

## Effect of Therapeutic Exercises Program on Patients' Outcomes Undergoing Open Heart Surgeries

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### Abstract

**Background:** Therapeutic exercises can prevent complications, prolong survival, improve outcome for patients after open heart surgery, and decrease hospital stay. **Aim of the study** was to evaluate the effect of therapeutic exercises program on patients' outcomes undergoing open heart surgeries. **Subjects & Methods: Research design:** A quasi experimental research design was used. **Setting:** The study was conducted in Cardiac Surgery department and Open Heart Surgeries Critical Care Unit of Cardio Thoracic Hospital at Zagazig University Hospitals. **Subjects:** Composed of sixty adult patients. **Tools of data collection:** four tools were used for data collection: 1<sup>st</sup> tool was a Patient assessment sheet. 2<sup>nd</sup> tool was an Observational checklist. 3<sup>rd</sup> tool was a Rating of Perceived Exertion Scales (RPE). 4<sup>th</sup> tool was a Patient questionnaire Cardiac Exercise Self Efficacy Instrument. **Results:** Revealed that the highest percentage of patients in the study and control groups were females, more than 40 years of age. There was a statistical significant difference in total post-operative exercise performance among subjects in the study group with (p value 0.001). After program implementation there were statistical significant differences between subjects in study group and those in control group regarding post-operative cardiac, pulmonary, renal parameters, hemodynamic state, oxygenation, and investigations findings. There was a reduction in the time spend on mechanical ventilation, and lessen in the length of ICU stay for patients in the study group than that for patients in control group. **Conclusion:** The therapeutic exercises had statistically significant effect on improving the post-operative clinical parameters, hemodynamic state, oxygenation, investigations findings, reduce the intubation time, and reduce the length of ICU stay of patients undergoing open heart surgeries. **Recommendations:** Therapeutic exercise programs should be held periodically for such group of patients to improve their outcomes.

**Key words:** Open heart surgery, Patient outcome, Therapeutic exercise, Effect

### Introduction:

Open Heart Surgery (OHS) is one of the most important procedures that can resolve many cardiac problems. The most important of which are myocardial revascularization, valve repair or replacement, repair of congenital or acquired structural abnormalities.

Characterized by many complications as pulmonary, cardiovascular, neurological and renal; those prolong hospitalization, increase costs and have a direct effect on survival probability<sup>(1)</sup>. The reported incidence of major cumulative perioperative complications following cardiac surgery is 12.4%. The incidence of respiratory failure is 9.5%

mechanical assist device, and heart transplantation<sup>(2)</sup>.

The post-operative phase is the most critical period for OHS patients. During this phase Patients undergoing OHS are at risk of developing perioperative complications and major adverse cardiac events. It is that of sepsis is 3%, dialysis-dependent renal failure, 2.2–5.9%, stroke, 2–2.5%, mediastinitis, 1.7%, and gastrointestinal (GIT) complications, 1.5%. The reported perioperative mortality ranges from 17.6% to 20 %<sup>(3)</sup>.

Preoperative physical therapy reduces postoperative pulmonary complications PPCs (i.e. atelectasis

and pneumonia) and length of hospital stay in patients undergoing cardiac surgery. Exercise therapy after cardiac surgery is generally used for the prevention and/or treatment of PPCs and motor complications in an attempt to accelerate the recovery of (lung) function and functional status. Regarding the recovery of function, evidence suggests that postoperative fast-track mobilization reduces the time to extubation and shortens the length of stay in the intensive care unit (ICU) after cardiac surgery<sup>(4)</sup>.

Postoperative exercises increase functional residual capacities, enhance quality of respiration, improve alveolar ventilation, decrease work of breathing and establish diaphragmatic excursion. In addition, improve cardiac output, myocardial contractility, resting heart rate; improve venous return and strengthen cardiac muscle<sup>(5)</sup>.

Physical exercise is often prescribed to patients undergoing cardiac surgery; the Physical exercise generally consists of early mobilization, range of motion exercises during the hospital stay. Chest physiotherapy and breathing exercises are also prescribed to patients undergoing cardiac surgery in order to prevent or reduce post-operative pulmonary complications<sup>(6)</sup>.

