

**How to Cite:**

Al-Najar, K. M., Ibraheem, M. H., Zaki, R. M., Mohamed, D. A., Hady, A. A. A. A., & EL-Nahas, N. G. (2022). Effect of respiratory muscle training on ventilatory function in women post mastectomy. *International Journal of Health Sciences*, 6(S9), 3205–3213.  
<https://doi.org/10.53730/ijhs.v6nS9.13268>

# Effect of respiratory muscle training on ventilatory function in women post mastectomy

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**Abstract**--Mastectomy is one of the widely spread surgeries to remove breast cancer, however, this type of intervention disturbs the ventilatory function of the patient after surgery. The role of physical therapy is crucial in such cases as to improve the function of the respiratory system, and chest expansion, decrease the severity of dyspnea, and provide better health after mastectomy. Purpose: to study the effect of respiratory muscle training by using (The Breather) on ventilatory functions in women after mastectomy. Objectives: 40 women with unilateral post-mastectomy were randomly selected from

Baheya Center with an age range from (40-50) years old. (Received radiotherapy /chemotherapy and physical therapy sessions), divided into 2 equal groups (each group=20). Methodology: Group A received respiratory muscle training with the breather device with physical therapy rehabilitation and Group B received physical therapy rehabilitation only. Both groups received sessions twice weekly for 12 weeks. Equipment used for evaluation: ventilatory function measuring device (Spirometer) used to measure ventilatory function (FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, MVV), Tape measurement used to measure chest expansion, and Functional Assessment of Chronic Illness Therapy - Dyspnea-10 item (FACIT-Dyspnea) Questionnaire. Results: There was a significant increase in FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, and MVV in groups A and B post-treatment compared with results of pre-treatment. The percent of change in FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, and MVV in group A was 51.42, 89.73, 22.86, 129.6, and 2.78% while that in group B was 22.49, 43.06, 15.25, and 62.58% respectively. However, there was no significant difference in the chest expansion between groups. There was a significant decrease in FACIT-Dyspnea and FACIT-Functional limitation in groups A and B. The percent of change in FACIT-Dyspnea and FACIT-Functional limitation in group A was 61.08 and 68.01% respectively while that in group B was 43.24 and 51.76% respectively. Conclusion: The breather showed improvement in ventilatory function when added to physical therapy rehabilitation after mastectomy.

**Keywords**--respiratory muscle training, ventilatory function, post mastectomy.

## Introduction

A mastectomy is a surgical procedure involving the removal of all or part of the breast. The term originates from the Greek word mastos, meaning woman's breast, and the Latin term ectomia which signifies excision. Mastectomy classifies into partial, simple, modified-radical, and radical (Goethals A, Rose J., 2022). Worldwide, there were about 2.1 million newly diagnosed female breast cancer cases in 2018, accounting for almost one in four cancer cases among women, and ~630 000 died of it. Breast cancer incidence has increased since the introduction of mammography screening and continues to grow with the aging of the population (ECIS, 2019).

The occurrence of lesions or the removal of serratus, pectoralis major, and pectoralis minor muscles, the presence of a surgical drain, superficial breathing, fear of experiencing pain, and/or use of analgesics may diminish thoracic expansion altering respiratory mechanics. However, with improved survival rates, more patients are facing persistent treatment-related symptoms. These treatments can be surgical, systemic (hormonal therapy and chemotherapy), and radiotherapy which, in turn, can have adverse effects on the respiratory system (Gomide, L.B.; Matheus, J.P.C.; Candido Dos Reis, F.J., 2007). Respiratory Muscle Training (RMT) can be defined as a technique that aims to improve the function of the respiratory muscles through specific exercises. It consists of a

series of exercises, breathing, and others, to increase the strength and endurance of the respiratory muscles and therefore improve respiration. (Pereira MC, 2019). The Breather is the first drug-free device for those who suffer from shortness of breath, speech and swallow difficulties, COPD, and other chronic illnesses resulting in respiratory muscle weakness. The breather is used to Practice Respiratory Muscle Training (RMT) at home to strengthen the lungs and improve respiratory fitness, get more oxygen that the body needs to function and improve mental clarity, and reduce the need for treatments through easing symptoms of COPD, stroke, asthma, CHF, hypertension, Parkinson's and more (pnmedical.com, 2022)

## **Methods**

### **Ethical Consideration**

Faculty of physical therapy ethical committee approved number: P.T.REC/012/002495. The experimental procedures and potential risks were fully explained to the patients before the study, & all patients signed informed consent. Confidentiality was assured. The study has been conducted at Baheya foundation for early detection & treatment of breast cancer from February 2021 to November 2021.

