

# Preoperative Chest Physiotherapy for Prevention of Post-Operative Pulmonary Complications (PPCS) in Adults Undergoing Elective Exploratory Laparotomy: A Experimental Study

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## ABSTRACT

**Introduction:** Exploratory laparotomy is a major surgical procedure that significantly alters respiratory mechanics due to anesthesia, postoperative pain, and diaphragmatic dysfunction, predisposing patients to Post-Operative Pulmonary Complications (PPCs).

**Objectives:** The study aimed to determine whether preoperative chest physiotherapy improves lung function, enhances quality of life, and reduces the length of hospital stay in adults undergoing elective exploratory laparotomy.

**Methods:** A comparative experimental study was conducted with 40 participants (aged 18–55) divided into Group A (advanced regimen including incentive spirometry, Balloon blowing, and breath stacking) and Group B (standard protocol including diaphragmatic and pursed-lip breathing). Outcomes were measured using a 15-item Quality of Life (QoL) scale and length of hospital stay.

**Results:** The study involved 40 participants divided into two groups to evaluate the impact of preoperative chest physiotherapy on recovery after elective exploratory laparotomy. In Group A, which received an advanced regimen (incentive spirometry, Balloon blowing, and breath stacking), participants showed a highly significant improvement in their quality of life scores. Statistical analysis revealed that the mean QoL score in Group A improved from  $65.35 \pm 4.452$  pre-intervention to  $61.55 \pm 4.925$  post-intervention, with a t-value of 19.00 and a p-value of  $<0.0001$ , indicating an extremely significant clinical improvement. Furthermore, Group A demonstrated enhanced lung function and a notable reduction in the length of hospital stay compared to the standard care provided in Group B.

**Conclusion:** Structured, multi-modal preoperative chest physiotherapy is highly effective in preventing PPCs and accelerating recovery.

**Keywords:** Preoperative Chest Physiotherapy, Post-Operative Pulmonary Complication (PPCs), Elective Exploratory Laparotomy

## INTRODUCTION

Laparotomy is a surgical procedure in which an incision is made in the abdominal wall to gain access to the abdominal cavity for diagnostic or therapeutic purposes. Although surgical procedures involving the abdomen have existed since ancient times, laparotomy became a widely practiced surgical technique during the 19th and 20th centuries with the advancement of surgical knowledge, anesthesia, and aseptic techniques. Initially, laparotomies were mainly performed to manage acute abdominal conditions and traumatic injuries.<sup>[3]</sup> Over time, the procedure has evolved and is now used for a wide range of diagnostic and therapeutic purposes. The incision used during laparotomy may vary depending on the surgical requirement and patient condition, commonly including midline, transverse, or paramedian incisions.<sup>[1]</sup>

Exploratory laparotomy is a specific type of laparotomy performed when the exact cause of abdominal symptoms cannot be identified through non-invasive clinical investigations. It allows surgeons to directly examine the abdominal organs to determine the underlying pathology.<sup>4</sup> This procedure is often indicated in cases of abdominal trauma, unexplained abdominal pain, intra-abdominal bleeding, or suspected malignancies.<sup>[2]</sup> During exploratory laparotomy, the surgeon gains access to the entire abdominal cavity, including vital organs such as the liver, pancreas, spleen, kidneys, stomach, gallbladder, small intestine, large intestine, and major blood vessels.<sup>[6]</sup> The procedure is usually performed under general anesthesia and is considered a major surgical intervention.<sup>[5]</sup>

Despite its clinical importance, exploratory laparotomy is associated with a significant risk of postoperative complications. Among these, postoperative pulmonary complications (PPCs) are one of the most common and serious problems following major abdominal surgeries. These complications include conditions such as hypoxemia, atelectasis, and postoperative pneumonia.<sup>[4]</sup> The occurrence of PPCs is influenced by several factors, including the effects of general anesthesia, reduced diaphragmatic movement, postoperative pain, shallow breathing, and retention of pulmonary secretions. These complications can lead to delayed recovery, increased hospital stay, higher healthcare costs, and increased morbidity and mortality.<sup>[9]</sup>

