

Effect of Prehabilitation on Postoperative Recovery of Frail Elderly Undergoing Coronary Artery Bypass Graft Surgery

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Abstract

Background: Prehabilitation, a multimodal preoperative intervention including exercise training, nutritional optimization, and psychological support, has emerged as a strategy to enhance physiological reserve and improve surgical outcomes.

Aim: This study aimed to evaluate the effect of prehabilitation program on recovery of frail elderly postoperative CABG surgery.

Methods: A quasi-experimental study was conducted at cardiothoracic inpatient, cardiothoracic ICU at Sudeanie hospital in Zagazig University & cardiothoracic outpatient clinic in Zagazig University hospital. A purposive sample of 80 elderly patients (≥ 60 years) scheduled for elective on-pump CABG surgery was recruited and randomly assigned into two groups: an intervention group ($n = 40$) and a control group ($n = 40$). Data were collected using a structured interviewing questionnaire, the Clinical Frailty Scale (CFS), and the 15-item Quality of Recovery (QoR-15) scale.

Results: The findings revealed a statistically significant improvement in postoperative recovery among patients in the intervention group compared to the control group. The study group demonstrated significantly higher mean scores across all domains of the QoR-15 on postoperative day three ($p < 0.01$). Multivariate regression analysis identified participation in the prehabilitation program as an independent positive predictor of improved quality of recovery.

Conclusion: The structured prehabilitation program significantly enhanced postoperative recovery and functional outcomes among frail elderly patients undergoing CABG surgery.

Recommendations: Prehabilitation programs incorporating physical exercise, nutritional counseling, and psychological support should be routinely implemented for elderly patients scheduled for CABG surgery to enhance postoperative recovery and reduce morbidity.

Keywords: Prehabilitation, Frailty, Elderly, Coronary Artery Bypass Graft, Quality of Recovery, Cardiac Surgery.

Introduction

Elderly is a chronological age of 65 years old or older, while those from 65 through 74 years old are early elderly and those over 75 years old as late elderly. The proportion of people aged over 60 years is growing faster than any other age group. The number of older people gradual increase In line with global trends the Egyptian population is also aging with 6.9 % of the population over 60 years in 2017 and this age group to be 9.2% by 2030 and 20.8% by 2050. (Mehanna, 2022). Worldwide by 2030, 1 in 6 people will be aged 60 years

or over and the population aged 60 years and over will increase from 1 billion in 2020 to 1.4 billion. By 2050, the people aged 60 years and older will double (2.1 billion). The number of peoples aged 80 years or older is expected to triple in 2050 to reach 426 million (**World Health Organization, (WHO), 2023**).

Coronary artery disease (CAD) is an inflammatory disease of the arterial in the coronary arteries (**Muneeb et al., 2023**). It is the leading cause of morbidity and mortality worldwide. WHO has notified about the rapidly increasing of cardiovascular disorders (**Kodeboina, et al., 2023**). CAD caused by atherosclerosis, inflammatory disease affecting the arteries, is the pathological process leading to CAD and also can be caused by multiple risk factors as age, obesity, smoking and poor diet (**Dai, et al., 2022**).

Coronary artery bypass grafting (CABG) surgery established as the intervention for patients with multi-vessel coronary artery disease or left main stenosis, offering long-term results compared to percutaneous coronary intervention (PCI). CABG is associated with low mortality rates of 1–2% among high-risk patients (**Dąbrowski et al., 2022**). Frailty presents a unique challenge. It is a syndrome characterized by diminished strength and physiological function that increases patient morbidity and mortality (**Doody et al., 2023**).

The association between frailty and adverse postoperative outcomes in elderly CABG surgery patients is common and are lead to a slower recovery, prolonged in-hospital stay, increase morbidity and mortality, increase in global medical costs. Moreover, this association between frailty and postoperative complications seems independent from age, comorbidity and the surgical risk. Frailty leads to various clinical consequences including cognitive impairment, loss of independence in daily activities, reduced mobility, and mortality (**Pozzi et al., 2023**).

With increased patients age the comorbidities become more common. Strategies to improve postoperative outcomes and to enhance recovery are required in patients undergoing coronary artery bypass grafting. Prehabilitation refers to process of increasing functional capacity before surgery to improve the patient's ability to facing physiologic stress and to avoid postoperative complications (**Olsen et al., 2023**). Prehabilitation programme preoperative CABG surgery including inspiratory muscle training, functional exercise training, psychological support, nutritional support, and smoking cessation (**Scheenstra et al., 2021**). It is strategies together that optimization of modifiable factors, reduce the length of hospital stay, decrease the postoperative morbidity (especially in pulmonary complications) and mortality, and improve the discharge from the hospital (**Pozzi et al., 2023**).