Care of cardiac surgery patients has changed substantially in the past decade, with an emphasis on streamlined procedures and shortened hospital stays.<sup>(7)</sup> Measuring the outcomes for cardiac surgical patients following cardiac surgery is essential in determining cardiac surgery efficacy as a treatment of coronary artery disease (CAD).<sup>(8)</sup>

#### **Significance of the study:**

According<sup>(9)</sup>, coronary heart disease deaths in Egypt reached 107,232 or 23.14% of total deaths. Patients undergoing open-heart surgery are more risk to many complications and risks after surgery because of the long time of anesthesia during the operation, stay on the heart-lungs machine for a long time, and low body temperature during the surgery

which affects the functions of the body organs and increases survival in intensive care so it is necessary to improve the outcomes of those patients through the physical exercises that improve all functional capacities, and help early mobilization.

#### **Aim of the study:**

The aim of this study was to evaluate the effect of therapeutic exercises program on patients' outcomes undergoing open heart surgeries.

#### **Research Hypothesis:**

To fulfill the purpose of this study, the following research hypotheses were formulated:

**H<sub>1</sub>:** After completion of the therapeutic exercises program the mean parameters scores of patients in the study group after the program are higher than the mean parameters score before the program.

**H<sub>2</sub>:** Homodynamic state and oxygenation for the study group after implementation of the program are better than that of control group.

**H<sub>3</sub>:** Length of stay on mechanical ventilator for study group is shorter than that of control group.

**H<sub>4</sub>:** Length of stay in ICU for study group is shorter than that of control group.

#### **Subjects and methods:**

##### **Research Design:**

A quasi experimental research design was utilized to conduct the study.

##### **Study setting:**

The present study was conducted in Cardiac Surgery department of Cardio Thoracic Hospital and Open Heart Surgeries Critical Care Unit affiliated to Zagazig University Hospitals.

##### **Study subjects:**

A purposive sample of 60 patients was recruited according to the following inclusion and exclusion criteria; Inclusion criteria included: Adult patient (18-65 years old), undergoing Coronary Artery Bypass

Graft surgery, valve replacement or valve repair surgery, and thoracic aorta surgery, both sexes, and hemodynamically stable. Exclusion criteria included: major complications from surgery such as pulmonary emboli, Hemorrhage, serious arrhythmia at rest, and chronic renal failure, Conditions might restrict exercise such as Parkinson disease, and presence of artificial joints. The sample size was calculated using the equation for the difference between two means to estimate an expected decrease of 1- day of ICU stay in the study group compared with the control group. Using the open-Info statistical software package at 95% level of confidence and 80% study power, and accounting for a dropout rate of about 10%, the required sample size turned to be 30 patients in each group. These patients were divided randomly into two equal groups: study group (30) for application of the program, and a control group (30) to receive the routine nursing care of the ICU nursing staff without any additional interventions.

#### **Tools of data collection:**

**Tool I: Patient assessment questionnaire:** It was constructed by the researcher in English language and adapted from Ahmed and Hassan<sup>(10&11)</sup>. This tool was used to assess patients. It was divided into four main parts.

- Part I: It covers 10 items of personal characteristics of the patients such as age, gender, marital status, level of education, job status, residence, crowded index, income, and smoking.
- Part II: It involves questions about the medical history of the patient such as the diagnosis, type of surgery, and any co-morbidity.
- Part III: this was for pre-operative assessment of various body systems. It included cardiac assessment, respiratory assessment, arterial blood gases, and renal assessment.

- Part IV: this was for assessment of intra-operative parameters. It covered the date and duration of the operation, pacemaker insertion, and recovery of the heart.

- Part V: this part was for post-operative assessment of the patient. It covered 28 questions that grouped under 9 main sections e.g. Neurological assessment, Cardiac assessment, Respiratory assessment, Renal assessment, Length of stay in ICU (days), Wound assessment, Time on mechanical ventilation (hours), Intake/Output chart.