Physiotherapy plays a crucial role in the prevention and management of postoperative pulmonary complications. Various physiotherapy interventions such as inspiratory muscle training, incentive spirometry, stacked breathing exercises, balloon-blowing exercises, and chest mobilization techniques are used to improve respiratory muscle strength, increase lung expansion, enhance airway clearance, and promote effective breathing patterns.<sup>[8]</sup> These interventions help maintain pulmonary function and reduce the risk of respiratory complications following surgery. Therefore, incorporating preoperative chest physiotherapy as part of patient management may significantly contribute to reducing postoperative pulmonary complications and improving recovery outcomes in patients undergoing exploratory laparotomy.<sup>[11]</sup>

## METHODOLOGY

**Study Design:** The present study was designed as a Experimental study to determine the effectiveness of preoperative chest physiotherapy For prevention of Post-Operative Pulmonary Complications (PPCs) in adults undergoing elective exploratory laparotomy. Ethical approval was obtained from the Institutional Ethics Committee of Dr APJ Abdul Kalam College of Physiotherapy,

Pravara Institute of Medical Sciences (PIMS), Loni (Approval Number: PIMS/DR.APJAKCOPT/IEC/2025/58). All procedures were carried out in accordance with institutional and national ethical guidelines. Written informed consent was obtained from each participant in their native language before inclusion in the study. Participants were recruited in coordination with the Surgery Wards at Dr. Vitthalrao Vikhe Patil Pravara Rural Hospital under Pravara Institute of Medical Sciences.

**Sample Size:** The sample select the 40 participant [both male and female] thosed admitted for the elective exploratory laparotomy. A random sampling method was used.

**Materials Used:** The following equipment was used for the study:

1. Consent form
2. Scales
3. Balloons
4. Incentive Spirometer device

**Inclusion Criteria:**

1. All genders
2. Age group 18-55 years old
3. Participants willing to participant in this study

**Exclusion Criteria:**

1. Participant who were hemodynamically unstable
2. Uncooperative participant
3. Participant with chest pain

**PROCEDURE**

This study was conducted at Pravara Rural Hospital, Loni, after obtaining ethical approval from the Institutional Ethical Committee of Dr. A.P.J. Abdul Kalam College of Physiotherapy. A total of 40 patients aged 18–55 years undergoing elective exploratory laparotomy were selected using simple random sampling. Participants who were hemodynamically stable and without chest trauma were included after obtaining written informed consent.