### **Inclusion Criteria**

Women post-mastectomy (modified radical mastectomy (MRM), simple mastectomy), unilateral mastectomy, married women, overweight or obese (BMI), and patients treated with radiotherapy/chemotherapy.

### **Exclusion Criteria**

Other breast cancer surgeries (e.g., axillary clearance, central quadrantectomy, or lumpectomy), bilateral mastectomy, single women, pregnancy, underweight patients, visual impairment (that affects the efficiency of the exercise), hemiplegia, or any mental/ physical disability.

## **Subjects**

40 female patients were selected from Baheya foundation for early detection & treatment of breast cancer to participate in this study with an age range from (40-50) years old. All patients were evaluated by ventilatory function measuring device (MEDITECH - SpirOx plus Spirometer, new version 2019/2020) used to measure ventilatory function (FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, MVV), tape measurement used to measure chest expansion, FACIT-Dyspnea Questionnaire (10 Item Short Form) used to assess dyspnea and functional limitation and all patients re-assessed after 12 weeks. They were assigned randomly into two groups A & B, equally in number (n=20). Group A received: respiratory muscle training device (The Breather), and physical therapy rehabilitation sessions, performed 2 times per week for 12 weeks. Group B received: physical therapy rehabilitation sessions only, performed 2 times per week for 12 weeks.

## Treatment procedure

Every patient had instructions on the procedure & before the beginning of treatment sessions. Measurements of ventilatory function (FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, MVV), chest expansion, and Functional Assessment of Chronic Illness Therapy - Dyspnea-10 item (FACIT-Dyspnea) Questionnaire were recorded before and after receiving the treatment sessions. Group A received respiratory muscle training with (The Breather) device [(each set formed of 10 repetitions = breaths include (inhale/exhale), then 1-2 minutes break, followed by 10 repetitions = breaths include (inhale/exhale)] each session consists of 2 sets. In addition to physical therapy sessions [consisted of Intermittent Pneumatic Compression pump, Shoulder Wheel, Wall Bar with Finger Ladder, Cycle Ergometer (arm minibike), Upper Limb Continuous Passive Motion (CPM) machine, and active exercises for the upper limb]] and Group B received physical therapy session only. Both groups received treatment sessions twice weekly for 12 weeks.

## Results

### Statistical analysis

Unpaired t-test were conducted for comparison of subject characteristics between groups. The normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to ensure homogeneity between the group. Mixed MANOVA was conducted to compare the effect of time (pre versus post) and the effect of treatment (between groups), as well as the interaction between time and treatment on mean values of FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, MVV, chest expansion, and FACIT-Dyspnea. Post-hoc tests using the Bonferroni correction were carried out for subsequent multiple comparisons. The level of significance for all statistical tests was set at  $p < 0.05$ . All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

### Subject characteristics

Table (1) showed the subject characteristics of groups A and B. There was no significant difference between both groups in the mean age, weight, height, and BMI ( $p > 0.05$ ).

Table 1  
Comparison of subject characteristics between groups A and B

	Group A Mean ± SD	Group B Mean ± SD	p-value
Age (years)	47.9 ± 3.83	47.7 ± 3.01	0.85
Weight (kg)	82.35 ± 9.72	81.15 ± 12.41	0.73
Height (cm)	163.55 ± 7.7	162.3 ± 5.35	0.55
BMI (kg/m <sup>2</sup> )	30.86 ± 3.84	30.78 ± 4.33	0.95

SD: Standard Deviation; p-value: the probability value

**Effect of treatment on FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, MVV, chest expansion, and FACIT-Dyspnea**

Mixed MANOVA revealed that there was a significant interaction between treatment and time ( $F = 7.35$ ,  $p = 0.001$ ). There was a significant main effect of time ( $F = 234.02$ ,  $p = 0.001$ ). There was a significant main effect of treatment ( $F = 3.39$ ,  $p = 0.008$ ).

**Ventilatory Function (FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC, MVV) (Table 2)  
Effect of treatment on FVC**

The mean difference in FVC between group A and B pre-treatment was 0.03 L. There was no significant difference in the FVC between groups pre-treatment ( $p = 0.88$ ). The mean difference in FVC between groups A and B post-treatment was 0.65 L. There was a significant increase in the FVC, and the percentage of change of group A (51.42 %) compared to group B (22.49 %), ( $p = 0.001$ ).

**Effect of treatment on FEV<sub>1</sub>**

The mean difference in FEV<sub>1</sub> between group A and B pre-treatment was 0.02 L. There was no significant difference in the FEV<sub>1</sub> between groups pre-treatment ( $p = 0.82$ ). The mean difference in FEV<sub>1</sub> between groups A and B post-treatment was 0.71 L. There was a significant increase in the FEV<sub>1</sub>, and the percentage of change of group A (89.73 %) compared to group B (43.06 %), ( $p = 0.001$ ).