#### **Tool II: Post-operative physical exercise observational checklist:**

this tool was developed by the researcher based on Craven & Hirnle and Wilkinson & Van<sup>(12) (13)</sup>. It was designed in the form of a checklist for the patients in the study group postoperatively. It was used to assess patients' practice of various exercises covered by the program in the morning and afternoon shifts on the first and second post-operative days. Night shift was excluded because it is the time for the patient sleep and rest. The tool consisted of 41 items which were covered into the following parts: Part 1: chest physiotherapy exercises; Part I1: Positioning and Range of Motion (ROM) exercises; Part III: Early ambulation.

#### **Total Scoring system for tool 2:**

Each item in each type of exercise was checked as "done," "done with difficulty," and "not done." These were scored from two to zero respectively so that a higher score indicates better performance. The scores of each exercise and for the total exercises were summed-up (82) and divided by the numbers of steps to calculate a mean score. Means, standard deviations, and medians were then calculated for the study group in the morning and afternoon shifts on the first and second postoperative days.

### **Tool III: Rating of Perceived Exertion Scales (RPE)**

It was a scale used by the researcher; adopted from Borg<sup>(14)</sup> with scoring 0-10. It is commonly used in determining exercise intensity levels.

### **Tool IV: Patient questionnaire Cardiac Exercise Self Efficacy Instrument CESEI**

The researcher translates and back translates this tool from Khalil<sup>(15)</sup> to measure patient's perceived self-efficacy in carrying out specific exercises. The scale consisted of 16 items on a 5-point Likert scale ranging from "very confident" to "not confident". These are scored from "5" to "1" respectively so that a higher score indicates higher self-efficacy level. Means, standard deviations, and medians were calculated.

#### **Content validity and reliability:**

Once the tools were prepared, their face and content validity were ascertained by a panel of five experts included two lecturers in Medical Surgical Nursing from Faculty of Nursing, Zagazig University, and 3 professors from Faculty of Medicine, Zagazig University, from the departments of Open Heart Surgery, Chest, and Physiotherapy / Rheumatology, who revised the tools for clarity, relevance, applicability, comprehensiveness, and ease of implementation. The agreement percentage was between 80-100%. In light of their assessments, minor modifications were applied. The reliability of the exercise self-efficacy scale was assessed through testing its internal consistency. It showed a good level of reliability with Cronbach alpha coefficient 0.85.

#### **Field work:**

The researcher designed the program based on review of the most recent and relevant literature. The main goal was to apply therapeutic exercises to improve the outcomes of patients undergoing open heart surgeries. These patients' outcomes parameters were based on the results

of pretest. The content of the program was developed based on this general aim in addition to specific objectives, which responded to patients' needs identified in the assessment phase. It consisted of two main parts. The first part was theoretical, providing detailed knowledge of therapeutic exercises. It covered common manifestations after open heart surgery, the rules to be considered when doing exercises, any contraindications, and when to stop. The second part was mainly practical. It involved training of patients in performing physical exercises, chest physiotherapy, and early ambulation. A booklet containing all the program materials and illustrations was prepared in simple Arabic language.

After an official permission was taken from the dean of the faculty of Nursing, Zagazig University, director of Zagazig University hospital before conducting the study. Additional written consents were taken from the patients who participated in the study after explaining its purpose. The aim of the study and the procedures were explained to them to obtain their cooperation for data collection. Each patient was interviewed separately using the designed data collection sheet. A pre-operative baseline assessment was done for each patient in both groups in the beginning of the study. Patient's outcome parameters included those of cardiac, respiratory, and renal assessment. The interviews were done according to the list of surgery three days per week (Saturday, Monday, and Wednesday) during the morning and after noon shifts. The study was implemented during the period from October 2015 and lasted to June 2016 over a period of 10 months. The developed program was implemented in the form of sessions carried out in the study settings for the patients in the study group within their period of hospitalization. The content of the program was distributed over 13 consecutive sessions. The first session was for orientation to clarify aim and contents of the program, its

general objectives, the teaching methods, learner's activities, and evaluation methods, took 2 hours. The second session covered the theoretical part of the program, took 30-45 Minutes, whereas the remaining eleven sessions were for the practical part. These included three sessions for demonstration of the procedure preoperatively, each session took 30 minutes and eight sessions for re-demonstration during the two days following the surgery. These sessions were conducted during the morning and afternoon shifts; the night shift was excluded to allow rest and sleep for the patients. Patients were handled the program booklet, with some explanations from the researchers regarding its use. At the end of the program, its effectiveness was evaluated through a posttest done for both groups, using the same data collection tools.