Postoperative CABG complications are expected, including bleeding, infection, neurological events, pulmonary complications, acute renal failure, atrial fibrillation and cardiac arrest. Most of health complications are expected from the fact that older patients have longer stays in the hospital and intensive care unit (ICU) and also higher rates of ICU readmission (**Steinmetz et al, 2020**).

Preoperative period presents a critical opportunity to optimize patient risk factor and potentially improve the resilience of the patient awaiting coronary artery bypass graft surgery (**Engelman et al, 2019**). Therefore, prehabilitation is very crucial. It is a range of preventive and restorative interventions delivered before surgery to enhance patients' fitness and health status to reduce the incidence or severity of postoperative adverse events and improve postoperative recovery (**McCann et al, 2019**). Moreover, prehabilitation increase physical activity levels and minimize sedentary life style before surgery in frail older patients that able to improve the resilience of frail CABG surgical patient preoperatively for promoting faster and better recovery after surgery (**Steinmetz et al, 2020**).

frailty is reversible with optimal interventions that can support recovery of cognitive Functions and physical functions in frail elderly patients. Gerontological nurse can performance as case managers for elderly frail patients and work in collaboration with relevant healthcare professionals to maintain balance in frail elderly Patients due to low physiological reserves. Also, gerontological nurse cooperate with a multidisciplinary team to increasing physical strength , prevention of weight loss, proper nutrition and management of malnutrition, prevention of falls, management of polypharmacy and delirium in addition to the surgical care of frail elderly patients undergoing CABG surgery . Nursing management of the frail CABG surgery patient is done inpreoperative, intraoperative, and postoperative care(**Korkmaz & Arıkan.2022**).

The nurse should collaborate with a multidisciplinary team involving cardiac surgeons, clinical cardiologists, perfusionist, anesthesiologists, and geriatricians, to assess and provide care to those high risk frail elderly patients to optimize outcomes. Pre-operative and post-operative interventions can reduce the risk of complications, support patient recovery and promoting surgical resilience (**Pozzi et al., 2023**).

Aim of the study

Evaluate the effect of prehabilitation program on recovery of frail elderly postoperative CABG surgery.

Research Hypothesis:

After implementation of prehabilitation program, recovery of frail elderly postoperative CABG surgery will be improved.

Subjects and Methods

a) Research design:

A quasi-experimental design was utilized to conduct this study.

b) Setting:

The study was conducted at cardiothoracic inpatient, cardiothoracic ICU at Sudeanie hospital in Zagzig University & cardiothoracic outpatient clinic in Zagzig University hospital.

c) Sampling:

A purposive sample of 80 patients who fulfilled the following criteria:

Inclusion criteria:

- Age: 60 years and older
- All pre-frail to moderately frail elderly patients (scored 4-6 in Clinical Frailty Scale).
- Elderly patients undergoing on pump elective primary isolated CABG by using heart lung machine.
- Elderly patients with an estimated 4 or more weeks of surgical waiting time were included.

Exclusion criteria:

- Patients who had critical left main coronary disease, congestive heart failure or acute coronary syndrome or redo cardiac surgery.
- Patients who are hospitalized for arrhythmias.
- Elderly patients Having psychiatric disorders, cognitive or communication problems who were unable to comply with study procedures.

Sample size calculation

The sample size was calculated by software Epi-info package at level of confidence 95%, margin of error 5% and power of test were 80%, assuming fair lifestyle among elderly patients with CABG is 73.0% from 250 elderly patients (**Manupreet, 2017**) come to cardiac clinic through 6 months, and the least percentage of improvement after the intervention program will be 10% then the sample should include 80 elderly patients. The enrolled patients who fulfilled the recruitment criteria were randomly assigned in a 1:1 ratio to the intervention group (40 patients) or the control group (40 patients).

Instruments

The following instruments were used to implement the existing study: Four-legged walker; Resistance ropes; A flow-sensing triflo II incentive spirometry {India model SG523130993}; Fingertip pulse oximeter {pulsiox-301, Italy}; and Portable bathroom weighing scale {Rossmax WB101, Switzerland}.

Tools for data collection:

Tool I: A Structural interviewing questionnaire:

This tool was developed by researchers after reviewing the national and international related literature. It will consist of two parts:

First part:

Demographic characteristics: This part include data about age, sex, marital status, level of education, occupation, residence, monthly income, residents at home.

Second part: Clinical Frailty Scale (CFS) (Rockwood et al, 2005).

CFS is a simple, quick and highly predictive semi-quantitative tool was used to assess the frailty status. CFS ranged from 1 (very fit) to 9 (terminally ill), classified as non-frail (scores of 1–3), vulnerable/pre-frail(score of 4) and frail (scores of 5–9).

