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# IMMEDIATE EFFECT OF DIAPHRAGMATIC STRETCHING ON PULMONARY FUNCTION TEST AND CHEST EXPANSION IN ASTHMATIC SUBJECTS: EXPERIMENTAL STUDY

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## ***INTRODUCTION***

In India, chronic respiratory diseases account for 3% of Disability Adjusted Life Years (DALYs); together COPD, asthma, and other respiratory diseases are the second leading cause of death in the Indian population and fourth in the world according to WHO ([2],[3])

Asthma is an chronic inflammatory disorder of the airways in which cells and cellular elements play a role. The chronic inflammation is associated with airway hyper responsive that leads to recurrent episodes of wheezing, breathless, chest tightness and coughing particularly at night and early morning ( [1])

The diaphragm, which is the main inspiratory muscle ,generates a craniocaudal movement of its dome during contraction [[4]]. The two striking features in COPD, airtrapping and lung hyperinflation, impair the function of the diaphragm, shortening its operating length and changing the mechanical linkage between its various parts there by placing it at mechanical disadvantage [[5]]. These pathological changes affect the diaphragm's ability of raising and expanding the lower rib cage which may lead to a decrease in the transverse diameter of the lower ribcage during inspiration. These changes cause an increase in the work of breathing and reduce the functional capacity [[6], [7]].

Hyperinflation affects the respiratory muscle interaction which leads to length changes in the diaphragm and intercostal muscles. So due to this chronic adaptability occurring in the skeletal muscles there will be reduction of number of sarcomeres in the muscle fibers by which the force generating capacity of the muscles will be altered and acquires the shortened position which leads to reduction of mobility in the muscles of respiration causing chest tightness and decreased chest expansion[[12]]

Some evidence suggests that manual therapy has the potential to affect and change respiratory mechanics in certain chronic pulmonary diseases, such as chronic asthma and COPD, which includes an increase in flexibility of the chest wall and thoracic excursion. This can indirectly lead to an improvement in exercise capacity and lung function [[8],[9]]. There is also evidence that respiratory muscle stretching may bring about an improvement in ventilation in patients with COPD by increasing the capacity for chest wall (CW) expansion [[10],[11]].

Stretching of muscle fibers promotes increase in the number of sarcomeres in shortened muscles and increases muscle length. An adequate length of respiratory muscles would promote an overall improvement in their

contractile capacity and an increase in thoracic Expansion and providing benefits in the performance of respiratory mechanics. [12]

The diaphragmatic stretch technique or doming of diaphragm technique is designed to relax the resting state of the diaphragm, enhancing its contraction and relaxation functions, thereby creating a greater pressure gradient between the thorax and abdomen [13].

Gonzalez- ´ Alvarez FJ et al. applied the diaphragm stretch ´ technique to check ribcage and abdominal excursion in healthy subjects and found a significant increase in the same level at xiphoid level [14].Yelvar YDG studied the immediate effects of manual therapy on inspiratory muscle strength and respiratory functions in patients who were a known case of COPD with no current or ongoing exacerbation, by applying the Redoming of diaphragm technique which showed an improvement in pulmonary function and inspiratory muscle strength [15].

## ***NEED OF STUDY***

- In India, chronic respiratory diseases account for 3% of Disability Adjusted Life Years (DALYs); together COPD, asthma, and other respiratory diseases are the second leading cause of death in the Indian population and fourth in the world according to WHO (2,3)
- In 2004, it was estimated that 57 000 deaths in India were attributed to asthma; it is one of the leading causes of morbidity and mortality in rural India, and is projected to increase in the coming decades.
- In INDIA there are very less research articles on Diaphragmatic stretching.
- There is no research on Diaphragmatic stretching in asthmatic subjects.
- Limited studies are available in Indian population and less survey has been done on diaphragmatic stretching in asthmatic population. Hence, this study was designed to access IMMEDIATE EFFECT OF DIAPHRAGMATIC STRETCHING ON PULMONARY FUNCTION AND CHEST EXPANSION IN ASTHMATIC SUBJECT.