#### **Pilot study:**

A pilot study for tools of data collection was carried out on 6 patients within selected criteria in order to test for clarity, relevance, comprehensiveness, understandable, feasible, applicability and ease for implementation. The results of the data obtained from the pilot study helped in modification of the tools, items were then corrected or added as needed.

#### **Administrative and ethical considerations:**

Permission to conduct the study was obtained by submission of official letters issued from the dean of the faculty of nursing at university to the directors of Zagazig university hospitals.

All ethical issues were taken into consideration during all phases of the study. The ethical research considerations in this study included the following: The research approval was obtained before the program implementation, the objectives and the aims of the study were explained to the participants, the researcher confirmed the confidentiality of

participants, and participants were allowed to choose to participate or not and they had the right to withdraw from the study at any time without penalty.

#### **Statistical analysis:**

Data entry and statistical analysis were done using SPSS 20.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations and medians for quantitative variables. Cronbach alpha coefficient was calculated to assess the reliability of the developed tools through their internal consistency. Quantitative continuous data were compared using Student t-test in case of comparison between two independent groups. For multiple group comparisons of quantitative data, one-way analysis of variance test (ANOVA) was used. When normal distribution of the data could not be assumed, the non-parametric Mann-Whitney or Kruskal-Wallis tests were used instead of Student t-test and ANOVA. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2\*2 tables was less than 5, Fisher exact test was used instead. In larger than 2\*2 cross tables, no test could be applied whenever the expected value in 10% or more of the cells was less than 5. Spearman rank correlation was used for assessment of the inter-relationships among quantitative variables and ranked ones. In order to identify the independent predictors of ICU stay and time on mechanical ventilation, multiple linear regression analysis was used, and analysis of variance for the full regression models was done. Statistical significance was considered at p-value < 0.05.

#### **Results:**

**Table 1:** illustrated the socio-demographic characteristics of patients in study and control groups. More than two thirds (70.0%) of

subjects in study and control groups were females and more than 40 years of age, with mean  $\pm$  SD ( $46.6 \pm 13.0$  and  $43.3 \pm 13.0$  respectively). The highest percentages of study and control groups (76.7% & 73.3% respectively) were married. As regard education level, more than one third (36.7%) of subjects in study group had university education, while about half (46.7%) of subjects in control group had secondary education. The percentages of job status in both groups were (63.3%) unemployed and (36.7%) were working. 70.0% of study group subjects lived in rural and 63.3% of control group. The incomes of 76.7% of subjects in both groups were sufficient. There were no statistical significant differences between patients in the study and control groups regarding socio-demographic characteristics.

**Table 2:** indicated that the median of stay on mechanical ventilation for patients in the study group was 6.00 hours. While the median of stay on mechanical ventilation for patients in the control group were 8.00 hours with two hours difference. There was a statistical significant difference between subjects in study and control groups regarding the stay on mechanical ventilation with (p value 0.01). The duration of ICU stay for the majority of subjects in study group

(93.3%) was less than 5 days. While more than two thirds (70.0%) of patients in the control group stay less than 5 days. There was a statistical

significant difference in duration of ICU stay between subjects in study group and control group with (p value 0.02) and mean  $\pm$  SD ( $2.0 \pm 5.0$  and  $3.0 \pm 7.0$  respectively).

**Table 3:** showed that the mean  $\pm$  SD of post-operative exercise self-efficacy score among patients in the study group was ( $4.6 \pm 0.2$ ) and the median of post-operative perceived exertion score among patients in the study group was (5.00)

**Table 4:** revealed that there was a significant negative correlation coefficient between exercise performance of patients in intervention group and their perceived exertion scores ( $r = - 0.449$ ). Also there was a significant negative correlation coefficient between exercise performance of patients in intervention group and the duration of their stay in ICU (days) ( $r = - 0.613$ ).