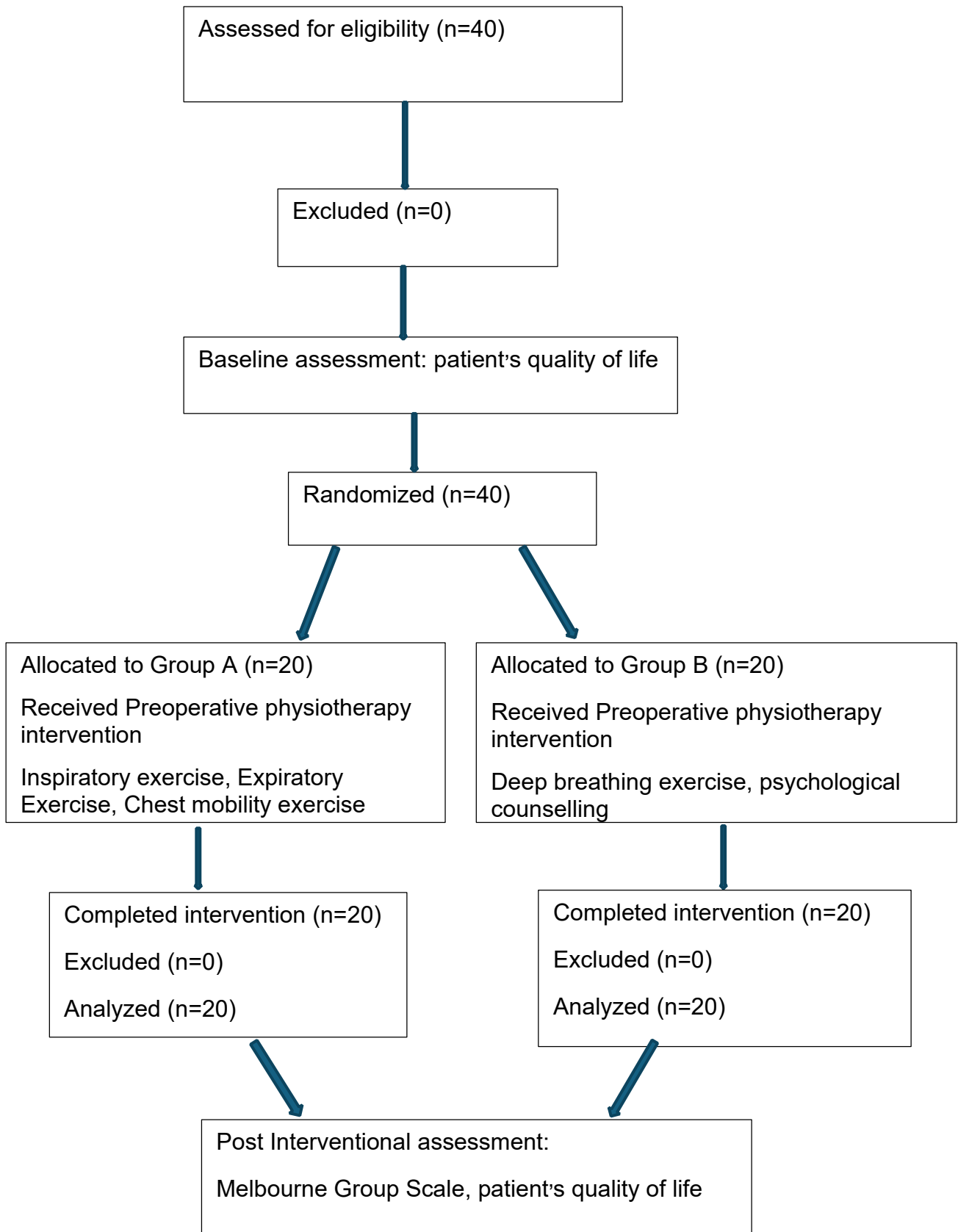
The participants were divided into two groups. Group A received advanced preoperative physiotherapy including incentive spirometry, balloon blowing, breath stacking, diaphragmatic release, and core stability exercises. Group B received standard physiotherapy including diaphragmatic breathing, thoracic expansion, pursed-lip breathing, functional mobility exercises, and counselling. The interventions were given for three days before surgery, and outcomes such as hospital stay and quality of life were recorded to evaluate the effectiveness of the treatment.

**OUTCOME MEASURES**

**Patient Quality of Life Scale** consists of 15 items that assess physical, psychological, and social aspects of a patient’s life, including pain, fatigue, mood, emotional stability, daily activities, and social relationships. Higher scores indicate a better quality of life and overall health status.

**Length of postoperative hospital stay** refers to the total number of days a patient remains hospitalized after surgery until discharge. Shorter hospital stays generally indicate better recovery and effective postoperative care, while longer stays may occur due to complications or delayed healing. This measure is commonly used to evaluate surgical outcomes and healthcare quality.

Flow Chart



**INTERVENTION PROTOCOL**

**GROUP A INTERVENTION**

Days	Intervention	Position/Repetitions	Effects
Day1	1)Patient Education	1 session	I. It enhances health outcome. II. Leads to better quality of life.
	2)Incentive Spirometer	Patient position: - Sitting with 10 breaths/ session,2-3 times/day	I. II. It helps the lung expansion. Maintain alveolar recruitment.
	3)Balloon Blowing Exercise	Patient position: - Sitting with 1 min blowing balloons with 4-6 long expiration, 2 Sessions/ day	I. II. It strengthens the intercostal muscles. It Improve oxygenation in lungs.
	4) Breath Stacking Technique	Patient position: - Sitting with 5-10 breath stacks/session,2-3 sessions/day	I. II. It improves oxygenation in lungs. It improves pulmonary function. III. Improve lung volume, IV. Improve peripheral oxygenation.
	5) Chest Mobility Exercises To mobilization upper chest and stretch pectoralis muscle Lateral stretching	Patient position: - Sitting with 10 reps*2-3 sets	Improve chest expansion and rib cage mobility. Improve diaphragmatic function. Improve lung expansion.
	1)Continue day 1 protocol		Same as above
Day2	2) Diaphragmatic release technique Costal fibers Right dome	Patient position: Supine 2 sets in 1015 deep breath in 1 min interval	I. Improve Diaphragmatic Mobility, strength.