## AIM

To study the immediate effect of diaphragmatic stretching on pulmonary function and chest expansion in asthmatic subjects

## OBJECTIVE

- The objective of the study is to
  1. To Assess the Immediate effect of diaphragmatic stretching on pulmonary function in asthma subjects.
  2. To Assess the Immediate effect of diaphragmatic stretching on Chest expansion in asthma subjects.

## MATERIAL AND METHODOLOGY

### Materials

- Spirometer
- Pen
- Paper
- Inch tape
- Cotton
- Betadine
- Use and throw mouth piece

- GINA scale

## METHODOLOGY:

**1. Study Design**- Experimental study

**2. Method of Sampling**- Simple random sampling

**3. Sample Size**- 22

**4. Place of Study**- Dr. Ulhas Patil Collage Of Physiotherapy, Jalgaon

**5. Study Population**- Asthmatic subjects

**6. Study Duration-** 6 months

**7. Selection Criteria**

- **Inclusion criteria**

1. Subjects who are suffering from mild to moderate Asthma according to GINA scale.

2. Subjects willing to participate in the study.

3. All male and female with Asthma with age group of 18-50 years old.

- **Exclusion criteria**

1. Individuals with other co-morbidities.

2. History of psychiatric illness

3. Patients with unstable hemodynamic parameters (arterial pressure<100mmHg systolic and <60mmHg for diastolic and mean arterial pressure (MAP) <80mmHg).

4. Patients who have undergone recent cardiothoracicor abdominal surgery.

5. Patients who have a recent history of chest wall or abdominal trauma; substantial chest wall deformity.

6. BMI more than 28.

## PROCEDURE

The study was approved by the Institutional ethical committee of Dr. Ulhas Patil college of physiotherapy Jalgaon. Eligible patients were selected based on inclusion and exclusion criteria. The purpose of study was made clear to each patient and a written consent was obtained prior to involving them in the study. A total 22 samples were selected and information about the technique was explained to the subjects. After taking the demographic data and baseline values of the outcome measures ( Pulmonary function test by using spirometer and chest expansion by inch tape performed by the therapist). Diaphragmatic Stretch Technique was given to the subject for 30sec hold with 1-minute interval between the sets for 3 sets. The two outcome measure were recorded immediately after the intervention.

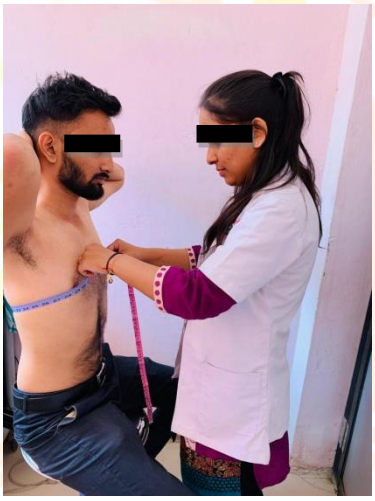
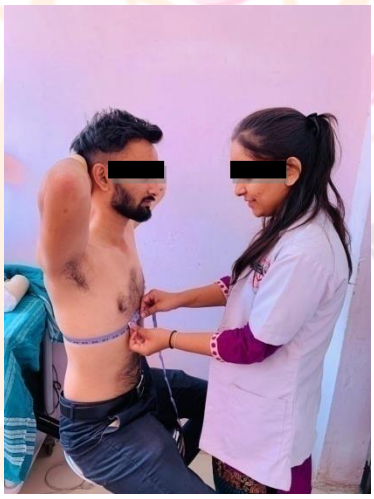
### Method to perform the technique

**Diaphragmatic Stretch Technique**:- The subjects were asked to sit erect for the intervention. The therapist standing behind the subject pass their hands around the thoracic cage, introducing fingers in the subcostal margins. The subject's trunk was rounded slightly to relax the rectus abdominis. As the subject exhaled, the therapist easing their hands caudally grasped the lower ribs at the subcostal margin. This firm, but gentle, traction was maintained as the patient inhales.