**Table 5:** the model for the days of ICU stay score in both groups indicated that the significant negative predictor of this score throughout the study phases was the intervention not the age, gender, number of co-morbidities, or smoking. As indicated by the standardized coefficient, the intervention was the most influential factor. As r-square indicates, 33% of the variance of ICU stay score is attributed to the factors in the model.

#### Discussion:

This study aimed to evaluate the effect of therapeutic exercise program on patients' outcomes undergoing open heart surgeries.

Regarding socio-demographic characteristics, results of the present study revealed that the age of more than two thirds of patients in study and control groups was more than 40 years. This might relate to the mean age for cardiac disease is common between 40-50 years. The finding of the present study is supported with Alwaqfi et al. <sup>(16)</sup> in study on "Predictors of temporary epicardial pacing wires use after valve surgery at Jordan University of Science and Technology and King Abdullah University Hospital", Jordan, revealed that the age of nearly half of studied patients was 40-59 years.

Moreover, Jazan. <sup>(17)</sup> in study on "predicting risk factors for pulmonary complications after open heart surgery" in Egypt; found that more than third of the studied sample aged more than 50 years. This is related to that age affects greatly functional capacity, and older age patients are significantly sicker and have reduced

cardiovascular functional capacity and immobility in older age patients group imply a further decrease in the maximal capacity of the cardiovascular system.

Related to gender, results of the present study showed that more than two thirds of patients in the study and control groups were females. The present result is consistent with Sharma & Gulati. <sup>(18)</sup> in study on "Coronary Artery Disease in Women at Ohio State University", Columbus, USA, revealed that Women are affected by coronary artery disease (CAD) in large numbers and to a large degree and CAD is the leading cause of mortality in women. Moreover, Mahday. <sup>(19)</sup> in study on "effect of counseling on patients' compliance with therapeutic regimen after artificial valvular heart replacement surgery" at Ain Shams University found that the percent of female patients was higher than that of male patients.

On the other hand, Khalil. <sup>(14)</sup> in study on "the effect of rehabilitation program on quality of life for patients with cardiothoracic surgery" at Ain Shams University and Case Western Reserve University, Ohio, USA ( joint supervision), found that males represented the higher percentage than females. In the same line, Carvalho et al. <sup>(20)</sup>. reported that, the Asian cardiothoracic annual indicated that, the prevalence of cardiovascular intervention; cardiac surgery, revascularization techniques are common among men. The findings of the current study could be related to that Women have unique risk factors for CAD, including those related to pregnancy, obesity, and autoimmune disease.

With regards marital status, the present study revealed that three quarters of patients in study and control groups were married. This finding goes in the same line with Ramadi et al. <sup>(21)</sup> in study on "Long-term Physical Activity Behavior After Completion of Traditional Versus Fast-track Cardiac Rehabilitation at University of Alberta", Canada,

revealed that the highest percentages of studied patients were married. Moreover, Basiouny. <sup>(22)</sup> in study on "the effect of position changing on patients' outcomes post coronary angiography" at Alexandria University mentioned that the majority of the studied patients were married. This could be related to the over social and psychological stress the married people face more than single one.

Regarding educational level, results of the present study showed that more than one third of patients in the study group had university education, while about half of patients in the control group had secondary education. This is in agreement with Tung et al. <sup>(23)</sup> in study on "Effects of a preoperative individualized exercise program on selected recovery variables for cardiac surgery patients: A pilot study at National Taipei University of Nursing and Health Science", Taiwan, found that about half of patients in the study had associated degree. This may be related to that the educated people have awareness and ability to understand the importance of exercises for them so their participation in the program is higher.

As regard job status, results of the present study showed that more than two thirds of patients in both study and control groups were unemployed while, more than one third of them was working. This is in agreement with Kivimaki & Kawachi. <sup>(24)</sup> in study on "work stress as a risk factor for cardiovascular disease in USA". Found that work stressors, such as job strain and long working hours, are associated with a moderately elevated risk of incident coronary heart disease. This is may be related to that the unemployed patients in the current study were house keepers.