Tool II: Quality of Recovery (QoR-15) score (Myles et al., 2018):

The 15-item Quality of Recovery (QoR-15) score which is one of the recommended standardized outcomes for assessing patient comfort after surgery was used on postoperative day 3 after cardiac surgery. The QoR-15 score included items measuring pain, physical comfort, physical independence, psychological support and emotional state with well-established validity (convergent, construct, and discriminant), reliability (internal consistency, split-half and test–retest),responsiveness, acceptability and feasibility properties. The QoR-15 score ranged from 0 to 150 and took about 3 minutes to complete.

Validity:

The developed tool will be formulated and submitted to three experts from Community Health Nursing and Gerontological nursing in Faculty of nursing in Zagazig, Mansoura & Assiut Universities to review relevance of the tools for comprehensiveness, understanding and applicability.

Reliability:

Reliability of tools was determined through estimating test-retest reliability and measuring its internal consistency. Internal consistency of the tools was assessed by calculating Cronbach alpha coefficients. The reliability proved to be high as shown by the values of Cronbach alpha coefficient in the following table:

Scales	No of items	Cronbach's alpha
Quality of Recovery	15	0.912

Pilot study:

Pilot study has been conducted to test the clarity, applicability and understandability of the tool. It has been conducted on 10% (8) of patients. They have been selected from settings similar to those chosen for the study. The results of the pilot helped in refining the interview questionnaire and to schedule the time framework. The participants of the pilot were included in the main study sample.

Field work:

Once permission was granted to proceed with the study, the researcher used to visit the cardiothoracic outpatient clinic on the scheduled days for each inpatient surgical unit to enroll elderly patients who fulfilled the inclusion criteria during their medical examinations. After medical diagnosis, the doctors referred patients who needed surgical procedure (CABG surgery) to the hospital cardiothoracic surgical inpatient units.

Once the patients were admitted into the inpatient cardiothoracic surgical department, the researcher interviewed enrolled patients and carried out the preoperative stage for each participant. After finishing the preoperative stage, the researcher tracked the participants until their planned operations were performed

following the hospital's operation list. Postoperatively, the researcher can start implementing postoperative stage for each participating patient. Throughout the hospital stay, the researcher traced all the study subjects according to study tools.

The fieldwork was executed over a period starting from November 2024 to May 2025. The researcher went almost every day and throughout the day, depending on the patient's flow to the outpatient clinics, and the operational list (schedule) of the unit. The fieldwork included the phases of assessment, planning, implementation, and evaluation of the prehabilitation program designed according to perioperative period stages as detailed;

Prehabilitation program description:

Preoperative stage

Assessment phase

Every study subject who met the eligibility criteria was interviewed individually to collect the preoperative baseline data. The researcher introduced herself and explained the aim of the study, briefly seeking their agreement to participate in the study, and reassuring them that information obtained was strictly confidential would not be used for any purposes other than research.

Planning phase

This phase entailed the framework for the program, setting the general and specific objectives of the program, allocation of the program resources and instruments, and construction of evaluation tools to measure the program effectiveness. According to the relevant literature about prehabilitation program, the researcher developed prehabilitation program for elderly patients undergoing on pump coronary artery bypass graft surgery according to the elderly patients' need and the study objectives. The identified needs, requirements, and deficiencies were translated into the program's goal and objectives and set in the form of an illustrative booklet. The prehabilitation program consisted of 9 sessions(introductory session, seven preoperative sessions, and two postoperative sessions) as follows:

- **Introductory session:(Duration:20 minutes)**

The main objective of this session was highlight the introduction to the study and collect the baseline data of the elderly patients.

- **Session 2: (Duration:20 minutes)**

The main objective of this session was Improve elderly knowledge about the anatomy,physiology of the cardiovascular system, and cardiac changes associated with ageing and frailty.

- **Session 3:(Duration:20 minutes)**

The main objective of this session was enhancing elderly knowledge about frailty, deep breathing exercises and improved degree to prevent disabilities and coronary artery bypass graft surgery (CABG).

- **Session 4:(Duration:20 minutes)**

The main objective of this session was improving the elderly ability to perform physical home exercise program to improve recovery post coronary artery bypass graft surgery (CABG).

- **Session 5:(Duration:20 minutes)**

The main objective of this session was equipping the elderly knowledge about nutrition, smoking cessation and positive psychological support in addition to standard surgical process.

- Session 6:(Duration:20 minutes)**

The main objective of this session was spotlight on common complications after (CABG) surgery.

▪ **Session 7:(Duration:20 minutes)**

The main objective of this session was spotlight on common cardiac complications after (CABG) surgery.

▪ **Session 8:(Duration:20 minutes)**

The main objective of this session equips the elderly with knowledge about the recovery process after (CABG) surgery.