### Description of outcome measures

**Pulmonary Function:-** Pulmonary function test was performed by using a portable electronic spirometer. Initially name, age, height, weight of the patient were entered in to the data of machine in order to get percentage predicted values. The patient is placed in a comfortable sitting position and was instructed to put the mouth piece in mouth and inhale as much as possible and then exhale rapidly and forcefully for as long as flow can be maintained. This was repeated for as long as three times until the largest value of FVC and FEV1 was given out automatically by spirogram with flow volume chart.


**Chest Expansion**:- The chest expansion was assessed with the patients standing with their hands placed on their head. They were given instructions to "breathe in maximally" and "breathe out maximally." Chest expansion was measured at three levels. Upper chest expansion at the level of the 2nd intercostal space, 4th intercostal space and lower chest expansion at the level of the xiphoid process.

## Statistical Analysis

- The data was collected from the participants and the obtained data from the study was entered in MS Excel before it was statistically analyzed.
- Means and standard deviations were calculated for all the needed variables. Statistical analysis was performed with data and it was analyzed by using Instat (version 3.05) software using paired T test.
- Normality was checked using Kolmogorov- Smirnov test with $P<0.05$. Level of significance was set at 0.021 and confidence interval of 95%.

## RESULTS

- A total 22 subjects with asthma were included in the study who met the inclusion and exclusion criteria .

| GENDER | FREQUENCY | PERCENTAGE |
|---|---|---|
| MALE | 7 | 32 |
| FEMALE | 15 | 68 |

Table 1:- Baseline data of participants based on gender

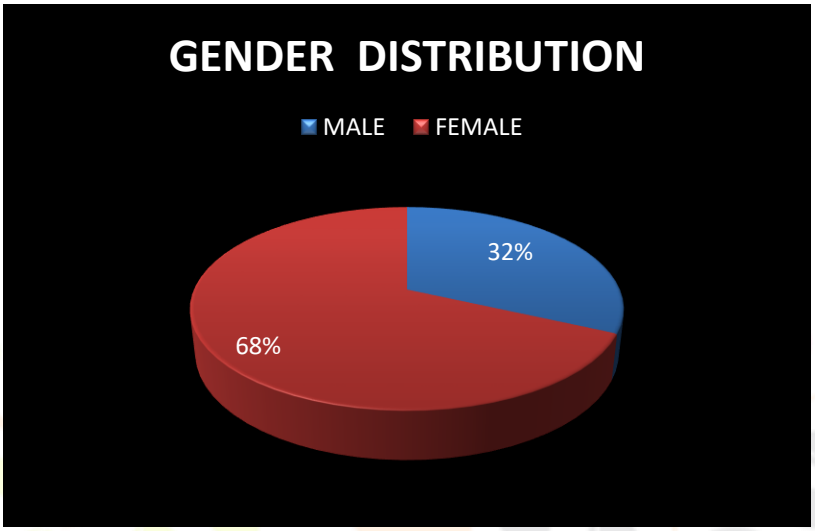
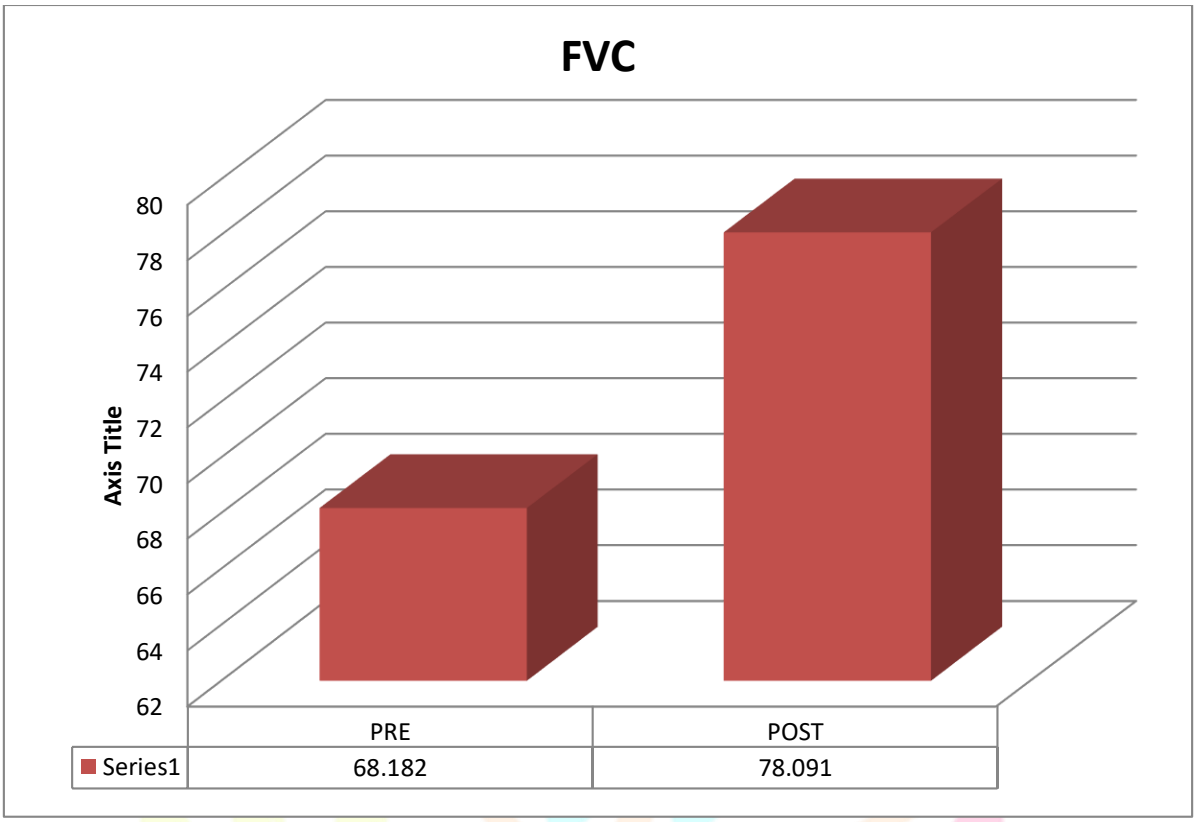