Related to residence, results of the present study revealed that more than two thirds of patients in the study and control groups were in rural while, one third of them were in urban. This is not in the same line with Kodaman et al. <sup>(25)</sup> in study on "Cardiovascular

Disease Risk Factors in Ghana during the Rural-to-Urban Transition: A Cross-Sectional Study in Ghana". Found that more than two thirds of patients in the study were in urban while more than half were in rural. In my opinion this may relate to that Zagazig University hospitals serve all surrounding villages and hamlets, therefore most of the patients from the rural.

Regarding income, results of the present study showed that the incomes of more than three quarters of patients in both study and control groups were sufficient. In my opinion the patients answered sufficient related that such surgeries were done at governmental hospitals. Additionally, our religious give the concept of thanks.

As regards time on mechanical ventilation, findings of current study showed that patients in study group spend time on mechanical ventilation less than those patients in control group with two hours difference. These findings are emphasized by Urell et al. <sup>(25)</sup> in study on "Deep breathing exercises with positive expiratory pressure at a higher rate improve oxygenation in the early period after cardiac surgery — a randomized controlled trial" in Sweden who had Found that there was a statistical significant difference between treatment group and control groups concerning time on mechanical ventilation. In my opinion this relates to the pre-operative coughing and breathing exercises and the use of spirometers that improve lung capacities.

The findings of current study revealed that the length of ICU stay for patients in study group was significantly less than that for patients in control group. These findings are emphasized with Dolansky. <sup>(27)</sup> in study on "An audiotaped information program after coronary artery bypass surgery improved physical functioning in women and psychological distress in men" in USA who had found that the length of hospital stay after CABG

has become shorter in Cardiac Home Information Program (CHIP) group. This is may be related to the effective preoperative screening of the patient's cardiopulmonary functions may allow prophylactic therapeutic intervention, reduce the risk of surgery, and improve patients' outcome.

This result goes in the same line with what was reported by Valkenet et al. <sup>(28)</sup> in study on "the effects of preoperative exercise therapy on postoperative outcome: a systematic review" in Netherlands that, breathing exercises and spirometers use help reduce hospital stay after coronary artery bypass surgery. While, this result comes in contradiction with Khalil. <sup>(14)</sup> in study on "the effect of rehabilitation program on quality of life for patients with cardiothoracic surgery" at Ain Shams University and Case Western Reserve University, Ohio, USA who stated that more than third of the patients included in the study stayed average 9 days and he had related that to the presence of certain preoperative and postoperative risk factors that can be predicted to prolonged hospital stay after open heart surgery.

Concerning the exercise self-efficacy score, the present study revealed that the patients in the study group achieved high score of cardiac exercise self-efficacy score with range 4.4-5.0. this result is supported by Gad Allah. <sup>(29)</sup> in study on "the effect of coughing and breathing exercise on post operative patient outcomes after open heart surgery" in Egypt who had found that the cardiac rehabilitation group achieved high levels of cardiac exercise self efficacy than the control group. In my opinion, such programs as therapeutic exercise program and cardiac rehabilitation program has improved self efficacy of patients and their confidence to practice exercise.

The finding of the current study showed that the median of post-operative perceived exertion exercise score among patients in the study group was some what hard, this relates to the patients' Practices for the



majority of exercises had easy, while some of them were somewhat difficult specially the use of spirometry. In my opinion this is a good indicator for effective preoperative exercise training. This is supported by Morishita et al. <sup>(30)</sup> who mentioned that the perceived exertion exercise scale is a common method for determining exercise intensity levels. It is used in some research studies for that purpose, but may also be used in training programs to describe the intensity of training sessions.