▪ **Session 9 :(Duration:20 minutes)**

The main objective of this session assesses postoperative elderly Quality of Recovery (QoR-15) score and Cardiac Postoperative Morbidity score(C-POM) at third day after (CABG) surgery.

Implementation phase:

The program was implemented in the study setting in the form of nine sessions, including theoretical and practical content for each participant. This was intended to give more chances for discussion, interaction, and practical training. The length of each session was variable according to elderly responses and active participation, as well as the time available, and the content of each session.

To ensure that the studied elderly understood the content, each session was started by a summary of what was covered in the previous session and the objectives of the new one, taking into consideration the use of simple language to suit the level of understanding of the elderly. Motivation reinforcement techniques such as praise and recognition during the session were used to enhance active participation and foster learning. The total sample was randomly assigned into study or control groups as follows:

Study group (intervention)

The elderly patients in the intervention group were provided with a booklet and brochures containing information about the general parts of the cardiovascular system, Mechanism of frailty, postoperative pain, postoperative potential complications, the recovery process, and the necessity or importance of preoperative prehabilitation program to the postoperative recovery period. Detailed written and pictorial instructions can direct the patients to correct perform preoperative prehabilitation program to be initiated immediately upon regaining consciousness after surgery. The patient's adherence to the program guidelines was recorded by the researcher throughout the postoperative days. The postoperative coaching and prompting were also performed by the researcher.

Methods of teaching: the researcher utilized various approaches to learning in carrying out the program. These included discussion on an individual basis, demonstration, and brainstorming to exchange ideas between the elderly participants and the researcher.

Teaching media: various media were used, including posters, pictures, and videos. The researcher also prepared an illustrated booklet and distributed it to all of the participants to enhance the process of learning and guide elderly patients undergoing coronary artery bypass graft surgery in practicing the preoperative prehabilitation program

Control group (Usual care)

Elderly patients in the control group received perioperative standard (routine) hospital care, which was provided for all patients undergoing coronary artery bypass graft surgery without structured exercise and preoperative health promotion/patient education program (no prehabilitation). No instruction or booklet was given to them. Perioperative routine care includes but is not limited to preoperative medical control of chronic disease, preoperative nutritional care, preoperative smoking cessation, standard anesthetic protocol, goal directed fluid therapy, restrictive use of surgical drains, early removal of a urinary catheter, and encouragement of early feeding.

Postoperative stage (Evaluation phase)

Postoperatively, the researcher evaluated the effectiveness of the preoperative prehabilitation program through following the study tool for all elderly patients in both group (study and control group). The differences in patient outcomes between the study and control group were measured by comparing their quality of recovery, assessing the incidence of morbidities post cardiac surgery through first postoperative three days , and disabilities through postoperative one month, as well as comparing to the degree of preoperative to detect disability if occurred.

Ethical consideration:

An official permission to conduct the proposed study was being obtained from the Scientific Research Ethics Committee. Participation in the study is voluntary and subjects was be given complete full information about the study and their role before signing the informed consent. The ethical considerations include explaining the purpose and nature of the study, stating the possibility to withdraw at any time, confidentiality of the information were guaranteed. Ethics, values, culture and beliefs were be respected.

Administrative design:

An official letter requesting permission to conduct the study was obtained from the Dean of Faculty of nursing, Zagazig University to the director of the mentioned hospital to obtain their approval to carry out this study. This letter included a permission to collect the necessary data and explain the purpose and nature of the study.

Statistical analysis:

Data collected from the studied sample was revised, coded and entered using Personal Computer (PC). Computerized data entry and Statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 24. Data were presented using descriptive statistics in the form of frequencies, percentages and Mean $\pm$ SD. Chi-square test (X²) was used for comparisons between qualitative variables. Spearman correlation measures the strength and direction of association between two ranked variables.

Results

Table (1): Characteristics of studied elderly patients in the study and control groups (n=40)

Items	Control group (n=40)		Study group (n=40)		X ² test	P. value
	No	%	No	%		
Age						
60<65 years	11	27.5	14	35.0	0.524	0.469
65<70 years	29	72.5	26	65.0		
Mean ± SD	69.2±2.7		67.4±2.3			
Sex						
Male	30	75.0	28	70.0	0.251	0.617
Female	10	25.0	12	30.0		
Marital Status						
Married	26	65.0	28	70.0	0.691	0.708
Widowed	11	27.5	8	20.0		
Divorced	3	7.5	4	10.0		
Level of education						
don't read &write	6	15.0	4	10.0	1.663	0.797
Read and write	7	17.5	4	10.0		
Basic education	14	35.0	16	40.0		
Secondary education	9	22.5	11	27.5		
University	4	10.0	5	12.5		