Table 1 and Graph 1 shows the distribution of males and females

i.e. male population was 32% and female population was 68%

Table 2:- Comparison of Pre and Post mean FVC %

| Parameter | Follow up | Mean+ SD | Mean Difference | Degree of freedom | t value | P value | Significance |
|---|---|---|---|---|---|---|---|
| FVC | Pre-Treatment | **68.18+ 24.92** | **9.909** | **21** | **4.041** | **0.0006** | **Extremely Significant** |
| | Post-Treatment | **78.09+ 23.25** | | | | | |

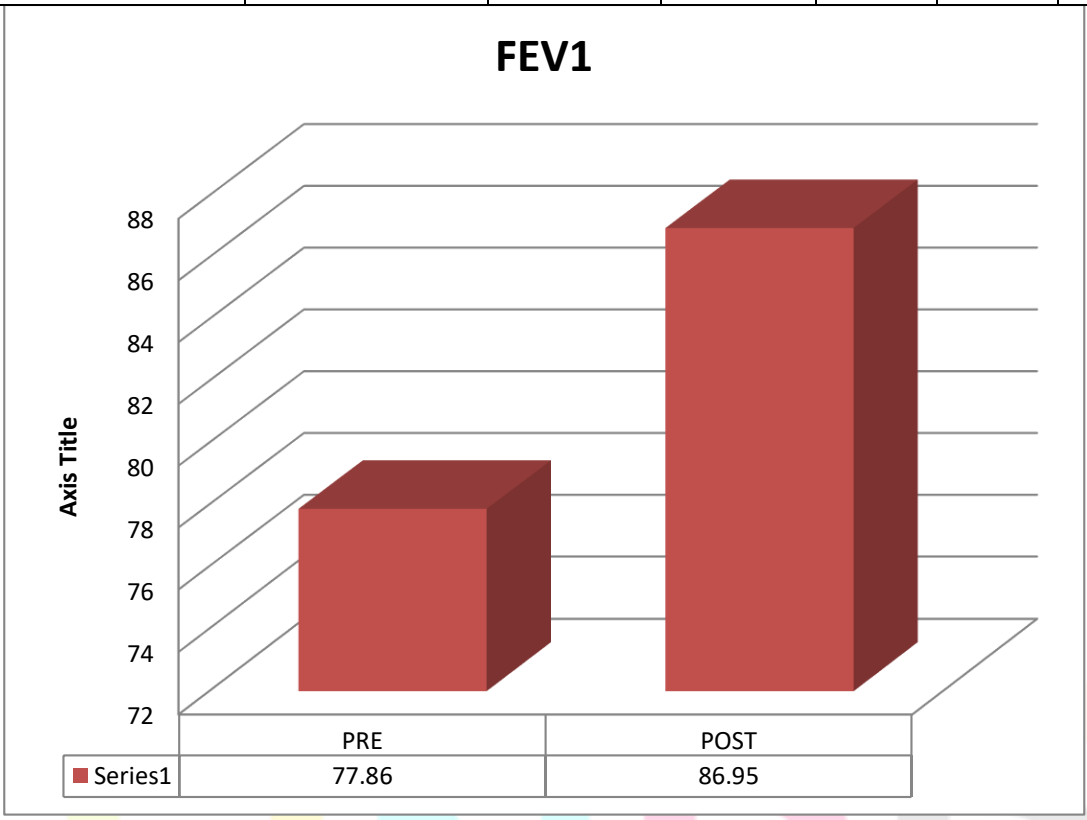