	Posterolateral area Xyphoid costal area Lateral ligament Medial arcuate ligament		
	3) Core Stability  Pelvic tilt activation Transverses abdominis	Patient position: supine with 5-10 reps*2 set/day	I. Improve core and II. respiratory muscle strength. Reduce intraabdominal pressure.
Day3	1)Continue day 1 and 2 protocol		Same as above
	2)box breathing technique 4-4-4-4	Patient position: sitting with 4sec inhale-4sec hold4sec exhale4sec hold,10reps*2 sets	I. II. It reduces stress and anxiety. It helps lower heart rate and blood pressure.  III. It Improve sleep.
	3)lower limb mobility exercises Heel slides Ankle pumps Straight leg Raises Hip marching	Patient position: sitting/supine with 10-15 reps*2sets	I. II. Improve venous return. It helps maintain mobility, muscle activation and joint function.  III. Improve the circulation.
	4) Jacobson's relaxation technique	Patient position: sitting/supine 1 session/day	I. It regulates and calm down Autonomic nervous system. II. It Regulate the body temperature.

**GROUP B INTERVENTION**

Day	Intervention	Position/Repetitions	Effects
Day 1	1)Patient Education		It enhances health outcome. Leads to better quality of life.

	2)Diaphragmatic Breathing Exercise	Patient position:- Sitting with 10 breath/ session,2-3 times/day	It reduce use of accessory muscles.
	3)Thoracic Expansion exercise	Patient position:- Sitting with 10 breath/ session,2-3 times/day	It Enhances ventilation- perfusion distribution. It Prevents collapse of lung segments before and after surgery
	4) Pursed lip breathing	Patient position:- Sitting with 10 breath/ session,2-3 times/day	It Helps maintain positive airway pressure It Decreases respiratory rate and improves gas exchange.
	5)Upper extremity mobility exercise Shoulder ROM Stretching exercise	Patient position:- Sitting with 10 reps*2-3 sets	I. Enhances functional ability for ADLs after surgery. II. Maintains or improves shoulder mobility
Day 2	1)Continue Same as day1		Same as above
	2) paper Blowing exercise	Patient position:- Sitting with 10 breath/ session,2-3 times/day	I. It helps keep airways open. II. It reduced the breathlessness.
	3)lower extremity mobility exercise Dynamic quads Sit to stand on chair Spot marching Ambulation	Patient position:- Sitting/standing with 10-15reps*2-3 sets	better walking ability early after operation
Day 3	1)Continue same as day1 and 2		Same as above
	2) Psychological counselling		It reduces anxiety. Stabilizes emotional wellbeing. Improves coping ability.
	4)Nutritional counselling		Enhances muscle strength and energy levels.