Occupation						
Employed	0	0.0	0	0.0	0.000	1.000
Non-employed	40	100.0	40	100.0		
Residence						
Urban	19	47.5	21	52.5	0.200	0.655
Rural	21	52.5	19	47.5		
Monthly income						
Sufficient	22	55.0	26	65.0	0.833	0.361
Not sufficient	18	45.0	14	35.0		
Residents in the house						
Live alone	8	20.0	6	15.0	0.367	0.947
With your wife/husband	9	22.5	10	25.0		
With sons	17	42.5	18	45.0		
With grandsons	6	15.0	6	15.0		

*Significant at $p < 0.05$. **Highly significant at $p < 0.01$. Not significant at $p > 0.05$

Table 1: reveals that, 62% of the studied elderly patients in the study group aged ranged between 65 and less than 70 years and the mean age of them was 67.4 ± 2.3 years, 70% of them were males, 70% of them were married, 40% of them had basic education, all of them were non-employed and 52% of them belonged to rural areas. Moreover, 65% of them had sufficient income and 45% of them were living with their sons. Meanwhile, 72.5% of the studied elderly patients in the control group aged ranged between 65 and less than 70 years and the mean age of them was 69.2 ± 2.7 years, 75% of them were males, 65% of them were married, 35% of them had basic education, 100% of them were non-employed, 52.5% of them belonged to rural areas. Furthermore, 55% of them had sufficient income and 42.5% of them were living with their sons. There were no significant differences in terms of demographic characteristics between the study and control groups ($p < 0.05$).

Figure (1): Elderly patient's total clinical frailty in the study and control groups (n=40)

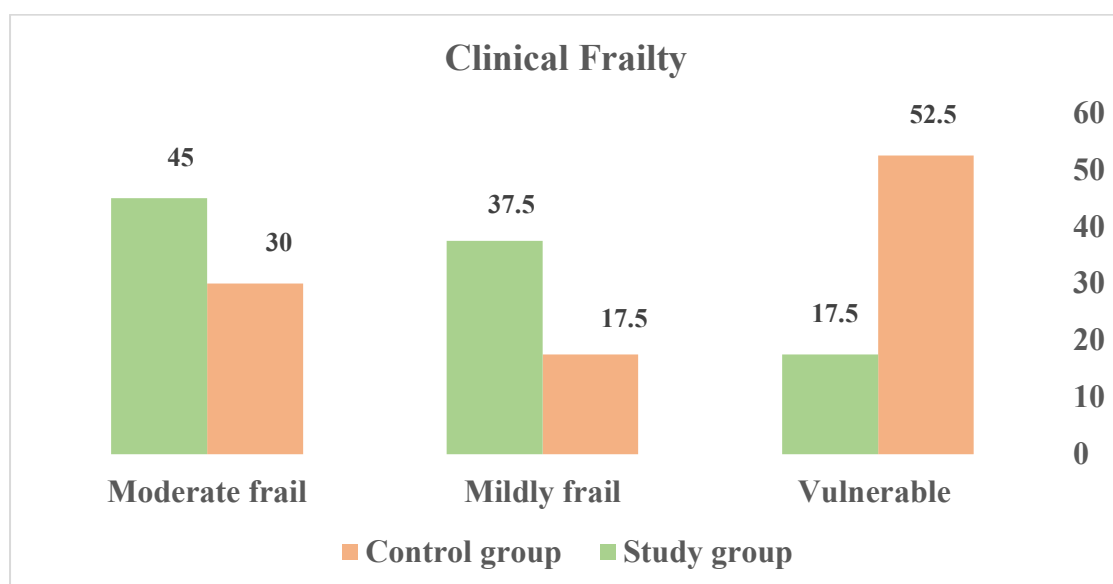


Figure 1: portrays that, 45% of the studied elderly patients in the study group were moderate frail, 37.5% of them were mildly frail and 17.5% of them were vulnerable frail. Meanwhile 52.5% of studied patients in the control group were vulnerable, 30% of them were moderate frail and 17.5% of them were mildly frail.

Table (2): Elderly patient's quality of recovery in the study and control groups (n=40)