The Pre and post comparison of FVC is shown in Table 2 and Graph 2, pre-test mean value of FVC is 68.18+ 24.92, when it is compared with post- test mean value of FVC i.e. 78.09+ 23.25, the observed p value is 0.0006, which shows there is Extremely significant improvement in FVC.

Table 3:- Comparison of Pre and Post mean FEV1 %

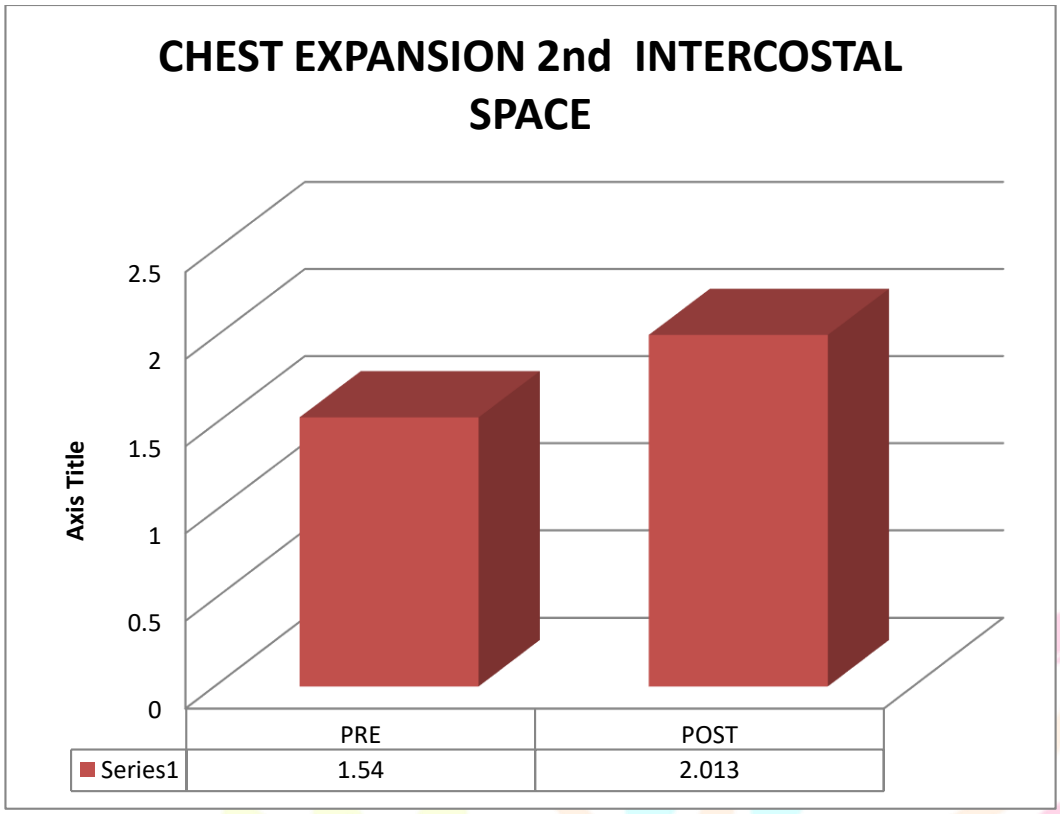
| Parameter | Follow up | Mean± SD | Mean Difference | Degree of freedom | t value | P value | Significance |
|---|---|---|---|---|---|---|---|
| FEV1 | Pre- Treatment | **77.86± 33.04** | **9.091** | **21** | **3.336** | **0.0031** | **Very Significant** |
| | Post-Treatment | **86.95± 32.04** | | | | | |