**Effect of treatment on FEV<sub>1</sub>/FVC**

The mean difference in FEV<sub>1</sub>/FVC between group A and B pre-treatment was 0.26%. There was no significant difference in the FEV<sub>1</sub>/FVC between groups pre-treatment ( $p = 0.92$ ). The mean difference in FEV<sub>1</sub>/FVC between groups A and B post-treatment was 5.56%. There was a significant increase in the FEV<sub>1</sub>/FVC, and the percentage of change of group A (22.86 %) compared to group B (15.25 %), ( $p = 0.001$ ).

**Effect of treatment on MVV**

The mean difference in MVV between group A and B pre-treatment was -1.28 L/min. There was no significant difference in the MVV between groups pre-treatment ( $p = 0.79$ ). The mean difference in MVV between groups A and B post-treatment was 27.58 L/min. There was a significant increase in the MVV, and the percentage of change of group A (129.60 %) compared to group B (62.58 %), ( $p = 0.001$ ).

**Effect of treatment on chest expansion (Table 2)**

The mean difference in chest expansion between group A and B pre-treatment was 0.09 cm. There was no significant difference in the chest expansion between groups pre-treatment ( $p = 0.97$ ). The mean difference in chest expansion between groups A and B post-treatment was 1.19 cm. There was no significant difference

in the chest expansion between groups post-treatment ( $p = 0.67$ ), and the percentage of change of group A (2.78%) compared to group B (1.59%).

**Functional Assessment of Chronic Illness Therapy-Dyspnea 10 item (FACIT-Dyspnea) Questionnaire (Table 3)**

- Effect of treatment on FACIT-Dyspnea:  
The mean difference in FACIT-Dyspnea between group A and B pre-treatment was -0.3. There was no significant difference in the FACIT-Dyspnea between groups pre-treatment ( $p = 0.71$ ). The mean difference in FACIT-Dyspnea between groups A and B post-treatment was -4.8. There was a significant decrease in the FACIT-Dyspnea, and the percentage of change in group A (61.08 %) compared to group B (43.24 %), ( $p = 0.001$ ).
- Effect of treatment on FACIT-Functional limitation:  
The mean difference in FACIT-Functional limitation between group A and B pre-treatment was 0.25. There was no significant difference in the FACIT-Functional limitation between groups pre-treatment ( $p = 0.73$ ). The mean difference in FACIT-Functional limitation between groups A and B post-treatment was -4.3. There was a significant decrease in the FACIT-Functional limitation, and the percentage of change of group A (68.01 %) compared to group B (51.76 %), ( $p = 0.001$ ).

Table 2  
Mean FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC, MVV, and chest expansion pre- and post-treatment of the group A and B

	Pre-treatment	Post-treatment	MD	% of change	p-value
	Mean $\pm$ SD	Mean $\pm$ SD			
FVC (L)					
Group A	2.12 $\pm$ 0.51	3.21 $\pm$ 0.57	- 1.09	51.42	0.001
Group B	2.09 $\pm$ 0.52	2.56 $\pm$ 0.49	- 0.47	22.49	0.001
MD	0.03 p = 0.88	0.65 p = 0.001			
FEV <sub>1</sub> (L)					
Group A	1.46 $\pm$ 0.28	2.77 $\pm$ 0.6	- 1.31	89.73	0.001
Group B	1.44 $\pm$ 0.25	2.06 $\pm$ 0.31	- -0.62	43.06	0.001
MD	0.02 p = 0.82	0.71 p = 0.001			
FEV <sub>1</sub> /FVC (%)					
Group A	70.31 $\pm$ 9.75	86.38 $\pm$ 7.16	- 16.07	22.86	0.001
Group B	70.05 $\pm$ 7.78	80.73 $\pm$ 7.61	- 10.68	15.25	0.001
MD	0.26	5.65			

MVV (L/min)	p = 0.82	p = 0.02			
Group A	44.26 ± 15.66	101.62 ± 15.67	-57.36	129.60	0.001
Group B	45.54 ± 15.78	74.04 ± 12.23	-	62.58	0.001
MD	-1.28	27.58			
	p = 0.79	p = 0.001			
Chest expansion (cm)					
Group A	92.35 ± 9.57	94.92 ± 9.59	-2.57	2.78	0.001
Group B	92.26 ± 7.82	93.73 ± 7.94	-1.47	1.59	0.001
MD	0.09	1.19			
	p = 0.97	p = 0.67			

