่างกายในคนไทยที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ พยาบาลสามารถนำไปใช้เป็นแนวทางในการปฏิบัติการพยาบาลเพื่อฟื้นฟูสมรรถภาพหัวใจในผู้ที่ได้รับการผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ อย่างไรก็ตาม ควรมีการศึกษาเพิ่มเติมในบริบทต่างๆ การติดตามระยะยาว และการใช้เทคโนโลยีสารสนเทศเพื่อการดูแลสุขภาพก่อนที่จะนำไปใช้อย่างกว้างขวาง

Pacific Rim Int J Nurs Res 2025; 29(2) 291-305

คำสำคัญ: โปรแกรมฟื้นฟูสมรรถภาพหัวใจ การผ่าตัดทำทางเบี่ยงหลอดเลือดหัวใจ การรับรู้สมรรถนะแห่งตน สมรรถภาพร่างกาย

ธันย์ชนก หนูเปี่ยม *นักศึกษาหลักสูตรพยาบาลศาสตรมหาบัณฑิต สาขาวิชาการพยาบาลผู้ใหญ่และผู้สูงอายุ (ภาคพิเศษ) โรงเรียนพยาบาลรามาธิบดี คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล E-mail: chaum.nur@gmail.com*
ติดต่อที่ : ปิยะวรรณ โภคพลากรณ์* *ผู้ช่วยศาสตราจารย์ โรงเรียนพยาบาลรามาธิบดี คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล*
E-mail: piyawan.pok@mahidol.edu
สุชิรา ชัยวิบูลย์ธรรม *รองศาสตราจารย์ โรงเรียนพยาบาลรามาธิบดี คณะแพทยศาสตร์โรงพยาบาลรามาธิบดี มหาวิทยาลัยมหิดล E-mail: suchira.cha@mahidol.edu*
ธำรง ก้องเกรียงไกร *นายแพทย์ชำนาญการ กลุ่มงานศัลยกรรม โรงพยาบาลตรัง*
E-mail: windsman88@gmail.com