The finding of the current study revealed that there was a significant negative correlation coefficient between exercise performance of patients in study group and their perceived exertion scores. In my opinion, this relates to the good training of exercises preoperatively that help the patient to perform exercises easily post-operatively so reduce the exertion scores. This finding in the line with that reported by Abbiss et al. <sup>(31)</sup> in study on "Role of Ratings of Perceived Exertion during Self-Paced Exercise: What is We Actually Measuring?" In Switzerland, he had found that patients with satisfied exercise performance had low perceived exertion scores.

The finding of the current study showed that there was a significant negative correlation coefficient between exercise performance of patients in study group and the duration of their stay in ICU. This finding is supported by Ahmed. <sup>(10)</sup> who designed a program of "early activity to determine its effect on patient's outcome" and concluded that improvement in patient's performance for early activity resulted in a decrease in length of hospital stay.

This might be related to the benefits of habitual exercises as improvement in functional capacity, improved cardiovascular efficiency; reduction in atherogenic and thrombotic risk factors, improvement in coronary blood flow, reduced myocardial ischemia and severity of coronary atherosclerosis, and

reduction in risk of cardiovascular disease mortality leading to reduction in the length of stay in ICU.

The result of present study showed that there was a non significant negative correlation coefficient between exercise self-efficacy of patients in study group and their perceived exertion scores. In my opinion, the reduction in perceived exertion scores encourage the patient to perform exercise and increase patient's compliance to exercise regimen resulting in improvement of patient's exercise self efficacy. This result is supported by Robbins et al. <sup>(32)</sup> in study on "Physical Activity, Self-Efficacy, and Perceived Exertion among Adolescents" in USA, found that lower RPE predicted greater post-activity self-efficacy. The effect of RPE on post-activity self-efficacy did not differ by gender, race, developmental stage, or by combinations of these variables.

The finding of current study revealed that there was a non significant negative correlation coefficient between exercise self-efficacy of patients in intervention group and their length of ICU stay. This finding is in line with Shalaby. <sup>(33)</sup> who developed "a clinical pathway for patients undergoing cardiac valvular surgery" in Egypt, who reported that the more closely patient adhered to the pathway in relation to activity progression, the shorter length of stay. This relates to multiple factors as patient's believe with the importance of exercises, the low exercise perceived exertion score, and effective program implementation help improving patient self efficacy and resulting in reduction in length of stay.

The finding of the current study reported that the significant negative predictor of the days of ICU score among patients in the study and control groups throughout the study phases was the intervention not the age, gender, number of co-morbidities, or smoking. As indicated by the standardized coefficient, the intervention was the most influent

factor by decreasing the length of ICU stay 1.3 day for patients in the study group than those in control group.

This finding is in agreement with Gad Allah. <sup>(29)</sup> in study on "the effect of coughing and breathing exercise on post operative patient outcomes after open heart surgery" in Egypt who documented that participation in early cardiac rehabilitation improve the overall physical condition and patient quality of life and did not affected by age, gender, or co-morbidities.

This result is supported with El-Baz. <sup>(34)</sup> who monitored patients undergone coronary artery bypath surgery, and valve replacement surgery who were following a clinical pathway, found that the patients following the clinical pathway were discharged a mean of 1 day earlier than those who were not following the path. In my opinion, this may be relates to the variation of the effect of other predictors as age, gender, or co-morbidities, and smoking while, the intervention of exercises strongly affect the length of ICU stay.

**Conclusion:**

On the light of the current study results, it can be concluded that, the therapeutic exercises included; chest physiotherapy exercises (breathing exercises, coughing exercises, and incentive spirometry), Range of motion exercises, and the early ambulation had statistically significant effect on improving the outcomes of patients undergoing open heart surgeries. The present study findings revealed an improvement in cardiac, pulmonary, renal parameters, Homodynamic state and oxygenation of patients in the study group post-operatively. Moreover, there was a reduction in the time spend on mechanical ventilation, and lessen in the length of ICU stay for patients in the study group. The present study findings supported all research hypotheses.

**Recommendations:**

It was recommended to implement the therapeutic exercises program in all ICUs for open heart surgeries. In service educational programs should conducted for critical care nurses and caregivers regarding the therapeutic exercises.