	Control group (n=40)	Study group (n=40)	Index score	T test	P. value
	Mean $\pm$ SD	Mean $\pm$ SD			
Able to breath easily	5.95 $\pm$ 2.160	7.95 $\pm$ 1.880	0-10	4.417	0.000**
Been able to enjoy food	5.93 $\pm$ 2.129	7.95 $\pm$ 1.880	0-10	4.471	0.000**
Feeling rested	6.00 $\pm$ 1.840	7.85 $\pm$ 1.861	0-10	5.853	0.000**
Have had a good sleep	5.83 $\pm$ 1.838	8.07 $\pm$ 1.591	0-10	5.501	0.000**
Able to look after personal toilet And hygiene unaided	6.15 $\pm$ 1.688	8.15 $\pm$ 1.562	0-10	4.917	0.000**
Able to communicate with family Or friends	5.60 $\pm$ 2.251	7.83 $\pm$ 1.767	0-10	5.687	0.000**
Getting support from hospital Doctors and nurses	5.60 $\pm$ 2.085	8.05 $\pm$ 1.753	0-10	4.523	0.000**
Able to return to work or usual Home activities	5.75 $\pm$ 2.010	7.75 $\pm$ 1.945	0-10	5.002	0.000**
Feeling comfortable and in control	5.63 $\pm$ 2.284	7.98 $\pm$ 1.901	0-10	5.092	0.000**
Having a feeling of general well- Being	5.70 $\pm$ 2.103	7.98 $\pm$ 1.888	0-10	5.122	0.000**
Moderate pain	5.63 $\pm$ 2.180	7.98 $\pm$ 1.915	0-10	4.832	0.000**
Severe pain	5.75 $\pm$ 2.097	7.95 $\pm$ 1.974	0-10	5.116	0.000**
Nausea or vomiting	5.90 $\pm$ 1.905	8.05 $\pm$ 1.853	0-10	4.438	0.000**
Feeling worried or anxious	5.93 $\pm$ 2.043	7.88 $\pm$ 1.884	0-10	3.829	0.000**
Felling sad or depressed	5.95 $\pm$ 2.050	7.68 $\pm$ 1.979	0-10	5.002	0.000**

*Significant at $p < 0.05$. **Highly significant at $p < 0.01$. Not significant at $p > 0.05$

Table 2: clarifies that, there was marked improvement of mean scores of all statements of quality of recovery scale of the studied elderly patients in the study group compared to of the studied elderly patients in the control group and these improvement were highly statistically significant ($p < 0.01$).

Figure (2): Elderly patient's total quality of recovery score in the study and control groups (n=40)

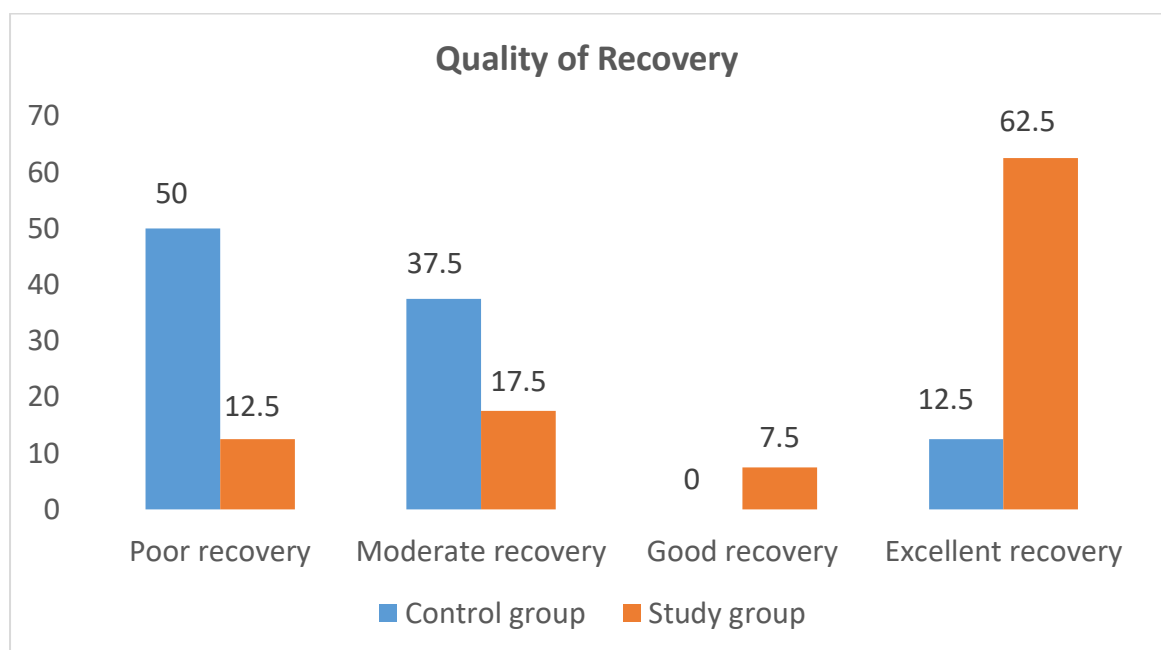


Figure 2 :depicts that, 62.5% of the studied elderly patients in the study group were excellent recovery, 17.5% of them moderate recovery, 12.5% of them poor recovery and 7.5% of them were good recovery. Meanwhile 50% of studied patients in the control group were poor recovery, 37.5% of them moderate recovery, 12.5% of them excellent recovery, while none of them were good recovery.