**GROUP A INTERVENTIONS**



Incentive Spirometer



Balloon Blowing Exercise



Lower Limb Mobility Exercises



### Chest Mobility Exercises

- To mobilization upper chest and stretch pectoralis muscle
- Lateral stretching



Jacobson 's relaxation technique

**GROUP B INTERVENTION**



Diaphragmatic Breathing Exercise

Thoracic Expansion Exercise

Paper Blowing Exercise

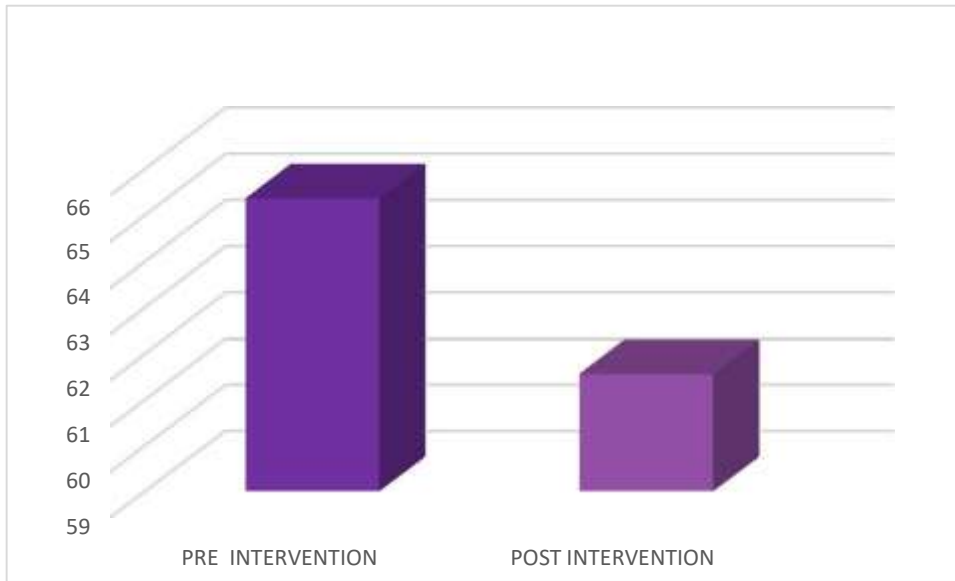


Lower extremity mobility exercise  
Dynamic quads  
Sit to stand on chair

**DATA ANALYSIS AND RESULTS:**

**Table 1.1 Quality of life-15 items Pre & Post-Intervention Group A mean difference**

QUALITY OF LIFE-15 ITEMS	MEAN	SD	T -VALUE	P-VALUE	Level of significance
PRE INTERVENTION	65.35	4.452	19.000	<0.0001	Extremely significant
POST INTERVENTION	61.55	4.925			

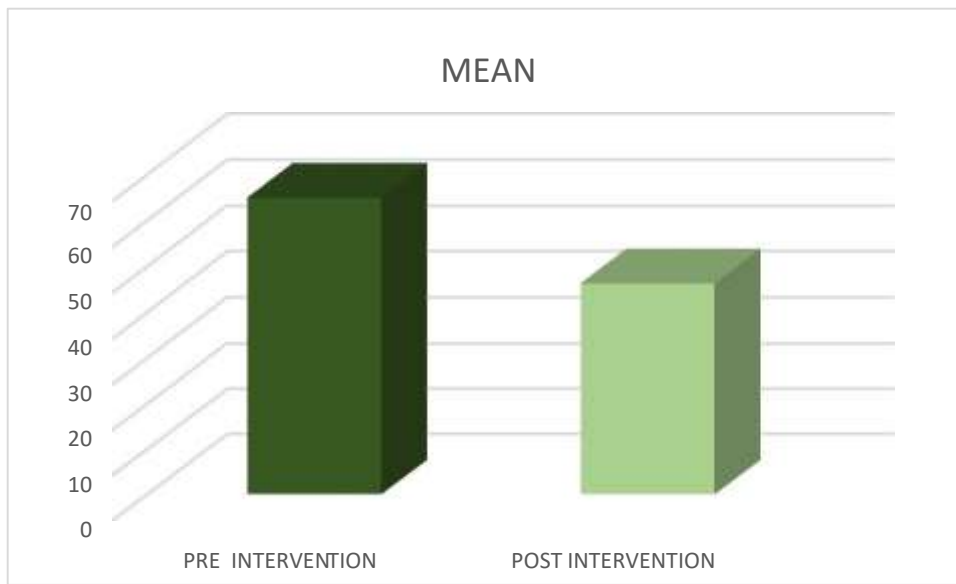


**Graph 1.1 Quality of life-15 items Group A Pre & Post-Intervention mean**

**DESCRIPTION:** The graph shows a significant change in quality of life (15items) from pre- to post-intervention in the Group A. In Quality of Life assessment using the T-test, a reduction in mean score represents improvement in the patient’s Condition. Therefore, the observed decrease in post-test mean values indicates an enhancement in quality of life following the intervention. This improvement is supported by the statistically significant difference between pre- and postintervention scores, demonstrating the effectiveness of the treatment.