| Parameter | Follow up | Mean+ SD | Mean Difference | Degree of freedom | t value | P value | Significance |
|---|---|---|---|---|---|---|---|
| Chest Expansion ($2^{nd}$ intercostal space) | Pre-Treatment | **1.54+ 0.46** | **0.4727** | **21** | **7.651** | **<0.0001** | **Extremely Significant** |
| | Post-Treatment | **2.01+ 0.57** | | | | | |




The Pre and post comparison of FEV1 is shown in Table 3 and Graph 3, pre-test mean value of FEV1 is 77.86+ 33.04, when it is compared with post- test mean value of FEV1 i.e. 86.95+ 32.04, the observed p value is 0.0031, which shows there is very significant improvement in FEV1.

Table 4:- Comparison of Pre and Post Chest expansion of $2^{nd}$ Intercostal space

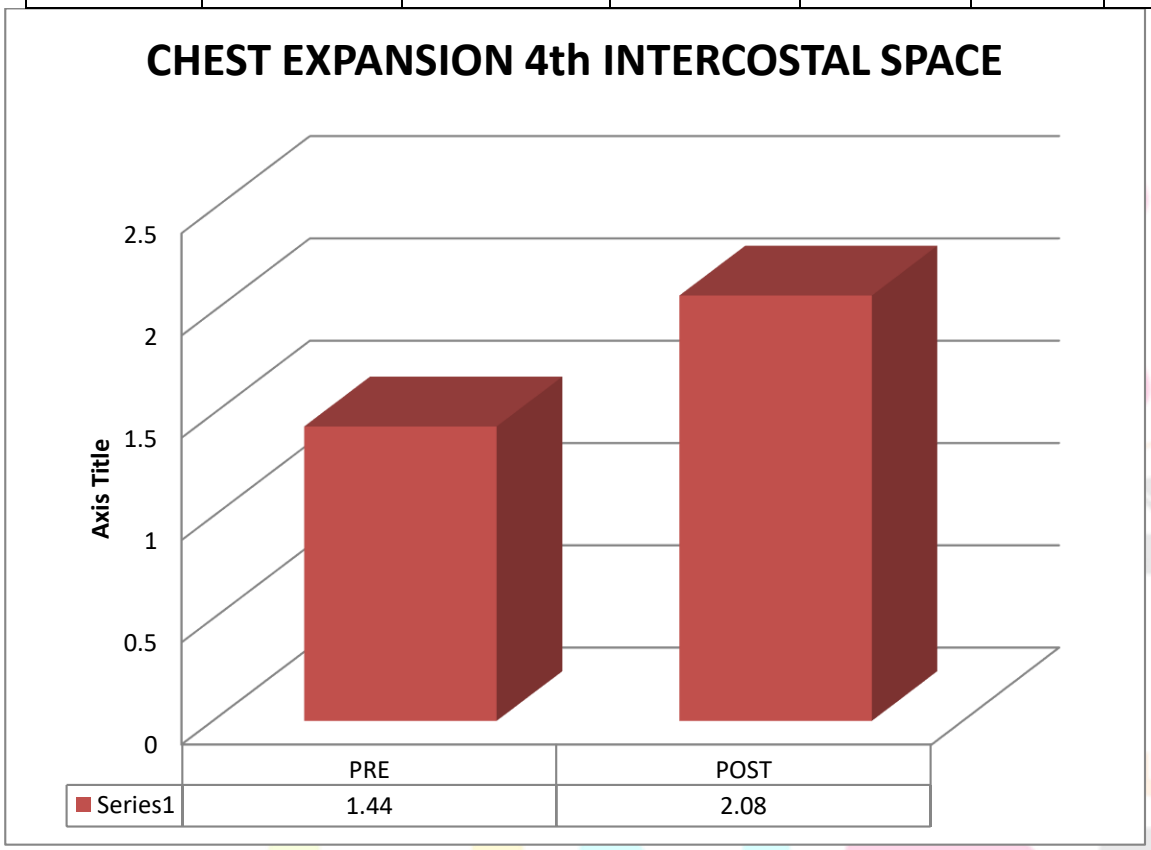