SD: Standard Deviation; MD: Mean Difference; p-value: the Probability value

Table 3  
Mean FACIT-Dyspnea pre- and post-treatment of the group A and B

	Pre-treatment	Post-treatment	MD	% Of change	p-value
	Mean ± SD	Mean ± SD			
FACIT-Dyspnea					
Group A	25.95 ± 2.83	10.10 ± 2.84	15.85	61.08	0.001
Group B	26.25 ± 2.17	14.9 ± 3.69	11.35	43.24	0.001
MD	-0.3	-4.8			
	p = 0.71	p = 0.001			
FACIT-Functional limitation					
Group A	27.2 ± 2.46	8.7 ± 2.57	18.5	68.01	0.001
Group B	26.95 ± 2.06	13 ± 3.41	13.95	51.76	0.001
MD	0.25	-4.3			
	p = 0.73	p = 0.001			

SD: Standard Deviation; MD: Mean Difference; p-value: the Probability value

## Discussion

This study was to monitor the pulmonary function, chest expansion, and dyspnea of patients who underwent mastectomy from the immediate postoperative period until 12 weeks after it. The results of the present study coincided with the results obtained by (Luz et al.,2020), who monitored pulmonary function and respiratory muscle strength of patients who underwent surgery for breast cancer from the preoperative period until 60 days after it. The main findings of the study are that breast cancer surgery does not impact long-term respiratory outcomes. There were transitory changes in pulmonary function and respiratory muscle strength in the 48h postoperative period, with a return to baseline values after 30 days, and their maintenance at 60 days. The results of this study are inconsistent with (Nikita et al., 2020), who claimed that all parameters that are before and after

radiation therapy changes were observed, and the changes were statistically not significant. But clinically in the case of FEV<sub>1</sub> which signifies larger airway obstruction shows an increase in the first week when compared with pre-radiation but the sudden reduction in the 2nd week was seen and gradual improvement in 3rd 4th and 5th weeks was observed. Some changes were seen in FVC, and PEFV values. But when considering FEV<sub>1</sub>/FVC, which is an important parameter to decide whether the lung has obstructive/restrictive changes, it shows not many changes that are pre-and post-radiation.

On the other hand, (Jafari et al., 2019) studied the Pulmonary Function Test changes two months after breast Radiotherapy; they concluded that no significant correlation between volumes of irradiated lung and spirometry parameters, so with increased volume of the lung there was no decrease in spirometry parameters (FEV<sub>1</sub>, FVC, FEV<sub>1</sub>/FVC). Similarly, to the results of this study, (Duruturk et al., 2018) found that inspiratory muscle training in patients with asthma can lead to improvement in respiratory muscle performance, exercise capacity, the activity of daily living, health-related quality of life, and a further decline in dyspnea and fatigue. Parallel with the present study, (ELKINS M. and DENTICE R., 2015) mentioned that the improvement in ventilatory functions may be due to improvement in the patient's pattern of breathing due to enhancement in respiratory muscle strength and endurance as IMT applies load to the diaphragm and accessory muscle which assist to increase tidal volume and pulmonary function. Increased functional capacity after intervention resulted from the improvement of respiratory muscle strength and endurance leading to enhancement of pulmonary O<sub>2</sub> uptake and reductions of dyspnea.

In contrast, changes in lung capacity and volume are expected after radiation therapy; therefore, the risk of damaging pulmonary parenchyma, and type 2 pneumocystis, however, there is a possibility of patients never show any changes due to compensation with healthy lungs which do not receive radiation (Santos DE et al., 2013). In addition to the results of the present study, (Bregagnol RK, Dias AS, 2010), reported that patients after breast cancer surgery present a reduction of forced expiratory volume in the first second (FEV<sub>1</sub>), forced vital capacity (FVC), and of respiratory muscles strength immediately after axillary lymphadenectomy, with a return to baseline values 30 days after surgery. The results in this study contradicted the results of (Jigar N Mehta, Nirav P Vaghela, Heta Patel, 2018), there was a significant difference in pre- and post-chest expansion values for which  $P < 0.005$  which is highly significant. There is a reduction in chest expansion because of incisional pain and a decrease in shoulder girdle movement. During vigorous or prolonged exercise, it is apparent that the speed and depth of respiration are increased. Despite the results of this study, (Ivanovski, Tanja & Potijk, Froukje., 2016), found that breast cancer survivors have significantly less chest expansion in comparison to healthy controls in position one at the axillary level. On the other measurement locations, xiphoid level, and axillary- and xiphoid level, breast cancer survivors had between 0.7 and 1.2 centimeters less chest expansion compared to healthy age-matched women.

## Conclusion

The effect of respiratory muscle training (the breather) after mastectomy is undeniable and remarkable, especially when combines with physical therapy rehabilitation, and that had significant effects on ventilatory functions, and dyspnea. Moreover, The Breather should be recommended for patients after mastectomy to be part of their routine care.

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