Table (3): Relationship between study group demographic characteristics and their total quality recovery score post intervention (n=40)

Items	Quality recovery								X ² test	P. value
	Poor		Moderate		Good		Excellent			
	No	%	No	%	No	%	No	%		
Age										
60<65 years	1	2.5	3	7.5	0	0.0	10	25.0	2.575	0.462
65<70 years	4	10.0	4	10.0	3	7.5	15	37.5		
Sex										
Male	3	7.5	4	10.0	3	7.5	18	45.0	2.122	0.547
Female	2	5.0	3	7.5	0	0.0	7	17.5		
Marital Status										
Married	4	10.0	4	10.0	2	5.0	18	45.0	2.808	0.833
Widowed	0	0.0	2	5.0	1	2.5	5	12.5		
Divorced	1	2.5	1	2.5	0	0.0	2	5.0		
Level of education										
Don't read &write	0	0.0	2	5.0	2	5.0	0	0.0	41.160	0.000**
Read and write	0	0.0	3	7.5	1	2.5	0	0.0		
Basic education	5	12.5	1	2.5	0	0.0	10	25.0		
Secondary education	0	0.0	1	2.5	0	0.0	10	25.0		
University	0	0.0	0	0.0	0	0.0	5	12.5		
Residence										
Urban	0	0.0	0	0.0	1	2.5	20	50.0	21.287	0.000**
Rural	5	12.5	7	17.5	2	5.0	5	12.5		
Monthly income										
Sufficient	2	5.0	5	12.5	1	2.5	18	45.0	3.362	0.339
Not sufficient	3	7.5	2	5.0	2	5.0	7	17.5		
Residents in the house										
Live alone	0	0.0	3	7.5	0	0.0	3	7.5	38.883	0.000**
With your wife/husband	5	12.5	2	5.0	3	7.5	0	0.0		
With sons	0	0.0	2	5.0	0	0.0	16	40.0		

With grandsons	0	0.0	0	0.0	0	0.0	6	15.0		
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*Significant at $p < 0.05$. **Highly significant at $p < 0.01$. Not significant at $p > 0.05$

Table (3): indicates that there were highly statistically significant relations between the studied elderly patient's demographic characteristics (level of education, residence and residents in the house) and their total quality recovery score post intervention ($p < 0.001$). meanwhile there were no statistically significant relation between the studied elderly patients demographic characteristics (age, sex, marital status, level of education, and monthly income) and their total quality recovery score post intervention ($p > 0.05$).

Table (4): Best fitting multiple linear regression model for the quality recovery

Items	Unstandardized Coefficients	Standardized Coefficients	T test	P. value
	B	B		
Level of education	0.494	0.487	3.438	0.001**
Residence	0.584	0.705	6.122	0.000**
Residents in the house	0.631	0.515	3.705	0.001**
Exercise	0.475	0.654	5.324	0.000**
Program intervention	0.450	0.569	6.109	0.000**
Model	R²	Df.	F	P. value
Regression	0.731	4	26.64	0.000**

a. Dependent quality recovery

b. Predictors: (constant): Level of Education, Residence, Residents in the House, Exercise and Program Intervention

Table 4: demonstrates that, level of education, residence, residents in the house, exercise and program intervention were a highly statistically positive predictors of quality recovery score at $p < 0.01$, respectively. The model explains 73.1% of the variation at total quality recovery score as the value of r-square indicates.

Discussion

There are effects of prehabilitation for patients undergoing major elective surgery including cardiac surgery. Prehabilitation includes a range of interventions based on individual needs but not limited to exercise therapy, nutrition counselling and psychological support. The goal is improving the patient's health status and reduce risk factors for poor outcomes in the four to six weeks before surgery. Therefore, prehabilitation program can improve the quality of recovery after surgery (**Jeske et al., 2022**).

Regarding to frailty score, the current study demonstrated highly significant differences before surgery between the study group and the control group, indicating that the study group already had a lower frailty baseline at entry. This suggests that the prehabilitation intervention may have been effective in improving patients' physiological reserve and reducing their vulnerability to the stress of surgery. These findings are in line with **Wong et al. (2024)**, who highlighted that prehabilitation programs reduce frailty and enhance surgical resilience in elderly patients. On the other hand, there are studies reported less conclusive evidence regarding the impact of prehabilitation on frailty in elderly patients undergoing CABG. For instance, **Pan et al. (2023)** retrospectively examined frailty in elderly CABG patients and found that preoperative frailty was significantly associated with poorer postoperative outcomes; however, no intervention to reduce frailty was evaluated, and the study did not support the notion that frailty could be modulated preoperatively.