**Table 1: Socio-demographic characteristics of patients in the study and control groups (N= 60)**

Item	Group				X <sup>2</sup> Test	p-value
	Study (n=30)		Control (n=30)			
	No.	%	No.	%		
<b>Age:</b>						
< 40	10	33.3	12	40.0		
40 +	20	66.7	18	60.0	0.29	0.59
Range	22.0 – 64.0		18.0 – 65.0			
Mean ± SD	46.6 ± 13.0		43.3 ± 13.0		t = 0.86	0.36
Median	53.50		43.00			
<b>Gender:</b>						
Male	9	30.0	9	30.0		
Female	21	70.0	21	70.0	0.00	1.00
<b>Marital status:</b>						
Single	2	6.7	3	10.0		
Married	23	76.7	22	73.3	--	--
Divorced/widow	5	16.7	5	16.7		
<b>Education:</b>						
Illiterate	3	10.0	1	3.3		
Basic	0	0.0	2	6.7	4.27	0.37
Secondary	10	33.3	14	46.7		
University	11	36.7	9	30.0		
<b>Job status:</b>						
Unemployed	19	63.3	19	63.3		
Working	11	36.7	11	36.7	0.00	1.00
<b>Residence:</b>						
Rural	21	70.0	19	63.3		
Urban	9	30.0	11	36.7	0.30	0.58
<b>Crowding index:</b>						
< 2	25	83.3	24	80.0		
2 +	5	16.7	6	20.0	0.11	0.74
<b>Income:</b>						
Insufficient	7	23.3	7	23.3		
Sufficient	23	76.7	23	76.7	0.00	1.00

(U) Mann-Whitney –test

(- -) Test result not valid

**Table 2: Mechanical ventilation, ICU stay, and wound condition among patients in the study and control groups (N= 60)**

Item	Group				X <sup>2</sup> Test	p-value
	Study (n=30)		Control (n=30)			
	No.	%	No.	%		
<b>Hours on mechanical ventilation:</b>						
Range	3.0 - 72.0		5.0-14.0		6.12	0.01*
Mean ± SD	9.3 ± 12.4		9.0 ± 3.2			
Median	6.00		8.00			
<b>Duration of stay (days):</b>						
<5	28	93.3	21	70.0	5.45	0.02*
5+	2	6.7	9	30.0		
Range	2.9 - 9.0		4.2 - 0.9			
Mean ± SD	2.0 - 5.0		3.0 - 7.0			
Median	3.00		4.00			
<b>Exudates:</b>						
No	1	3.3	1	3.3	Fisher	1.00
Yes	29	96.7	29	96.7		

(\*) Statistically significant at p<0.05

**Table 3: Post-operative exercise self-efficacy and perceived exertion scores among patients in the study group (N= 60)**

Item	Range	Mean ± SD	Median
exercise self-efficacy score (max=5)	4.4 - 5.0	4.6 ± 0.2	4.53
Perceived Exertion score (max=10)	4.0 - 8.0	5.0 ± 0.8	5.00

**Table 4: Correlation matrix of patient exercise performance, exercise self efficacy, perceived exertion scores, and days of hospital stay (study group) (N=30)**

Scores	Spearman's rank correlation coefficient			
	Exercise performance	Exercise self-efficacy	Perceived exertion	Days Of stay
Exercise performance				
Exercise self-efficacy	.084			
Perceived exertion	-.449*	-.170		
Days of 1CU stay	-.613**	-.086	.271	

(\*) Statistically significant at  $p < 0.05$ (\*\*) Statistically significant at  $p < 0.01$ **Table 5: Best fitting multiple linear regression model for the days of ICU stay (both groups) (N=60)**

Item	Unstandardized Coefficients		Standardized Coefficients	t-test	p-value	95% Confidence Interval for B	
	B	Std. Error				Lower	Upper
Constant	1.60	0.38		4.242	< 0.001	0.85	2.35
Intervention	- 1.30	0.24	- 0.58	5.450	< 0.001	- 1.78	- 0.82

r- square = 0.33

Model ANOVA:  $F = 29.70, p < 0.001$ 

Variables entered and excluded: age, gender, number of co-morbidities, smoking

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