**Table 1.2: Quality of life-15 items Pre & Post-Intervention Group B mean difference**

Quality of life-15 items	MEAN	SD	T VALUE	P VALUE	Level of significance
PRE INTERVENTION	64.9	4.266	38.382	<0.0018	Significant
POST INTERVENTION	46.2	5.376			

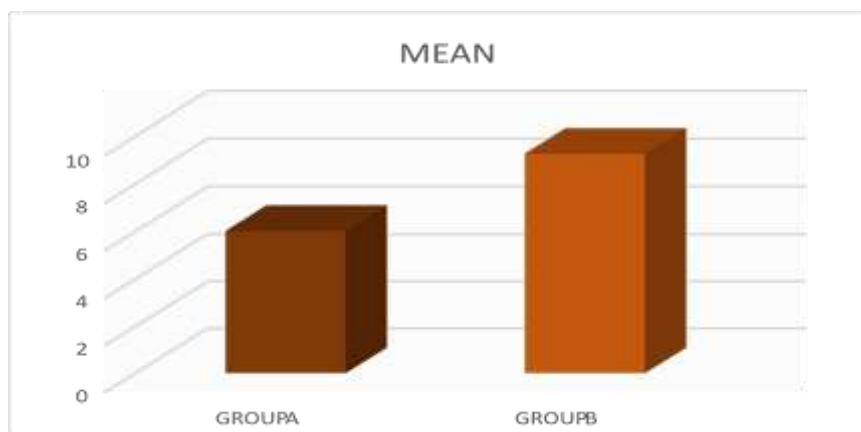


**Graph 1.2 Quality of life-15 items Group B Pre & Post-Intervention mean**

**DESCRIPTION:** The Quality of Life-15 scores in Group B showed a marked improvement after the intervention. The mean score decreased from 64.9 pre-intervention to 46.2 postintervention, with a highly significant difference ( $t = 38.382, p < 0.0001$ ), indicating that the intervention was extremely effective in enhancing quality of life.

**Table 1.3 Hospital Length Stay Comparisons between Group A and Group B Post Intervention Mean**

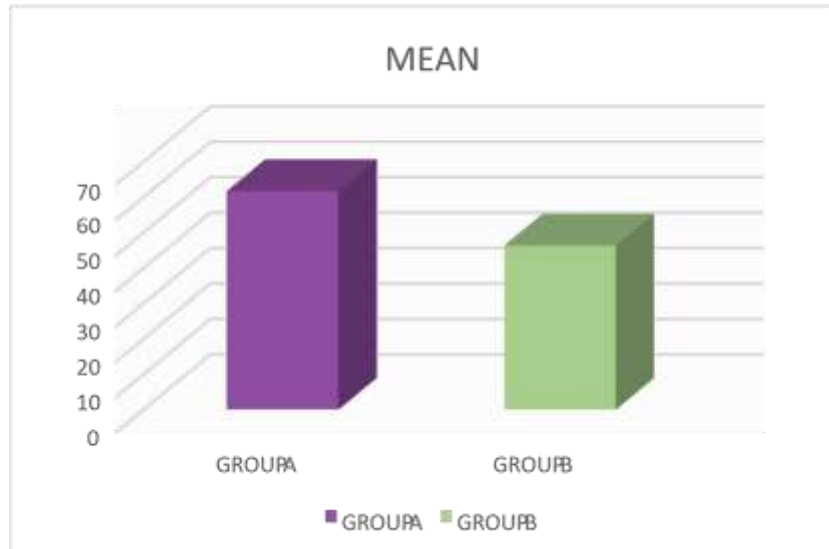
Hospital Length Stay	MEAN	SD	T VALUE	P VALUE	Level of significance
GROUP A	6.000	0.8584	10.049	<0.0001	Extremely significant
GROUP B	9.250	1.164			



**Graph 1.3 Hospital Length Stay Group A and Group B mean**

**DESCRIPTION:** The Group A had a significantly shorter hospital stay (mean = 6 days) compared to the Group B (mean = 9.250 days). The difference is statistically highly significant ( $t = 10.049$ ,  $p < 0.0001$ ), showing the intervention effectively reduced hospital length of stay.