Additionally, this result disagreed with the Japanese observational study of **the Sugimoto et al. (2023)** who used the Hospital Frailty Risk Score (HFRS) in CABG patients over 65 years of age and reported that higher frailty scores were associated with significantly worse discharge outcomes and a higher incidence of postoperative complications. Nonetheless, the study did not examine any prehabilitation protocol to improve frailty. These findings underscore that while frailty is a strong predictor of poor outcomes in cardiac surgery, its modification through prehabilitation remains controversial. This discrepancy might be related to that the effectiveness of such prehabilitation interventions may vary depending on the type, duration, and intensity of the program, as well as patient selection criteria.

The current study hypothesis was that after the implementation of prehabilitation program, recovery of frail elderly postoperative CABG surgery will be improved. This Hypothesis was supported by the current study results which indicated that the program was successful in enhancing quality of recovery among the patients when comparing control and study group main score. Additionally, the effect of the prehabilitation program was confirmed through multivariate analysis which identified the prehabilitation program as an independent positive predictor of the quality of recovery. This certainly related to content and process of the prehabilitation program which was developed to be suitable to the patients. From the researcher point of view, these converging results suggest that holistic prehabilitation programs which integrate dietary optimization, psychological support, and physical preparation may produce the greatest benefits for quality of recovery following CABG.

These finding are in agreement with previous study by **Yau et al. (2025)**, who emphasized the importance of preoperative preparation in improving surgical outcomes and quality of recovery. Moreover, these results are consistent with **Kinugasa et al. (2023)** who found that patients with poor preoperative nutritional status had significantly lower QoR-15 scores on postoperative days 2, 4, and 7. This supports the role of nutritional status as a key determinant of postoperative recovery. Also, this result is agreed with **Steinmetz et al. (2020)** who demonstrated that exercise-based prehabilitation significantly improved functional capacity and quality of life pre- and post-operative in CABG patients compared to controls.

Regarding to the relationship between study group demographic characteristics and their total quality recovery score post intervention, the findings indicated that higher quality of recovery scores were associated with better income and cohabitation with family members, particularly sons, in the study group. From the researcher perspective, emotional and social support, along with fewer financial burdens, may provide psychological reassurance and encourage adherence to recovery plans, ultimately improving the quality of recovery. These findings were in line with the study of **Chintapanyakun et al. (2021)** conducted in Thailand and suggested that family support and financial stability significantly influence patient recovery experiences.

On the other hand, these finding disagree with **Castro et al. (2023)** who found that social support (HR = 0.24, 95% CI 0.079–0.727) was a strong protective factor for 12-month survival, but it did not specifically distinguish higher income or co-residence with children as independent predictors. Additionally, these finding disagree with the study of **Cromhout et al (2022)** who reported that lower income and living alone predicted longer hospital and ICU stays after cardiac surgery (OR for high income vs lower, and living alone OR for death).

Regarding best fitting multiple linear regression model for the quality of recovery (**Table 4**), the current study's regression model identifies nutritional status, psychological readiness, and prehabilitation engagement as the strongest predictors of better quality of recovery. From the researcher point of view, these converging results suggest that holistic prehabilitation programs which integrate dietary optimization, psychological support, and physical preparation may yield the greatest benefits for quality of recovery following CABG. These findings largely aligned with the study of **Kinugasa et al. (2023)** found that patients with poor preoperative nutritional status had significantly lower QoR-15 scores on postoperative days 2, 4, and 7. This supports the role of nutritional status as a key determinant of postoperative recovery. Also, this result agreed with **Steinmetz et al. (2020)** who demonstrated that exercise-based prehabilitation significantly improved functional capacity and quality of life pre and post-operative in CABG patients compared to controls. While that study did not explicitly measure "psychological readiness" as a singular variable, its intervention implicitly addressed components such as patient motivation, support, and preparedness. **Conclusion**

On the light of results of the current study and answers of the research questions, it could be concluded that, the total quality of recovery (QoR) score was significantly higher among the study group compared to the control group after the intervention as well as multivariate analysis identified participation in the prehabilitation program as an independent positive predictor of improved recovery quality suggesting that the prehabilitation program effectively enhanced postoperative functional recovery. Therefore, the prehabilitation program effectively improved frailty status, enhanced postoperative recovery among frail elderly patients undergoing CABG surgery. **Recommendation**

On the light of results of the current study findings the following recommendations are suggested:

- Prehabilitation programs incorporating physical exercise, nutritional counseling, and psychological support should be routinely implemented for elderly patients scheduled for CABG surgery to enhance postoperative recovery.
- Prehabilitation protocols should be tailored to each patient's baseline frailty level, nutritional status, and comorbidity conditions to maximize effectiveness and minimize risks.
- Conduct large-scale randomized controlled trials to further evaluate the long-term impact of prehabilitation on postoperative morbidity, mortality, and quality of life among elderly CABG patients.

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