The Pre and post comparison of Chest expansion (2nd IC) is shown in Table 4 and Graph 4. pre-test mean value of (2nd IC) is 1.54± 0.46, when it is compared with post- test mean value of (2nd IC) i.e. 2.01± 0.57, the observed p value is <0.0001, which shows there is Extremely significant improvement in Chest expansion.

| Parameter | Follow up | Mean± SD | Mean Difference | Degree of freedom | t value | P value | Significance |
|---|---|---|---|---|---|---|---|
| **Chest Expansion (4th intercostal space)** | **Pre-Treatment** | **1.44 + 0.51** | **0.6409** | **21** | **9.960** | **<0.0001** | **Extremely Significant** |
| | **Post-Treatment** | **2.08+ 0.59** | | | | | |

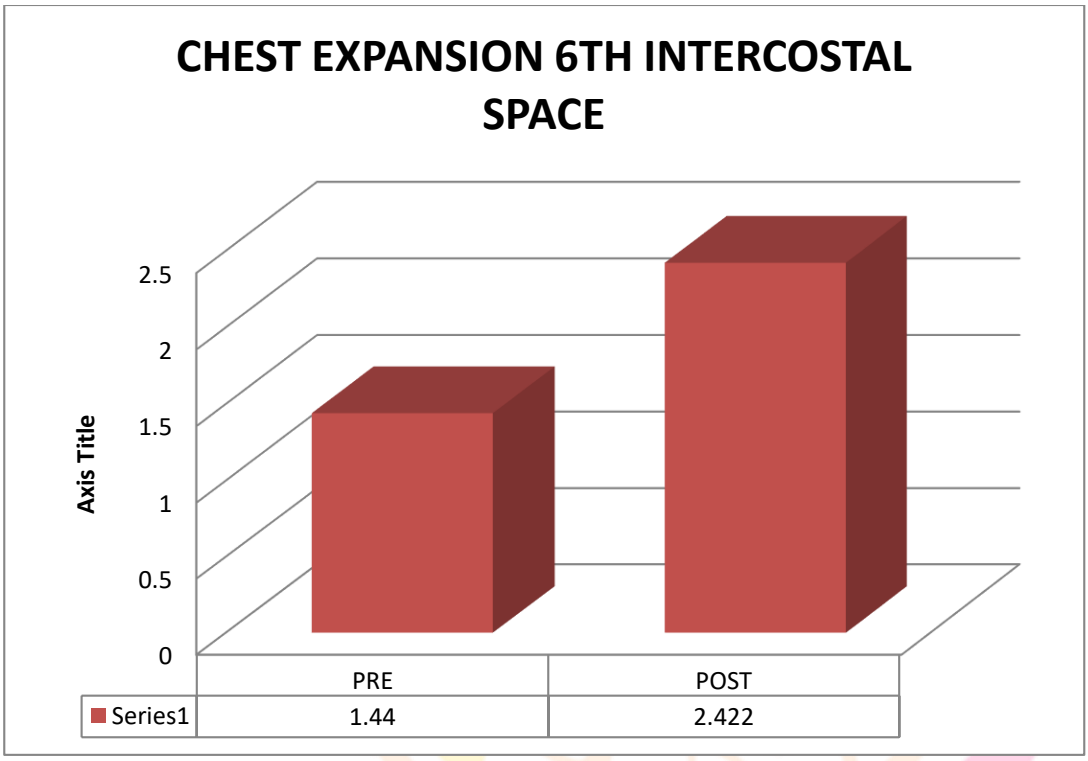
Table 5:- Comparison of Pre and Post Chest expansion of 4th Intercostal space