**Table 1.4 Quality of life-15 items Comparisons between Group A and Group B Post Intervention Mean**



**Graph 1.4 Quality of life-15 items Comparisons between Group A and Group B Post Intervention Mean**

**DESCRIPTION:** Post-intervention results for the Quality of Life-15 items scale demonstrate a significant gap between the two study groups. Group A achieved a mean score of 61.550, which is substantially higher than the 46.200 mean score recorded for Group B. This difference is supported by a T-value of 9.415 and a Pvalue of  $< 0.0001$ , classifying the results as extremely signify

## DISCUSSION

This comparative experimental study was conducted during the academic year 2025–2026 at Pravara Rural Hospital, Loni, to evaluate the effectiveness of preoperative chest physiotherapy in patients undergoing elective exploratory laparotomy. Major abdominal surgeries can significantly affect respiratory function due to anesthesia, postoperative pain, diaphragmatic dysfunction, and reduced chest wall movement, which increases the risk of postoperative pulmonary complications (PPCs).

The results of the study showed that structured preoperative chest physiotherapy was more effective than conventional care in improving postoperative respiratory outcomes. Patients in Group A, who received advanced physiotherapy interventions such as incentive spirometry, breath stacking, and balloon-blowing exercises, showed better lung function and faster recovery compared to Group B, who received standard physiotherapy. These exercises helped improve lung expansion, inspiratory and expiratory muscle strength, chest wall mobility, and secretion clearance, which are important for preventing pulmonary complications after surgery. As a result, Group A patients experienced fewer respiratory complications, which contributed to earlier mobilization and faster recovery.

The study also found a significant difference in postoperative hospital stay. Patients in Group A had an average hospital stay of 6.05 days, whereas Group B stayed for 9.35 days, indicating that preoperative physiotherapy can reduce hospitalization time and healthcare costs. Additionally, quality of life scores

were higher in Group A (61.55) compared to Group B (46.2), suggesting that the physiotherapy program improved both physical recovery and psychological well-being. Overall, the findings support the importance of preoperative respiratory physiotherapy (respiratory prehabilitation) as an effective strategy to reduce postoperative pulmonary complications, improve patient recovery, and enhance quality of life in individuals undergoing exploratory laparotomy.

### **Clinical Implication for Practice**

The study highlights the importance of starting physiotherapy before surgery rather than only after surgery. A 3-day preoperative physiotherapy (prehabilitation) program helps strengthen respiratory muscles and improve diaphragmatic function before the effects of anesthesia and postoperative pain occur. This proactive approach can reduce pulmonary complications such as pneumonia and atelectasis, improve patient recovery, and optimize the use of hospital resources

### **LIMITATIONS AND STRENGTH**

#### **LIMITATION**

1. The research was undertaken using a relatively smaller sample base of 40 people.
2. The period of the intervention was short and limited to a preoperative three-day protocol.
3. The research targeted only a certain age group, ranging from 18 to 55 years.

#### **STRENGTH**

The study used a structured multi-modal physiotherapy program including incentive spirometry, balloon blowing, and breath stacking, which proved more effective than traditional care alone. It also allowed patients to learn and practice breathing techniques before surgery while they were pain-free, improving their ability to perform them after the operation

#### **Future Scope**

Future studies should include larger, multi-centered studies to broaden the findings of this research. Moreover, investigating the effect of technology-assisted home-based preoperative exercises may, in turn, broaden the availability of effective interventions.

### **CONCLUSION**

In conclusion, this study demonstrates that a structured preoperative chest physiotherapy regimen incorporating incentive spirometry, Balloon blowing, and the breath stacking technique is significantly more effective than standard conventional breathing exercises in preventing Post-operative Pulmonary Complications (PPCs) in adults undergoing elective exploratory laparotomy. The data reveals that participants receiving this advanced intervention experienced fewer clinical symptoms of respiratory distress, a marked improvement in overall quality of life, and a substantial reduction in the length of hospital stay. By implementing these exercises before surgery, patients were able to master the techniques while pain-free, leading to better compliance and more efficient lung expansion during the critical recovery phase. Consequently, integrating "respiratory prehabilitation" into the standard surgical care pathway serves as a cost-effective and non-invasive strategy to optimize clinical outcomes and accelerate the functional recovery of surgical patients.

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