| Parameter | Follow up | Mean± SD | Mean Difference | Degree of freedom | t value | P value | Significance |
|---|---|---|---|---|---|---|---|
| Chest Expansion (6th intercostal space) | Pre-Treatment | **1.44 ± 0.57** | **0.9773** | **21** | **8.370** | **<0.0001** | **Extremely Significant** |
| | Post-Treatment | **2.42± 0.69** | | | | | |




The Pre and post comparison of Chest expansion (4th IC) is shown in Table 5 and Graph 5. pre-test mean value of (4th IC) is 1.4 4± 0.51, when it is compared with post- test mean value of (4th IC) i.e. 2.08± 0.59, the observed p value is <0.0001, which shows there is Extremely significant improvement in Chest expansion

Table 6:- Comparison of Pre and Post Chest expansion of 6th Intercostal space




The Pre and post comparison of Chest expansion ($6^{th}$ IC) is shown in Table 6 and Graph 6. pre-test mean value of ($6^{th}$ IC) is 1.44± 0.57, when it is compared with post- test mean value of ($6^{th}$ IC) i.e. 2.42± 0.69, the observed p value is <0.0001, which shows there is Extremely significant improvement in Chest expansion.

## DISUSSION

The study was designed to study the immediate effect of diaphragmatic stretching on pulmonary function and chest expansion in asthmatic individuals. 22 Subjects were included in the study based on inclusion and exclusion criteria.

The subjects were given immediate intervention and were assessed for FVC, FEV1 and Chest expansion at $2^{nd}$ , $4^{th}$ and $6^{th}$ intercostals space pre and post intervention. As per statistical analysis the results of the study have shown substantial improvement in outcome measures of pulmonary function and thoracic expansion.

The Diaphragmatic Stretch Technique was found to have statistically significant improvement in pulmonary function parameters. Noll et al. (2010) found that Manual techniques improve the regulation of the autonomic nervous system. Mobilization of the sympathetic system region may cause inhibition of the sympathetic activation, and diaphragmatic release may cause activation of the parasympathetic system. The autonomic system regulates relaxation; therefore, it reduces dyspnea, fatique and rate of respiration and increases pulmonary function and oxygen saturation.

D.K. Braga et al, found that acute activation of muscle spindle caused by Diaphragmatic stretching, that increases the sensory afferent stimulus, increasing neuromotor response, eventually increasing muscle tension, improving muscle viscoelasticity and consequently decreasing muscle stiffness and increasing thoracic mobility (33,34) muscle stretching may stimulate the receptors in the muscle- tendon region i.e. the golgi tendon organs, thereby causing an inhibitory effect (35,36)

The underlying mechanism behind the diaphragmatic stretch teachnique is to relax the resting state of the diaphragm and enhance its contraction and relaxation functions, thereby creating a greater pressure gradient

between the thorax and abdomen. The result of my study are similar to study conducted by Gonzalez-'Alvarez FJ et al. on diaphragmatic stretching to check ribcage and abdominal excursion on unhealthy subjects and found a significant improvement on chest expansion.

## Limitations

- The study did not include long term follow-up.
- There were more females compared to males.
- Sample size was small.

## CONCLUSION

The present study concluded that there is Immediate effect of Diaphragmatic Stretching on Pulmonary Function and Chest Expansion in Asthmatic subjects.

## CLINICAL IMPLICATIONS

This technique can be included in Pulmonary Rehabilitation protocol for asthmatic subjects to increase chest expansion and Pulmonary functions.

## FUTURE SCOPE

- Further studies can be done to check the effects of this technique on other conditions.
- Study can be done on males and females separately
- Other respiratory parameters can be considered for further studies.

## ACKNOWLEDGMENT

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